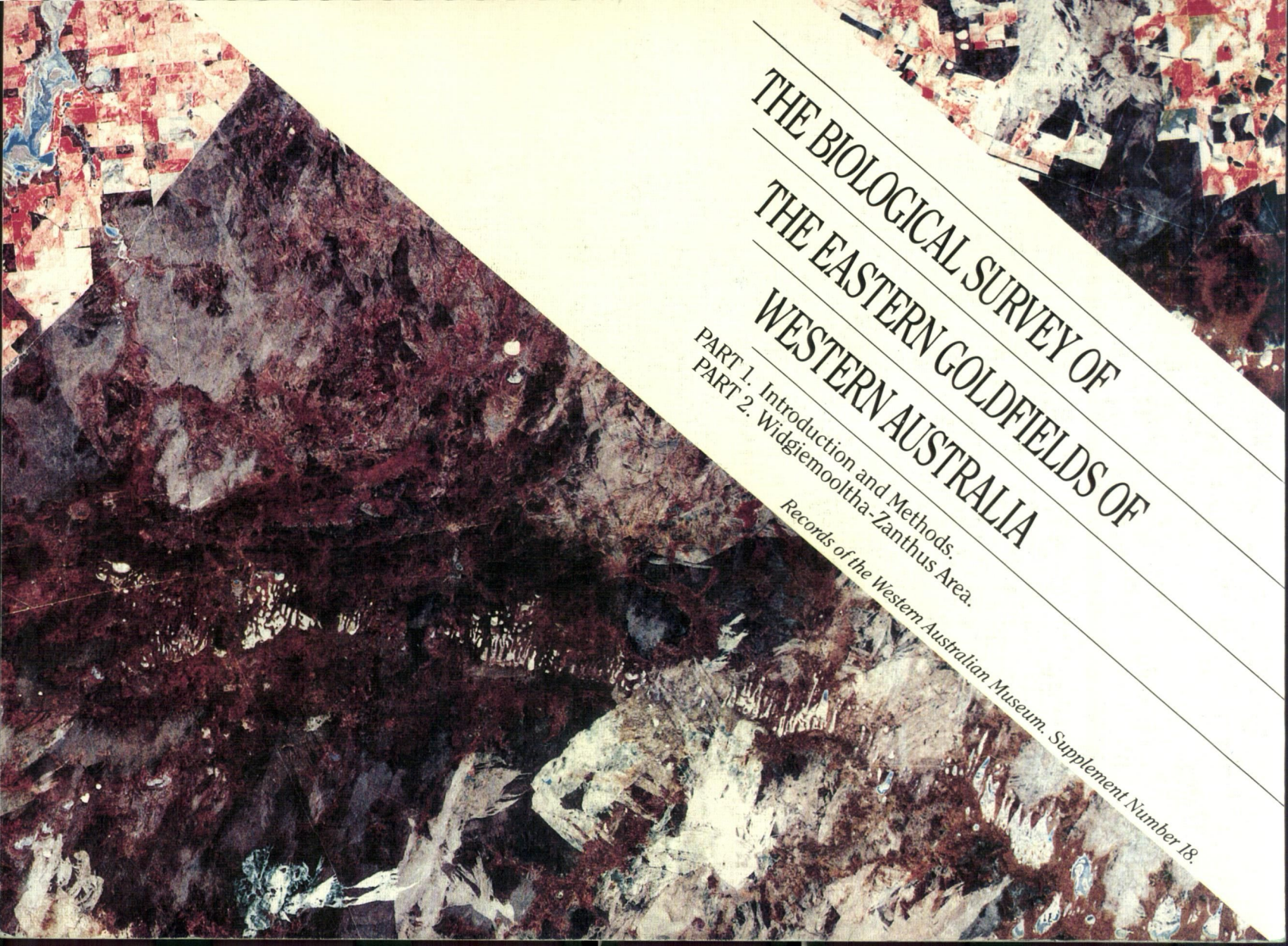

THE BIOLOGICAL SURVEY OF THE EASTERN GOLDFIELDS OF WESTERN AUSTRALIA

PART 1. Introduction and Methods.
PART 2. Widgiemooltha-Zanthus Area.

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THE BIOLOGICAL SURVEY OF THE EASTERN GOLDFIELDS OF WESTERN AUSTRALIA

THE BIOLOGICAL SURVEY OF THE EASTERN GOLDFIELDS OF WESTERN AUSTRALIA

Part I

INTRODUCTION AND METHODS

by

Biological Surveys Committee

Western Australia

1984

Front Cover Landsat image of south western sector of the Eastern Goldfields in the region south of Southern Cross. Wheatfields occupy the western portion. Courtesy Lands and Survey Department.

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Abstract

This part is the first in a series that will describe the biological survey of the Eastern Goldfields District of Western Australia. It deals specifically with the background, aims and objectives of the survey and outlines the methods used to document vegetation, soils, flora and vertebrate fauna at numerous sample sites representative of this heterogeneous region.

The Eastern Goldfields District (266,000 km²) was selected for survey for the following reasons because: there had been no previous detailed survey of the biota of the District, which is a region of considerable interest in that it lies between the mesic South West and arid Eremaean regions; extensive areas of vegetation have remained relatively unmodified since European settlement; the need to evaluate the adequacy of existing conservation reserve systems; pressure to release more land for clearing for cereal crops in south-western and southern parts of the district. This survey commenced in 1977 as a collaborative project by several organisations already involved with biological surveys, but with different primary aims and responsibilities.

Introduction

Historical Background

Biological surveys provide basic information about plant and animal distributions and ecology, and are a prerequisite for understanding the biology of wild species and developing meaningful nature conservation programmes.

In Western Australia several organisations and individuals have contributed information over the years but, until recently, there was little State-wide forward planning or coordination; this being precluded by the scarcity of data from almost all of the natural districts of Western Australia and a lack of financial and manpower resources. Nevertheless, much has been accomplished and notable published biological surveys involving plants or vertebrate animals carried out in various parts of the State have included:

*South West:*Bernier and Dorre Islands (Ride *et al.* 1962), Dragon Rocks Nature Reserve (McKenzie *et al.* 1973), the Western Australian Museum's Survey of Wheatbelt Nature Reserves (see Kitchener 1976), Cape Le Grand National Park (Kitchener *et al.* 1975) and Cockleshell Gully (Chapman *et al.* 1977), the Forests Department's work on the Northern Swan Coastal Plain and Darling Range vegetation (Havel 1968, 1975a, 1975b) and the Western Australian Naturalists' Club's survey of The Wongan Hills (Kenneally 1977).

*Arid Zone:*The Western Australian Wildlife Research Centre's expeditions to the deserts (Burbidge *et al.* 1976, McKenzie and Burbidge 1979, Burbidge and McKenzie 1983) and the W.A. Museum's regional lists of birds, reptiles and amphibia (e.g. Storr 1981, Storr and Harold 1978).

*Kimberley:*Prince Regent Nature Reserve (Miles and Burbidge 1975), Drysdale River National Park (Kabay and Burbidge 1977), north-west Kimberley Islands (Burbidge and McKenzie 1978), Ord River Area (Kitchener 1978), Mitchell Plateau (Western Australian Museum 1981) and the south-west Kimberley (McKenzie 1981a, 1981b, 1983).

The majority of survey work has been carried out by State Government organisations but several individuals have made significant contributions, e.g. D.L. Serventy's work on bird distribution (Serventy 1977), J.S. Beard's series of 1;250,000 and 1:1,000,000 vegetation maps (see Beard and Webb 1974) Ford's bird studies (e.g. Ford 1971, 1982 and Ford and Sedgwick 1967) and W.H. Butler's work with Museums (e.g. Bannister 1969), on Barrow Island (Butler 1971) and elsewhere. Recently much additional information has been made available in Environmental Review and Management Programmes submitted by mining and development companies to the Environmental Protection Authority.

Many of the data generated by early survey work and from the collections of animals and plants in the Western Australian Museum and Western Australian Herbarium were placed into a nature conservation context by the Reports of the Conservation Through Reserves Committee (CTRC 1974, 1977, 1981) which examined nature conservation reserve requirements on a regional basis.

In 1977 a move was made to improve the planning and coordination of biological surveys within State Government organisations. It was thought that:

(a) several organisations with different primary aims and responsibilities could benefit mutually within a formal biological survey framework,

(b) it was particularly important to ensure that biological survey work benefited nature conservation as much as possible,

(c) coordination would ensure that the maximum amount of useful information would be gathered during a survey, and

(d) coordination and planning would ensure that the relatively small resources available in Western Australia would be put to the most effective use. The limited manpower and financial resources available for biological surveys in this State are largely a function of its small population (8% of the Australian total) in relation to its large area (33% of Australia).

Interdepartmental correspondence in 1977 resulted in the formation of a Biological Surveys Committee (BSC). The Committee, which first met in December 1977, comprises representatives of the Western Australian Museum, Western Australian Herbarium of the Department of Agriculture, National Parks Authority of Western Australia and the Western Australian Wildlife Research Centre of the Department of Fisheries and Wildlife. In the months following its initial meeting the BSC reviewed available data and assessed priorities for the need for additional information in the context of available resources. It decided to plan and coordinate two types of survey:

1. Local Surveys providing inventories of particular areas, especially those recommended for biological survey by the Environmental Protection Authority in its reserve proposals resulting from the CTRC reports (EPA 1975, 1976, 1980); and
2. District Surveys aimed at providing information on plant and animal distributions, population fluctuations, habitat requirements and the effects of man's impact on the environment. District surveys can be used to evaluate the existing conservation reserve (National Park and Nature Reserve) system, to provide data from which to develop reserve management plans and to highlight species in danger of extinction or which need special conservation measures.

The BSC believed that district surveys should form the basis of a Biological Survey of Western Australia. Such a continuous survey programme is urgently needed to document

fully the State's biological resources and to evaluate and monitor its nature conservation programmes. Unfortunately, financial and manpower limitations do not permit a permanent State-wide biological survey at this time.

The BSC decided to base its district surveys on the twelve "systems" defined by CTRC (1974). After considering each system in terms of existing knowledge and vulnerability to impact it decided that the one most in need of survey was CTRC System 11 – the Eastern Goldfields. It also decided that local surveys were to be continued opportunistically, and priorities for these were developed on a similar basis. Areas in the Eastern Goldfields which were recommended for local survey were included in the district survey. Results of some inventory surveys completed so far in other districts can be found in Burbidge *et al.* (1978, 1980) and Youngson and McKenzie (1977).

The Study Area

The Eastern Goldfields was selected for a district survey for three main reasons:

1. The great scientific interest in the "Coolgardie Botanical District" (Diels 1906, Gardner and Bennetts 1956) or "South West Interzone" (N.T. Burbidge 1960, Beard 1979) to which the renowned goldfields woodlands are largely confined, and which includes species from both the south-west (a region of high species endemism, Marchant 1973, Hopper 1979) and the arid interior, as well as its own special biota. Nowhere else in the world does such a variety of trees occur in an area of such low rainfall. No systematic collecting of plants or animals had been carried out previously in the district, but available data suggested that many plant species might have very restricted geographic distributions.
2. The pressure to have further land in the southern part of the district released for growing cereal crops, resulting in widescale clearing of the natural vegetation (e.g. Rural and Allied Industries Council 1979). Little information was available about this area on which to base proposals for reserves if subdivision and clearing proceeded. In this context it was notable that CTRC (1974) suggested that the existing larger conservation reserves in the Eastern Goldfields may not be sited in the best locations. The mining industry was also actively seeking new mineral deposits in the general area, but with the possible exception of some small hills and ranges with specialised ecosystems, mining was unlikely to have a major impact.
3. Following detailed biological survey work by the Western Australian Museum in the Wheatbelt (see Kitchener 1976), a similarly detailed and immediately subsequent examination of the adjacent Eastern Goldfields would provide opportunities to gather comparable data on the persistence of species in somewhat similar but untruncated communities. Unlike those of the Eastern Goldfields, Wheatbelt landscapes have been extensively cleared for agriculture; remaining areas of native vegetation are isolated. Comparisons of this nature would allow additional assessments of the effects of agricultural development and reserve size on the flora and fauna of south-western Australia.

The district chosen for survey closely followed the boundaries of CTRC (1974) but excluded a small area in the north around Wiluna; this was done both to avoid the inclusion of yet another natural district, the Carnegie Salient of the Ashburton District (Beard 1979), and to limit the already heavy work load. The Eastern Goldfields district is roughly rectangular, extending between 27°S – 33°S and 118° 30'E – 123° 45'E (Figure 1) and covers an area of about 266,000 km² – an area slightly larger than that of the State of Victoria (227,600 km²).

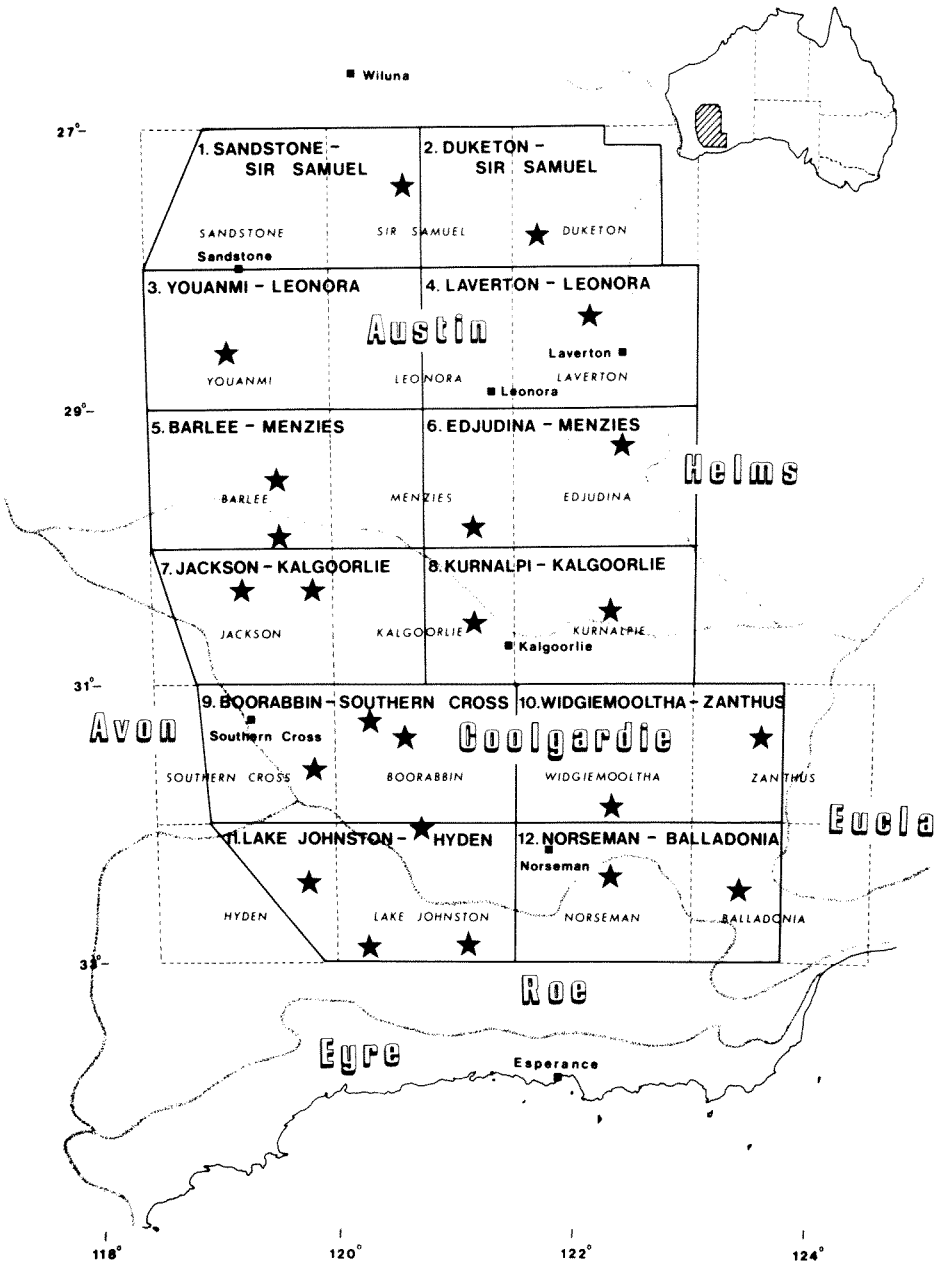

Figure 1. The Eastern Goldfields showing boundaries and names of the twelve cells in relation to the 1: 250 000 map series, botanical districts (after Beard 1980) and towns. Stars denote vertebrate survey campsites.

Geologically the Eastern Goldfields district corresponds to the Eastern Goldfields Province of the Yilgarn Block of the Archaean Western Shield (McArthur and Bettenay 1979). It consists of granites and gneisses enclosing narrow elongated north-west trending zones of metamorphosed sedimentary and volcanic rocks known locally as greenstone belts. Topographically the District is flat or gently undulating with a few, scattered, low ranges (mainly of banded ironstone) and laterite-capped breakaways. Granite exposures are common, especially in the south. Most are small, low and fairly flat, but the Fitzgerald Peaks, of which Peak Charles is the highest, rise dramatically from the surrounding plain.

Rainfall is low and unreliable, especially in the north and east, and the annual average varies between 200 and 340 mm. Most rain falls in winter but summer rains can be significant. Drainage is poorly coordinated and there are extensive saline playa lakes, remnants of rivers which occurred in the distant past (van de Graaf *et al.* 1977). Natural fresh water is scarce, ephemeral, and largely confined to claypans and small rock pools. However, man-made permanent sources of fresh water occur in agricultural and pastoral areas.

Objectives

Broad Objectives

After considering the biogeographic and conservation problems apparent in the district, several broad objectives were framed.

1. *Distributional patterns*
   The Eastern Goldfields includes a wide variety of environments where quite subtle changes in topography, soils or rainfall often produce major changes in vegetation. These range from gradational changes in the sand plain communities of the south-west through complex mosaics to discrete patches. Vegetation types of the last sort include the woodland and spinifex (*Triodia, Plectrachne)* communities, and those restricted to mountain ranges and palaeodrainage channels. The study area also includes two important biogeographic boundaries – the mulga-eucalypt line (Serventy and Whittell 1948) and the boundary between the Coolgardie and Austin Botanical Districts (Diels 1906, Gardner and Bennetts 1956, Beard 1979).

   It was proposed to investigate these various patterns and their implications for the biota, particularly their effect on species-richness and diversity, in relation to the definition of biological boundaries. The patterns of movement of the more mobile animals, particularly birds and bats, and the extent of their seasonal utilisation of habitat and movements through the region or between habitat isolates, were assessed. Such information has important implications for our understanding of the integration of the various ecosystems.
2. *Species studies*
   For many species a profile of habitat utilisation in terms of situation, soil factors and plant or animal associations was built up throughout the study. Also information was gathered on flowering phenology in relation to the reproductive and dietary patterns of the fauna. This information will assist in interpreting species and community distributional patterns, particularly for those biota with fragmented ranges.

   Collections of both plants and animals were also needed in order for taxonomic studies to take place.
3. *Biogeographic affinities*
   The Eastern Goldfields has been described as an interzone between the biota of the mesic south-west and the arid interior (N.T. Burbidge 1960). Data on the distribution and affinities of species and communities will assist in an evaluation of this hypothesis.
4. *Fire ecology*
   Fire is an important factor in the south-west of the study area but is less frequent or widespread in the north and east. Data collected on fire history and plant and animal distributions and abundance as well as the seral stage of communities will aid an evaluation of the role of fire in the Eastern Goldfields and the future use of fire in managing natural environments.
5. *Nature conservation*
   Information gathered on distributional patterns and community structure is fundamental to an evaluation of the adequacy of the existing conservation reserves. Life history data allow more detailed judgements on the desirable spatial relationships of reserves and whether and in what way these should be connected. Such information, coupled with an understanding of species-richness and diversity in relation to natural habitat patch size,

have provided valuable indicators as to the preferred size of nature reserves in the wheatbelt environments to the west of the Eastern Goldfields (Kitchener *et al.* 1981a & b, 1982, Humphreys and Kitchener 1982) and the variety of habitats they should contain (Kitchener 1982). Those elements which were required for the rational placement of a conservation reserve system in the Eastern Goldfields were built into the design. This will allow, at the completion of the project, recommendations that would place in the Goldfields a National Park and Nature Reserve system, correctly scaled and positioned in the landscape to optimize both its coverage and effectiveness for nature conservation.

Aims

Plants

1. Define structural and floristic types present in the vegetation,
2. correlate plant communities with geology, geomorphology, and soils,
3. list and document the general distribution of plant species,
4. evaluate the conservation status of plant species and communities,
5. develop, update or revise plant lists and vegetation maps of major National Parks and Nature Reserves,
6. provide Herbarium voucher specimens suitable for taxonomic research, and
7. provide habitat indices for the faunal studies.

Animals

1. Document the vertebrate fauna and make collections of specific groups to assist in their taxonomic appraisal, by both morphological and, for mammals and some reptiles, electrophoretic techniques,
2. determine geographical and seasonal variation in use of habitats by vertebrate species,
3. examine aspects of the life history strategies of vertebrates, and
4. evaluate the status of vertebrate species within the Eastern Goldfields and make recommendations for their conservation and management.

Table 1 Biological Survey of the Eastern Goldfields Vertebrate Survey Timetable.

Season	Interval	WAWRC			WAM				NPA	
		1979	1980	1981	1978	1979	1980	1981	1980	1981
Summer	January-March	1,4	9	8,5	–	6	2,3	11	11	9
Autumn	April-mid-June	–	1,4	9	–	2,3	7	10	–	–
Winter	Mid-June-August	5	8	1,4	–	11	10	6	9	11
Spring	September-November	8	5	9	10,11	7	6	2,3,7	11	–

Key: WAWRC: Western Australian Wildlife Research Centre
WAM: Western Australian Museum
NPA: National Parks Authority of Western Australia

1, 2, etc: Cell numbers as follows: 1, Sandstone – Sir Samuel; 2, Duketon – Sir Samuel; 3, Youanmi – Leonora; 4, Laverton – Leonora; 5, Barlee – Menzies; 6, Edjudina – Menzies; 7, Jackson – Kalgoorlie; 8, Kurnalpi – Kalgoorlie; 9, Boorabbin – Southern Cross; 10, Widgiemooltha – Zanthus; 11, Lake Johnston – Hyden; 12, Norseman – Balladonia.

Notes: (a) NPA Cell 9 – Boorabbin National Park only.
Cell 11 – Frank Hann and Peak Charles National Parks only.

(b) Cell 12 surveyed by WAWRC during 1977, 78 and 79.

Methods

Design

The need to complete a comprehensive survey of an area as large as the Eastern Goldfields in a reasonable time with limited manpower and resources necessitated a systematic survey of selected groups of the biota at a few carefully chosen sites.

Vascular plants and terrestrial vertebrates were selected for intensive documentation because of the relatively advanced state of knowledge of their biology and taxonomy, and because the appropriate taxonomic expertise was accessible to the Committee.

To obtain a degree of spatial and temporal representation in the survey design, the BSC divided the Eastern Goldfields into twelve 'cells' (Figure 1), each of which was sampled in three different seasons (Table 1). The cells were based on the 1:250,000 topographic series, each map occupying one degree of latitude by one and a half degrees of longitude. This mapping grid is the basis of the Bureau of Mineral Resources and Geological Survey of Western Australia's surface geology maps and J.S. Beard's vegetation maps and because selection of biological survey sites depended on information contained in these map series it was a convenient basis for our design. The Eastern Goldfields District boundary does not, however, exactly folow 1:250,000 map boundaries; consequently the cells do not have as regular a shape as the topographic, geological or vegetation series.

Two teams, one from the Western Australian Museum and the other from the Western Australian Wildlife Research Centre, each took responsibility for the vertebrate survey of six cells. The cells were allocated so each team covered as wide a latitudinal and longitudinal range as possible (Figure 1). This was to allow members of each team to apply their particular expertise to the variety of habitats, plants and animals of the district and also provide a means of detecting differences between the various field workers in the collection of data as a result of their differing skills. Staff input from the National Parks Authority increased effort in cells 9 and 11, the most complex part of the district, by documenting the fauna of three National Parks – Boorabbin, Frank Hann and Peak Charles. Effort in the four northernmost, less diverse, cells was limited correspondingly. The assistance of taxonomic specialists, especially Dr G.M. Storr of the Western Australian Museum (Reptiles) and Dr P.R. Baverstock of the Department of Agriculture, South Australia (Mammals) aided our work. Entomologists from the W.A. Museum joined some trips to expand the Museum's collection.

Two consulting botanists, A.V. Milewski and K.R. Newbey, with support from the Western Australian Herbarium, worked both with the vertebrate teams and alone. The responsibility of the two botanists was divided differently; one (KRN) being assigned to the five south-western cells (7, 9, 10, 11 and 12) and the other (AVM) to the seven more inland ones (1, 2, 3, 4, 5, 6, and 8). The BSC was fortunate to be offered assistance by two other botanists – Mr. M.I.H. Brooker of the Division of Forest Research, CSIRO, and Mr. B.R. Maslin of the Western Australian Herbarium – who are specialists in the taxonomy of *Eucalyptus* and *Acacia* respectively, the two dominant genera in the vegetation of the Eastern Goldfields.

The Biological Survey of the Eastern Goldfields commenced in 1977 with work by the Wildlife Research Centre in the Dundas Nature Reserve in Cell 12 and a vegetation survey of Frank Hann National Park by a consultant (Monk, Hnatiuk and George, 1979). This

survey provided much of the local experience necessary to select the most appropriate survey techniques and to plan feasible logistics for the main field survey which commenced in the spring of 1978 and finished early in 1982.

The results of the Biological Survey of the Eastern Goldfields will be published in several series. The first, of which this paper is Part I, will consist of descriptions of the physical environment and biota for each of the 12 cells. The second will comprise detailed syntheses of the vegetation, flora and vertebrate fauna of the District as a whole and the third will be an analysis of the conservation status of its animals and plants.

Vegetation and Floristics

Selection of Sample-sites

Because of the apparently differing scales of complexity in vegetation pattern, the southern cells (7, 9, 10, 11, 12) were subdivided into eight half-degree sub-cells whilst the northern ones were subdivided into 1 degree sub-cells.

Sample-sites within sub-cells were selected subjectively so as to:

(a) represent the range of variation in vegetation structure and floristics as determined from study of vegetation maps, geological survey maps, aerial photos, and such ground traverses as were possible using available roads and tracks,

(b) represent by means of replicates, the geographic range of variation in vegetation,

(c) represent mature stands of vegetation that were not influenced by man's activities (e.g. grazing, timber cutting, road run-off); however, in the northern and eastern areas, grazing and cutting were so extensive that such disturbance frequently could not be avoided,

(d) represent vegetation that was as floristically and structurally homogenous as possible; these criteria were subjectively assessed only,

(e) document the vegetation and flora of vertebrate sample-sites.

Description of Sites and Sampling Methods

At each site, the relevé technique (Mueller-Dombois and Ellenberg 1974) was used to gather vegetation data. Essentially this consisted of compiling a species list together with estimates of the abundance of each species, and a description of the physical environment at each site subjectively determined to be representative of a kind of vegetation. Homogeneity of the area sampled was subjectively determined, primarily on the basis of physiognomy and secondarily on the basis of floristic composition of the prominent species in each stratum. Previous work in south-western Australia had indicated that a sample area equivalent to 500 – 5.000 m², depending on floristic richness and the physiognomy of the site, was required to adequately sample the vegetation (George, Hopkins and Marchant 1979, Newbey 1979). Releveś were thus made within this range or occasionally covering a slightly larger area.

Data recorded at each site were as follows:

– vegetation: height, stratification, density and growth forms (Raunkiaer 1934, Muir 1977, Newbey 1979.

- plant species present: their heights, abundance, and sociability (Braun-Blanquet 1965).
- soil profile characteristics as determined from soil pits, road cuts, mine excavations or augered samples: for each horizon its texture, colour, pH, and presence of calcium carbonate; for the surface its friability, erosion potential, drainage, amount of plant litter and/or stone; in some cases samples were analysed for salt content and major nutrients such as phosphorus, calcium and potassium.
- geomorphology: the landform and position in landscape.
- geology: where relevant to the vegetation, the nature of the bedrock as determined by examination of outcrops or from geological survey records.

The floristic list for each cell was a combination of site lists and other records made whilst travelling within the cell. At least one voucher specimen for each species was collected per cell if a specimen of suitable quality for deposition in the permanent collections of the Western Australian Herbarium (PERTH) could be found. The specimens thus lodged may be identified in the collection by the stamp "Voucher Specimen, System 11 Survey".

An evaluation of the distributional range was made for as many species as time and resources would allow, using the collections at PERTH. Priority was given firstly to species from the south-western part of the survey area, secondly to herbs from the remainder of the area, then to the rest of the flora recorded.

Where field observations showed that the existing vegetation maps were inadequate for the purposes of reserve management the structural types and some plant communities were mapped for the major Nature Reserves and National Parks in the Eastern Goldfields.

Detailed lists of terms and definitions used in recording information on soils, geomorphology, life forms and vegetation have been lodged at the libraries of the Western Australian Herbarium and the Western Australian Wildlife Research Centre, under the reference: Newbey K.R., Milewski A.V. & Hnatiuk R.J. "Definitions of terms used in the vegetation survey of System 11: Eastern Goldfields of Western Australia".

Vertebrate Animals

Selection of Survey-sites

Choice of survey sites for vertebrates was made subjectively after considering the following criteria.

1. *Geographical.* The division of the Eastern Goldfields into cells and the responsibility for data collection in each cell is outlined above.
2. *Landforms.* Areas (campsites) for vertebrate survey were selected to maximise coverage of major geomorphological and vegetation systems within each cell. Generally two survey areas were chosen within each cell but greater survey emphasis was placed on south-western cells and slightly less emphasis on northern cells.

   Two main sources of information were available to assist in choosing survey areas:

   (a) surface geology maps, at a scale of 1:250,000 in the publications of the Geological Survey of Western Australia and the Bureau of Mineral Resources, Canberra, and

(b) the structural vegetation maps (1:250,000 and 1:1,000,000) of Beard (1969, 1972a, 1972b, 1974, 1975, 1976).

The location of survey areas within a cell was determined by proximity to the major geomorphological and vegetation systems as well as accessibility by vehicle. However, consideration was also given to documentation of proposed and existing National Parks and Nature Reserves within the cell as well as to vacant Crown land.

3. *Habitats.* Sample-sites around each selected survey area were chosen to represent the major soil and vegetation types of the landforms. One or more sample-sites were located within each habitat and the largest and most homogeneous area of habitat selected for survey. A minimum of five sample-sites, each visited during three seasons, was chosen for intensive systematic sampling methods. Sample-sites were examined for five consecutive days during each season.

   A variable number of other-sites was examined, primarily by opportunistic methods, to broaden the range of environments documented within each survey area.
   When choosing sample- and other-sites, some consideration was given to limiting their distance from a camp to 30 km in order to minimise the time and cost of travelling and to maximise the time for data collection.

Description of Survey Areas

A detailed vegetation and soil description was made for each sample- and other-site. The degree to which these were typical of the habitats and landforms they were chosen to represent was assessed in relation to similar vegetation and soils elsewhere in the Eastern Goldfields.

Sampling Methods

In order to achieve the objectives of the study a wide variety of methods and techniques were used to document and collect the vertebrate fauna. These can be divided into two main sampling approaches: systematic and opportunistic. The systematic approach involved labour- and time-intensive methods which were restricted to sample-sites and favoured certain groups of vertebrates.

Systematic Sampling. In an endeavour to make objective comparisons of the vertebrate fauna of sample-sites, both within and between survey areas and during different seasons, the following systematic methods were employed:

1. *Bird Census*

   One quadrat, with sides of 200 m, was established at each sample-site. The observer walked quietly around the perimeter and then diagonally accross the quadrat, observing, listening and recording birds. Approximately half an hour was spent at each quadrat; for each bird the species, number of individuals, age and sex (where possible), activity and vegetation stratum occupied were recorded. Information on temperture, wind speed and direction, cloud cover and rain was detailed during each census. Census counts were made for five consecutive days starting at approximately the same time. However, the sequence of censusing quadrats was varied so that every quadrat was sampled at different times of the day during each trip.

   This procedure was adopted by all survey teams so that broad comparisons could be made of the avifauna in different sampling areas and sites.

   The literature on bird census techniques, their advantages and limitations, is very

extensive with no method universally acceptable; a most thorough and recent review of the subject can be found in many papers in Ralph and Scott (1981). Variation and bias in census methods can be attributed to four principal sources (Verner 1981, Dawson 1981) these being: site selection effects, sampling schedule effects, species specific effects and observer effects.

The procedure adopted for this survey was based on group experience and designed to overcome many sampling schedule effects (e.g. season, time of day, duration of sampling and frequency of sampling) and several site selection effects (e.g. number of sites, vegetation density and homogeneity). For many quadrats the perpendicular distance of an observation from the line of traverse was recorded so that certain species specific effects (e.g. detectability and density) could be analysed using the 'variable strip method' outlined by Eberhardt (1968). Observer bias was minimised as a source of variation by a team using the same observer throughout the survey.

2. *Trapping*

(a) Surface trapping

Metal mammal traps of three types were set in lines at each of the sample-sites. Each trapline consisted of three cage traps (23 cm × 23 cm × 66 cm), nine break-back rat-traps and nine Elliott (9 cm × 9 cm × 32 cm) mammal traps spaced approximately 10 metres apart and under shelter. Traplines were set with universal bait and run for five successive nights in areas adjacent to the fenced pit-lines.

This procedure was based on standard surface mammal trapping techniques that have been used extensively in Australian studies. All major vertebrate surveys in Western Australia (see references) have used this or a very similar procedure.

(b) Fenced Pit-lines

Between 6 and 10 pit traps were spaced equidistantly under a 50 m long drift fence in each sample-site. Drift fences were of flywire 30 cm high and were generally embedded 1 – 5 cm into the substrate in order to redirect the movements of small terrestrial and fossorial (near-surface) vertebrates. Pit traps varied in design but were 20 – 70 cm deep and 12.5 cm in diameter. Fenced pit-lines were left open for at least five consecutive days and nights in each sample-site. Additional fenced pit-lines were occasionally used at other-sites.

The use of pit traps and associated drift-fences has only recently become a widely used technique in Australia. Cogger (1975) indicates the value of this method for surveying herpetofauna while McKenzie and Youngson (1983) have outlined the relative merits of surface and pit-trapping for vertebrates in the Great Sandy Desert.

Opportunistic Sampling. The methods employed not only allowed sampling in sites where systematic procedures were inappropriate (e.g. granite outcrops, breakaways), but permitted more rapid, if less intensive, faunal documentation. They also allowed certain vertebrate groups, e.g. bats, to be documented for which the systematic methods were inappropriate. The three main considerations of opportunistic sampling were:

(a) to examine vertebrate habitat utilisation in a greater array of habitats within each survey area,

(b) to assess the variation in the vertebrates within habitats, and

(c) to provide a more thorough inventory of the vertebrate fauna of each cell.

1. *Birds*

   Inventories of birds were compiled from records made by all vertebrate survey team members and consultants, both while actively searching for birds and while carrying out other duties.

   All observations of birds were documented with respect to the species, habitat, age, sex (where possible), numbers present, activity and vegetation stratum used when first observed. Sight records and inferred records from tracks (e.g. emu, mallee fowl) and calls were made. In dense vegetation observations were made with the assistance of bird whistles and in some cases recorders were set with time-delay switches to record calls of species during the 'dawn chorus'. Calls and sightings of nocturnal birds were noted during spotlighting and headtorching for other vertebrates. Breeding information was recorded whenever possible.

   Historical records and the records of the Royal Australasian Ornithologists' Union (R.A.O.U.) Bird Atlas Scheme were also used in compiling inventories.

2. *Mammals*

   The following data were recorded for mammal sightings – species, location, habitat, and number and group composition (if appropriate). Recognisable tracks of the larger nocturnal species (e.g. cats, foxes, dingos) were noted during routine daytime vertebrate searching in all habitats.

   Collections of bats were made at night by mist-netting, bat-trapping, shooting at dusk and, with the aid of a spotlight or floodlight, after dark. Because of the limitations of time, exhaustive inventories of bat communities were not feasible; bats were mostly collected at sites where they congregate: flyways, caves and, especially, drinking sites such as pools and dams. Sites found to be productive on the first trip were re-sampled on subsequent visits; those near or within sample-sites were favoured. During the collection of bats, data on location, surface geology, vegetation structure and floristics, height above ground, temperature, time of night, windspeed, moon phase and cloud cover were noted.

   Other opportunistic methods employed in the mammal survey were the collection of cranial and skeletal material, recording of sign (e.g. echidna diggings, nests of stick-nest rats (*Leporillus)*) and collection and analyses of fur samples from carnivore scats by the method of Brunner and Coman (1974).

3. *Reptiles and Amphibians*

   Various opportunistic sampling methods to collect herpetofauna were used in all sample-sites and numerous other-sites.

   Collections of active diurnal species were made by hand, stunning with rubber bands, and shooting. Inactive and cryptic species were obtained by digging out burrows, termite mounds and ant nests, turning over bark, litter, logs, soils, rocks and roadside spoil or by burning and digging out spiniflex (*Triodia* and *Plectrachne* spp.) clumps.

   The majority of sample-sites were surveyed after dark using headtorches to locate geckos and frogs by eyeshine and some nocturnal skinks by body reflections and movement.

Acknowledgements

The Biological Surveys Committee wishes to thank all people who have contributed to the Biological Survey of the Eastern Goldfields, especially volunteer field assistants and landholders who gave us permission to work on their land. We thank the Bureau of Flora and Fauna, Commonwealth Department of Home Affairs and Environment, for allowing Dr R.J. Hnatiuk to continue to work on this project after taking up his current position.

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THE BIOLOGICAL SURVEY OF THE EASTERN GOLDFIELDS OF WESTERN AUSTRALIA

Part 2

WIDGIEMOOLTHA – ZANTHUS STUDY AREA

Comprising papers by

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CONTENTS

APPENDIX

Abstract

The Widgiemooltha – Zanthus Study Area lies between 31° and 32° South and 121° 30′ and 122° 45′ East.

Ten landform units and subunits are recognized within the Study Area. The most extensive units are Calcareous Plains, Salt Lake Features and Undulating Plains of both greenstone and basic granulite; Broad Valleys occur only in the south-western corner. Granite Exposures are more common in the western part but Hills of granite or basic granulite and Breakaways are uncommon. The quartzite Woodline Hills is a landform unit unique within the Eastern Goldfields.

Vegetation and flora were examined at 121 sites. These sites, when broadly classified, represent 39 vegetation types. Most are characteristic of the Coolgardie Botanical District (South-western Interzone). Low woodlands are the dominant structural form with smaller areas of woodland, mallee, tall shrubland, low shrubland and hummock grasses. The tall shrubland of the Woodline Hills is an important vegetation type not found elsewhere in the Eastern Goldfields. An important vegetation pattern occurs largely within the Study Area on the Fraser Range, and consists of mallees and low woodlands, interspersed with herblands.

The vascular flora comprised 6 species of fern and 536 species, 12 subspecies and 15 varieties of flowering plants. Four apparently undescribed species were recorded: *Lasiopetalum* aff. *ogilvieanum*, *Prostanthera* sp., and a genus each of Asteraceae and Caryophyllaceae.

Two gazetted rare plant species were recorded, *Eucalyptus kruseana* and *E. brachyphylla*, and several important range extensions documented.

The vertebrate fauna of the Study Area was documented, principally from two survey areas; 3 amphibian, 59 reptile, 78 bird and 24 mammal species were recorded. The Study Area contains species whose distributions are either south-western or arid zone centred; this illustrates the biogeographical significance of the area. The skink *Hemiergis millewae* has its only known Western Australian populations in the Study Area. One gazetted rare animal species was recorded: *Falco peregrinus*.

Nature Reserves cover only 0.17% of the Study Area and contain only 8 of the 39 vegetation types identified; none of the unique or important vegetation types, uncommon flora or fauna are known from the reserves. Two landform units with their characteristic vegetation patterns are of special conservation interest. These are the quartzite Woodline Hills and the Fraser Range, primarily of basic granulite, neither of which are represented in reserves.

I Introduction

K.R. Newbey

The Widgiemooltha – Zanthus Study Area (Figure 1) is a rectangle of approximately 23,730 km² situated between Kalgoorlie and Zanthus to the north, and Balladonia and Norseman to the south.

The earliest European explorers in the Study Area were: C.D. Hunt who explored to the south-east of present-day Kalgoorlie in 1864 – 6, the Dempster brothers who discovered the Fraser Range in 1866, W.P. Goddard who, in 1890, travelled from present-day Kalgoorlie to Fraser Range, and D. Lindsay who during 1891 – 2 travelled from present-day Coolgardie to Fraser Range and then northwards (Jarvis 1979).

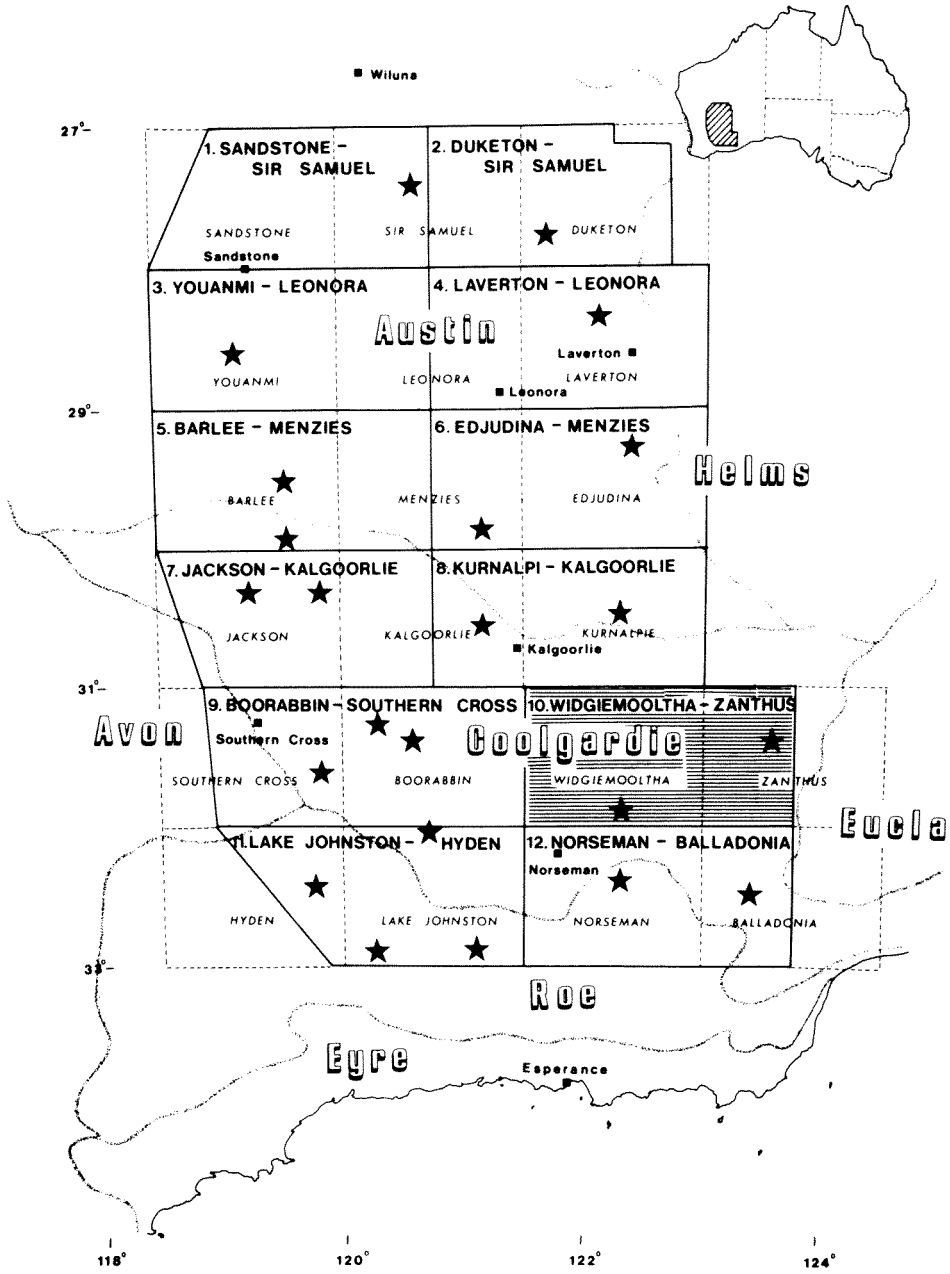


Figure 1 Map showing the extent of the Eastern Goldfields Region, the vegetation districts and the boundaries of the Study Areas included in the biological survey. The shaded portion shows the Widgiemooltha-Zanthus Study Area covered by this report.

Following the major gold discovery at Coolgardie by Bayley and Ford in 1892, prospectors travelled widely in search of other deposits. In the same year gold was also discovered at Kalgoorlie and Norseman (Beard 1975). It is presumed that the western half of the Study Area was relatively well known by 1895. Other men who became familiar with the Study Area were the sandalwood cutters (Richmond 1977). They used horses to extract the roots, stems and branches of Sandalwood trees (*Santalum spicatum*) which were sold to South-east Asia to be burned as incense.

The first pastoral station in the area was established at Fraser Range in 1866 by the Dempster brothers. During the 1890's other pastoral leases were taken up from Norseman to Kalgoorlie as well as eastwards along the northern boundary of the Study Area.

With the discovery of a major goldfield (Golden Mile) at Kalgoorlie, a woodline was constructed to woodlands that provided the large quantities of timber required for mining, power, desalinisation plants and domestic use. The woodline consisted of a number of narrow gauge railway lines that radiated from near Kalgoorlie. The railway line was movable and the tracks were shifted to another locality when the woodland was cut out in a particular area. Almost all trees over 8 cm in diameter were cut. Cutting began in the Study Area south-east of Kalgoorlie sometime about 1900 although early records are sketchy. By 1920 cutting had extended about 30 km to the east and south-east. Very little cutting appears to have taken place between 1920 and 1938 after which the woodline again became active in the Study Area, spreading out south-eastwards. A detailed account of life on the woodline during the period 1946 – 50 is provided by Hunter (1980). During the early 1950's the woodline was replaced by road transport. By this time the woodline had almost reached the Eyre Highway about 40 km east of Norseman. Since then timber leases have been let in the "Cowarna" area during 1965 – 75. During 70 years of cutting in the Eastern Goldfields, an estimated 350,000 tonnes of native timber were cut annually (Brennan 1977). The extent of the woodline can be seen on the 1:250,000 surface geology maps of the Study Area (Sofoulis 1966). In some areas, Boree (*Melaleuca pauperiflora* and *M. aff. pauperiflora*) were also extensively cut for both mining timbers and fence posts for pastoral leases.

Most of the early pastoral leases are still in operation today. The expansion of grazing is limited by the availability of reliable water for livestock. Nickel mining is well established at Kambalda. A few prospectors are active in the western quarter of the Study Area. Isolated mineral exploration occurs throughout, including a search for coal in the eastern third. A few sandalwood cutters still operate in the Study Area.

During 1977 the Biological Surveys Committee of Western Australia was formed and decided that the Eastern Goldfields (System 11 of Conservation Through Reserves Committee (1974)) was the district in most urgent need of survey (Biological Surveys Committee 1984). The background to this decision and the design and methods employed in the survey have already been detailed (*ibid*).

This report, the first of 12 on Study Areas within the Eastern Goldfields, documents the physical and biotic elements of the Study Area, examines relationships between the two, and discusses distributions, fire history and the adequacy of conservation of these units. These reports will provide the basis for publications on the physical environment, major biological groups and the adequacy of National Parks and Nature Reserves within the Eastern Goldfields.

The Study Area is covered by the Geological Survey of Western Australia 1:250,000 Widgiemooltha sheet, SH 51 – 14 (Sofoulis 1966) and the western half of the Zanthus sheet,

SH 51 – 15 (Doepel & Lowry 1970).

The main access to the Study Area is peripheral. Bitumen roads run from Coolgardie and Kalgoorlie to Norseman near the western boundary. The section of the Eyre Highway which runs from Norseman to Balladonia is just south of the Study Area's southern boundary. A good graded road from Kalgoorlie to Zanthus runs close to the northern boundary. All other tracks in the Study Area vary in condition; most are impassable following rain. The western third has numerous tracks; the remaining area very few.

The major botanical survey work was carried out by K.R. Newbey during March, August and September 1980, and August 1981 and 1982. Field traverses are shown on Figure 2 which also shows the main landform units outlined later. The central area was not surveyed due to lack of access. As some geological surfaces had no suitable access, four sites were sampled on the Zanthus – Balladonia track a few kilometres east of the Study Area. The methods employed are reported in Biological Surveys Committee (1984).

The vertebrate fauna was recorded in a representative area of each major vegetation formation within a 15 km radius of the two campsites at Woodline (31° 54'S, 122° 24'E) and Buningonia Spring (31° 26'S, 123° 33'E). Significant collections of invertebrate material were made and will be reported elsewhere. Each Survey Area was visited in November 1978, August 1980 and April 1981 (for between 5 and 7 days).

II Physical Environment

K.R. Newbey

The Study Area has cool winters and hot summers with slightly more rainfall during winter than summer (Figure 3a). Apart from the south-western corner, the climate of the Study Area has been classified as Hot Arid Desert (Dick 1975). The small south-western section is Hot Dry Continental. Alternatively, the climate of the south-western half is Sub-desert (attenuated), and most of the remainder is Sub-desert (accentuated) (UNESCO – FAO 1963). The remaining small area in the north-eastern corner near Zanthus is Desert.

The only weather station in the Study Area with records over a long period is Zanthus which has recorded rainfall for 56 years. Most of the climatic data presented is from recording stations near to the Study Area: Kalgoorlie, Norseman and Balladonia.

Temperature

Average maximum temperature for each month ranges from 37° C (January) to 17° C (July). Numerous frosts are experienced during winter but snow has not been recorded. Recorded extremes of temperature are: Kalgoorlie (45.2° C and – 3.0° C), Norseman (44.9° C and – 2.8° C) and Balladonia (48.0° C and – 3.3° C). Mean annual evaporation increases from the south (2400 mm) to the north (2700 mm) (Anon 1981).

Rainfall

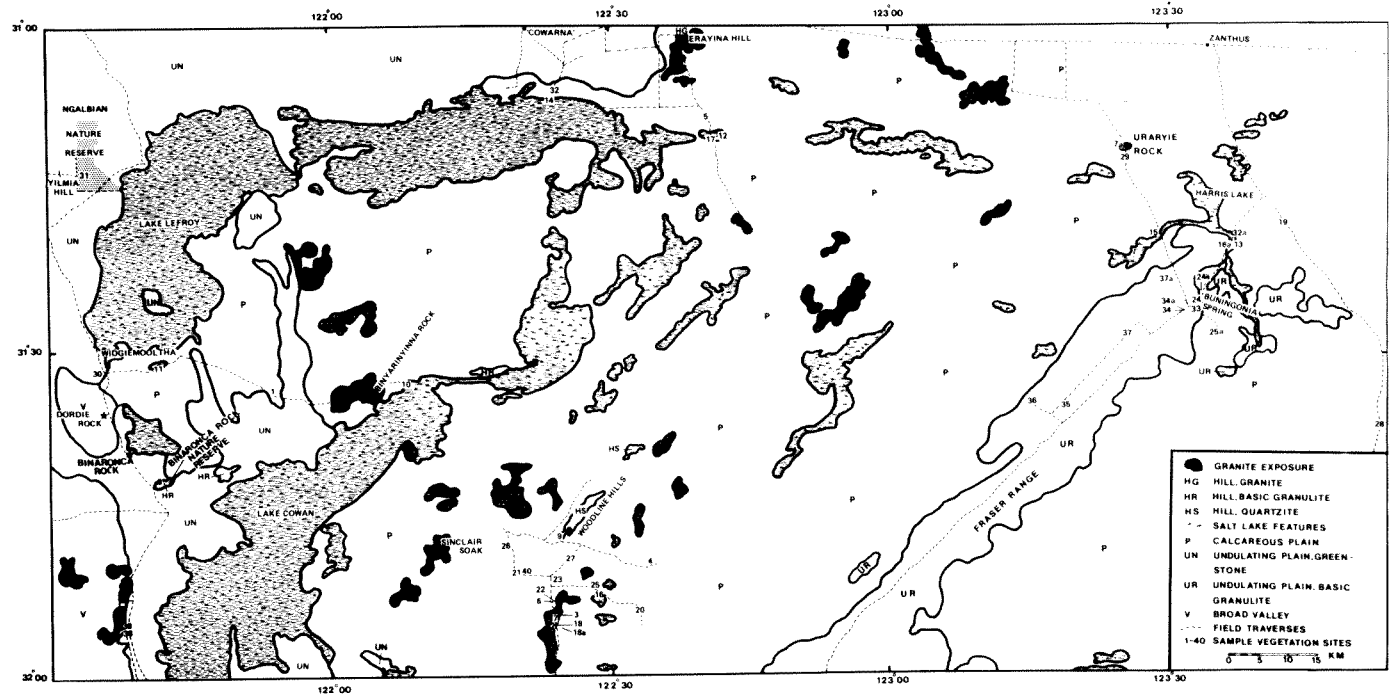
Rainfall decreases from the south-west (276 mm) to the north-east (213 mm). The average annual rainfall tends to be evenly distributed throughout the year, being slightly higher in winter than summer. The important aspects of the rainfall are its unreliability and the range between highest and lowest annual recording: Kalgoorlie (488 – 123 mm), Norseman (613 – 152 mm), and Zanthus (543 – 44 mm). During winter, the rain is light and associated with the passage of cold fronts over the southern part of the Study Area. The falls decrease from south-west to north-east. Heavy rains occur during summer from thunderstorms, and cyclones which have degenerated into rain-bearing depressions. Falls of 50 – 150 mm are not uncommon, but very unreliable. Associated with rainfall is the growing period which also decreases from south-west to north-east (2.0 – 0.0 months) (Anon 1981).

Winds

Average wind speeds at both 0900 and 1500 graded across the Study Area from 1 – 20 km/hour in the SE to 11 – 30 km/hour in the NW. The main directions are summer (NE – SE), autumn and winter (NE – SE at Kalgoorlie grading to SW – NW at Balladonia) and spring (NE – SE).

The maximum wind speeds recorded at Kalgoorlie each month are mainly 60 – 80 km/hour. The highest recordings were 138 km/hour (November 1979), 132 km/hour (October 1955) and 121 km/hour (May 1975). Some squalls associated with thunderstorms may damage the vegetation. The only evidence of severe damage seen during field work, was in the Fraser Range and *ca* 50 km north of Norseman. A swathe about 50 m wide, and at least 250 m long has been cut in *Eucalyptus uncinata* mallee. Stems (to 8 cm diameter) of all the mallees, and the branches of larger shrubs has been twisted off close to the ground. North of Norseman, most branches up to 15 cm diameter have been torn off *Eucalyptus salmonophloia* and *E. salubris*.

Figure 2 Showing the main landform units of the Widgiemooltha-Zanthus Study Area. Field traverses for the vegetation study are indicated with numbers identifying the vegetation sites described.



Radiation

The average daily radiation during January grades from south (770 mWh. cm^{-2}) to north (790 mWh. cm^{-2}). During July the gradient is from south-east (330 mWh. cm^{-2}) to north-west (370 mWh. cm^{-2}) (Anon 1975).

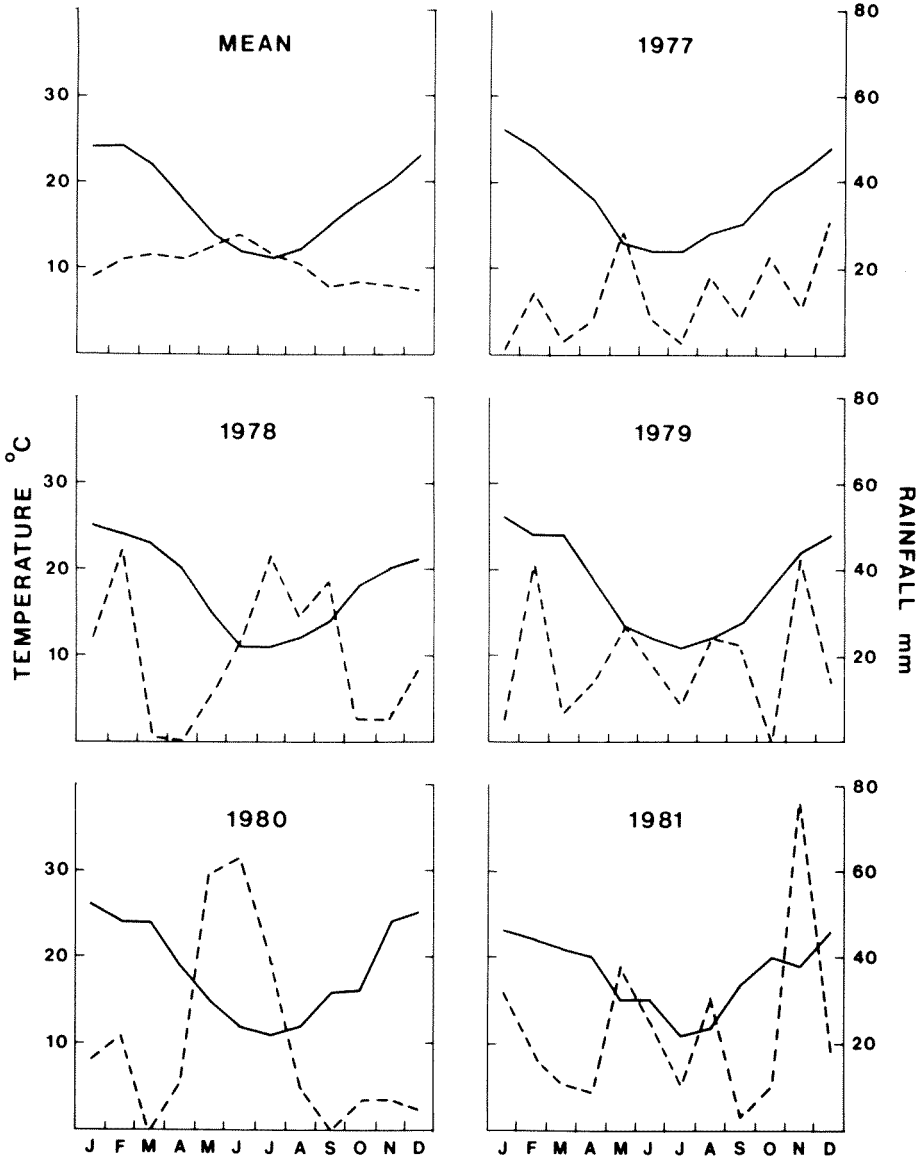


Figure 3 Ombrothermic diagrams showing the mean monthly rainfall and average monthly temperature for the years 1977-1981 and the long term mean. These figures incorporate data from the Kalgoorlie, Zanthus, Balladonia and Norseman meterological stations.

Survey Weather

Although the biological survey commenced in 1978, temperature and rainfall data for the preceding year would have influenced the biota and they are included (Figures 3a – f). Average temperatures during the survey period only varied by more than 2° C during November 1980 (up 4° C) and June 1981 (up 3° C). Substantial monthly totals of rainfall (40 mm or more) were recorded: February and July 1978, February and November 1979, May – July 1980, and May and November 1981. The longest period of prolonged rainfall occurred June – September 1978 and May – July 1980. The erratic nature of the rainfall is illustrated by variation in the monthly totals for the period 1977 – 81 (Figures 3b – f).

The first survey (November 1978) was preceded by above average rainfall in July to September; the second survey by above average winter rainfall; and the third survey by below average rainfall.

Geology and Landforms

The geology of the Study Area has been mapped and described in detail: Widgiemooltha 1:250,000 sheet (Sofoulis 1966) and Zanthus 1:250,000 sheet (Doepel & Lowry 1970). The Study Area, tectonically stable since the Proterozoic, consists of the following elements which are important to both the development of the landscape and the vegetation:

a) most of the Study Area is underlain by Archaean or Proterozoic gneisses and granites eroded into a flat plain, largely by the transgression of the Eocene sea (Lowry 1970), and covered with Tertiary soils, with scattered exposures of bedrock;

b) near the western margin is an Archaean greenstone belt, 40 – 70 km wide, eroded into low hills and ridges with narrow colluvial flats;

c) running south-west from Zanthus to the Study Area's southern boundary is an eroded horst of Proterozoic basic granulite constituting the Fraser Range (Wilson 1969).

d) east of the Fraser Range is the Miocene limestone of the Nullarbor Plain;

e) from Norseman to south of Zanthus are a series of salt lakes which are the remnants of an ancient major drainage line (van de Graaff *et al.* 1977);

f) near the centre of the Study Area are the Woodline Hills of Proterozoic quartzite;

g) running east-west 25 km south of Widgiemooltha is a single line of basic granulite outcrops of the Widgiemooltha Dyke Suite.

As used in the present publication, the term "granite" refers to all granitoid rocks. They all weather into similar soils which support vegetation of similar structure and species composition.

The Study Area, which is within Salinaland of Jutson (1950), is mostly flat with a gentle slope from north-west to south-east. Height on the western boundary is 320 – 360 m sloping to 265 m near Zanthus and 161m in the south-eastern corner. Mt. Marion (475 m) and Mt. Yilmia (451 m) near Kambalda West, the two highest points in the Study Area, are in the greenstone belt.

Apart from some areas north of Lake Cowan, drainage lines were rarely sighted. The drainage lines seen during field work rarely exceeded 12 km in length and had ephemeral flows into the larger salt lakes.

During the Cainozoic, areas of laterite developed over deeply weathered granite (Sofoulis 1966). A few small remnants of this surface remain as breakaways e.g. south-east of Widgiemooltha.

Soils

The soils of the Study Area have been discussed briefly by Northcote *et al.* (1968), and will be described in detail by Newbey & Milewski. During the present survey, soil data were recorded at each vegetation site. Calcareous Earths, high in Ca and Mg, are the most widespread soil group and cover much of the Calcareous Plains and the greenstone areas. Neutral soils are skeletal to shallow over granite, granulite and quartzite. Associated with salt lakes are saline and sub-saline soils. Aeolian Sands are present as sand dunes peripheral to salt lakes, or forming extensive sheets on both the Calcareous Plains or Broad Valleys. Some soils have formed *in situ* over granite and have a typical coarse sand fraction in the profile. However, their pH is 8.0 and not the typical 6.0 – 6.5. They are referred to here as "Meta-granitic Soils" and occur as areas less than 1 ha in size within extensive areas of calcareous soils. Their high pH has resulted from the influence of surrounding soils. A summary profile for each soil group is presented in Table 1, and the correlations between soil groups, geology, landform units and elements, and vegetation are presented in Table 2.

Landform Units

Newbey & Milewski have developed a clasification of 10 units to describe the landscapes of System 11. Seven units were recorded in the Study Area, 2 of these (Hill and Undulating Plain) are divided into 5 sub-units on the basis of bedrock type (Figure 2). They are briefly described below. The units absent from the Study Area are Drainage Line (C), Dune Field (D) and Sandplain (S).

Breakaway (B): The few breakaways seen during field work were in the western third of the Study Area. They are 3 – 4 m high with a free face, have scree slopes of 12° – 15°, and are partially covered with Gritty Loams. The top have shallow pockets of soil in exposures of duricrust, as well as soil sheets – all with variable drainage. Similar soils are found on the scree slopes. Colluvial soils of the pediment are thicker and may become water-logged by run-off from the higher and bare areas of the breakaway.

Dune Field (D): A few, single dunes are present in the Study Area but do not occupy an area of sufficient size to be defined as Dune Fields.

Granite Exposure (G): Exposures of bedrock, flat to low-domed, vary in size from a few square metres to 0.5 km^2. Soils present on the rock and forming the peripheral apron are Granitic Soils. Exposures are mainly bare rock but skeletal sheets of soil accumulate in slight depressions on the exposure, or along faint drainage lines. The apron consists of soil profiles up to 2 m thick weathered *in situ* from the underlying granite. In some areas the bedrock is within 2 m of the soil surface but is not exposed. Overlying this bedrock are soils similar to those of the apron. On the exposure and the apron the frequency of waterlogging and the rate of drying increases as the profile thickness decreases.

The main differences between Granite Exposures and Granite Hills are that the latter are more than 30 m high and largely covered with vegetation. Granite Exposures have only a few small soil sheets on the exposure.

Hill (H): Hills rise more than 30 m above the surrounding plains and have slopes ranging from 5° to 15°. The surface is largely covered with skeletal and excessively-drained soils, and

Table 1 Soil Groups occurring in the Landform units of the Widgiemooltha-Zanthus study area.

Soil Group	A horizon	B horizon	Bedrock
BREAKAWAY (B)			
Gritty Loams	5-35 cm, pH 6.0-6.5	If present, 10-40 cm, higher clay content than **A**	Kaolonized granite
GRANITE EXPOSURE (G)			
Granitic Soils	3-30 cm, pH 6.0-6.5	If present, 10-90 cm, sandy clay.	Granite
HILL, GRANITE (HG)			
Granitic Soils	3-25 cm, pH 6.5	Absent	Granite
HILL, GRANULITE (HR)			
Granitic Soils	3-20 cm, pH 6.5	Absent	Granulite
HILL, QUARTZITE (HS)			
Gritty Sands	3-20 cm, pH 6.5	Absent	Quartzite
SALT LAKE FEATURES (L)			
Aeolian Sands	5-400 cm, pH 6.0-7.0, sand to loam	If present, higher clay content than **A**	Unknown
Saline Soils	2-15 cm, pH 7.0	Multi-strata	Unknown
Sub-saline Soils	As above	As above	Unknown
Alluvium	2-100 cm, pH 5.75-6.75	If present, multistrata	Unknown
CALCAREOUS PLAIN (P)			
Deep Calcareous Earths	10-30 cm, pH 7.0-8.25	>100 cm, pH 8.0-8.25, carbonate nodules usually present	Unknown

Table 1 (cont.)

Soil Group	A horizon	B horizon	Bedrock
Shallow Calcareous Earths	5-30 cm, pH 8.0-8.25	Rarely present	Greenstone
Aeolian Sands	10-20cm, pH 7.5-8.0	As above	Unknown
UNDULATING PLAIN, GREENSTONE (UN)			
Deep Calcareous Earths	10-20 cm, pH 7.5-8.25	>100 cm, pH 8.0-8.25, carbonate nodules usually present	Greenstone
Shallow Calcareous Earths	5-30 cm, pH 8.0-8.25	Rarely present	Greenstone
Sub-saline Soils	As above	As above	Unknown
Meta-granitic Soils	10-15 cm, pH 8.0	Absent	Granite
UNDULATING PLAIN, BASIC GRANULITE (UR)			
Deep Calcareous Earths	10-20 cm, pH 7.5-8.25	>100 cm, pH 8.0-8.25, carbonate nodules often present	Basic granulite
Shallow Calcareous Earths	5-30 cm, pH 8.0	Rarely present	Basic granulite
Meta-granitic Soils	10-15cm, pH 8.0	>100 cm, sandy clay, pH 8.0	Granite
Gravelly Sands	15-25 cm, pH 7.75	>50 cm, sandy clay, pH 7.0	?Granite
BROAD VALLEY (V)			
Deep Calcareous Earths	10-20 cm, pH 7.0-7.55	>100 cm, pH 8.0-8.25, carbonate nodules often present	Unknown
Aeolian Sands	15-30 cm, pH 6.5-7.0	>100 cm, pH 8.0, carbonate nodules often present	Unknown
Meta-granitic Soils	10-15 cm, pH 8.0	>100 cm, sandy clay, pH 8.0	Granite

numerous small areas of bare rock. Most prominent are the Woodline Hills of quartzite near the centre of the Study Area. Hills are divided into sub-units based on their bedrock type.

a) *Hill, granite* (HG): The only granite hill noted during field work was Erayinia Hill (50 m high) 10 km south-east of Karonie. Granite usually has coarse-textured cracking but the cracking on Erayinia Hill is medium-textured. The covering of Granitic Soils is extensive and includes many small rock fragments which probably help to prevent the soil being washed away by heavy falls of rain.

b) *Hill, basic granulite* (HR): Binaronca Rock, 25 km south of Widgiemooltha, of basic granulite and 30 m high, was the only outcrop surveyed of the Widgiemooltha Dyke Suite. Granitic Soils, often stony, cover most of the slopes.

c) *Hill, quartzite* (HS): The linear Woodline Hills rising 30 – 50 m above the surrounding plains, have 10° to 15° slopes covered with Gritty Sands, and numerous but small exposures of bedrock.

Salt Lake Features (L): Salt lakes are flat-floored with ephemeral water up to 30 cm deep following rain. Peripheral dunes, 1 – 4 m high, occur mainly on the southern and western margins. Where a former, major drainage line has been reduced to a scattered string of salt lakes, extensive areas of flats are usually present. Three types of flats are recognized:

a) saline flats – 15 – 30 cm above the level of the lake floor, highly saline and damp to waterlogged;

b) damp flats – also 15 – 30 cm above the lake floor but with a very low salt content;

c) well-drained flats – 2 – 4 m above the salt lake floor and mainly well-drained.

The soils of Salt Lake Features have a complex history which includes colluvial, alluvial and aeolian actions and frequent reworkings – especially by wind during Recent arid periods (Bowler 1976). Lake dunes, of fine and loose sands to clay loams, are usually stabilized by vegetation.

Calcareous Plain (P): The plains are flat with local relief rarely exceeding 4 m, and they dominate the Study Area. Deep Calcareous Earths of colluvial and alluvial origin and usually well-drained are the main soil group present. The other important soil group is Aeolian Sands forming extensive sheets 20 – 30 cm thick over deep calcareous soils. Occasionally, a low dune is present and stabilized by vegetation. Some eastern areas have Deep Calcareous Earths which appeared to have been formed of fine dust blown off the Nullarbor Plain during Recent arid periods.

The major differences between Calcareous Plains and Broad Valleys (V) are their size and origin. Calcareous Plains are in the order of 70 – 100 km wide and their level surface appears to have resulted from transgression by the Eocene Sea (Lowry 1970). Broad Valleys are 2 – 15 km in width and consist of colluvial, alluvial and aeolian fills of ancient river systems. Many of the soils are similar but those of Calcareous Plains tend to be more calcareous than those of the Broad Valleys.

Undulating Plain (U): Differential weathering of the bedrock has resulted in series of low hills, ridges and rises with local relief of 2 - 30 m, and slopes of 5° to 15°. In between the hills etc. are narrow colluvial flats. The unit was subdivided on the basis of bedrock type.

a) *Undulating Plain, greenstone* (UN): The greenstone belt consists of undulating plains with hills of mainly basic basalt, which is more resistant to weathering than the ultra-basic sections underlying colluvial flats. Towards Karonie the landscape grades into an almost flat

Table 2 The Relationships between Landform units, Geology, Soils and Vegetation.

Geological Surface Wi	Geological Surface Za	Landform element	Soil	Vegetation
BREAKAWAY (B)				
Tf		Whole feature	Gritty Loams	Breakaway complex
GRANITE EXPOSURE (G)				
Ag, Pmg	Px	Seletal soil sheets and inner apron	Granitic Soils	Granite Complex
Ag, Pmg		Outer Apron	Granitic Soils	*A.* sp. (KRN 7568) Tall Shrubland *A.* Sp. (KRN 8497) Tall Shrubland *A. acuminata* Tall Shrubland *E. grossa* Mallee *E. loxophleba* Mallee
HILL, granite (HG)				
Pmg		Slopes and summit	Granitic Soils	*A. quadrimarginea* Tall Shrubland
HILL, basic granulite (HR)				
Plw		Slopes and summit	Granitic Soils	*A. quadrimarginea* Tall Shrubland
HILL, quartzite (HS)				
Puw		Slopes and summit	Gritty Sands	*Baeckea* sp. (KRN 7010) Tall Shrubland
SALT LAKE FEATURES (L)				
Qrl(p)	Qpv	Lake margins and floors, and Saline flats	Saline Soils	*Halosarcia* Low Shrubland
		Damp flats	Sub-saline soils	*Cratystylis subspinescens* Low Shrubland
Qrl(p)	Qre	Well-drained flats	Aeolian Loams	*Myoporum platycarpum* Tall Shrubland
		Claypan	Alluvium	*Melaleuca* Tall Shrubland
		Outer lake slope	Sub-saline soils	*E. lesouefii* Low Woodland over *Sclerostegia disarticulata*
Qrl(p)		Peripheral lake dune	Aeolian Sand	*Callitris columellaris* Low Woodland *E. platycorys* Low Woodland Dune Complex

Table 2 (cont.)

Geological Surface Wi	Za	Landform element	Soil	Vegetation
CALCAREOUS PLAIN (P)				
Qrs(p)	Qo	Level surface	Aeolian Sands	*E. cylindrocarpa* Mallee *E. gracilis Mallee* *E. oleosa* Low Woodland over *Triodia scariosa* *E. transcontinentalis* Low Woodland
	Qps	Level surface	Deep Calcareous Earths	*Casuarina cristata* ssp. *pauper* Low Woodland *E. lesouefii* Low Woodland *E. longicornis* Low Woodland *E.* mixed Low Woodland *E. oleosa* Low Woodland *E. salmonophloia* Woodland *E. salubris* Low Woodland
Qpk	Qpe	Level surface	Deep Calcareous Earths	*E. salubris* Low Woodland
Qpb Tep	.....	Level surface	Shallow Calcareous Earths	*E. longicornis* Low Woodland
Tb	.....	Slight rise	Deep Calcareous Earths	*E. dundasii* Low Woodland
.....	Qpv	Colluvial flat	Deep Calcareous Earths	*Atriplex vesicaria* Low Shrubland *E. salmonophloia* Woodland
.....	Qpc	Slight rise	Deep Calcareous Earths	*Dodonaea lobulata* Tall Shrubland
.....	Qe	Lithified dunes	Shallow Calcareous Earths	*E. transcontinentalis* Mallee
UNDULATING PLAIN, greenstone (UN)				
Qps	.....	Colluvial flat	Deep Calcareous Earths	*E. lesouefii* Low Woodland *Maireana sedifolia* Low Shrubland
As, Av, Aa, Ab, Ad	.....	Ridge	Shallow Calcareous Earths	*E. lesouefii* Low Woodland *E. stricklandii* Low Woodland *E. torquata* Low Woodland
			Meta-granitic Soils	*A. quadrimarginea* Tall Shrubland
Tb	.....	Ridge	Shallow Calcareous Earths	*Casuarina cristata* ssp. *pauper* Low Woodland

Table 2 (cont.)

Geological Surface Wi	Geological Surface Za	Landform element	Soil	Vegetation
Avu		Colluvial flat	Deep Calcareous Earths	*E. salmonophloia* Woodland
Qra(p)		Colluvial flat	Sub-saline Soils	*Atriplex vesicaria* Low Shrubland
UNDULATING PLAIN, basic granulite (UR)				
	Px	Colluvial flat and rise	Meta-granitic Soils	*E. griffithsii* Mallee
		Ridge	Meta-granitic Soils	*Melaleuca uncinata* Tall Shrubland
			Gravelly Sands	*Allocasuarina campestris* ssp. *campestris* Tall Shrubland
			Shallow Calcareous Earths	*E. lesouefii* Low Woodland
			Deep Calcareous Earths	*E. oleosa* Low Woodland
		Colluvial flat	Deep Calcareous Earths	*E. uncinata* Mallee
	Qpe	Gentle slope	Meta-granitic Soils	*E. oleosa* Low Woodland *Triodia scariosa* Hummock Grassland
BROAD VALLEY (V)				
Qps		Valley bottom	Deep Calcareous Earths	*E. cylindrocarpa* Mallee *E. salmonophloia* Woodland *E. transcontinentalis* Low Woodland
			Aeolian Sands	*E. eremophila* Mallee
		Lower valley slope	Meta-granitic Soils	*E. griffithsii* Mallee

Geological Surfaces columns: Wi = Widgiemooltha (Sofoulis 1966)
Za = Zanthus (Doepel & Lowry 1970)
Greenstone and granite surfaces are presented as groups because the vegetation is not specific.
(p) = in part
Vegetation: *A.* = *Acacia*, *E.* = *Eucalyptus*

plain with eroded ridges 2 – 3 m high. The colluvial flats are 400 – 1,000 m in width and each of the larger flats is drained by a single channel. Soils derived from greenstone are high in Mg and Ca. Shallow Calcareous Earths occur on the hills whereas the flats consist of Deep Calcareous Earths.

b) *Undulating Plain, basic granulite* (UR): The Fraser Range is unique within the Eastern Goldfields. Almost two-thirds occurs within the Study Area; the remainder within the Norseman – Balladonia Study Area. The range is a horst that appears to have experienced uplift that increases from north-east to south-west. The complex bedrock (Wilson 1969) has weathered at different rates and resulted in a crude and well-spaced lattice of low and rounded ridges. In the north-east, the ridges are 1.5 – 2.0 m high, grading to 3 – 5 m in the south-west. A few low hills are present on a small southern section of the range.

Broad Valley (V): Overlying granite are broad, saucer-shaped valleys 3 – 5 km wide with internal relief usually less than 20 m and slopes rarely exceeding 2°. The valleys are well-drained but the indistinct drainage lines only flow following very heavy falls of rain. Within the Study Area, the unit is only found west of the greenstone belt in the south-western corner. The unit is not as well developed here as to the west of the Study Area where Broad Valleys are a major component of the landscape. Deep Calcareous Earths are dominant but they are sometimes covered with a shallow A horizon of non-calcareous, loamy fine sand.

Freshwater

Permanent areas of freshwater are man-made and consist mainly of scattered dams of 10,000 – 15,000 m^3 capacity on pastoral leases. Near "Cowarna" homestead, construction has resulted in a former small claypan being enlarged to *ca* 120 m x 400 m and 3 m deep when full. Natural areas of freshwater are small pools on or at the base of granite exposures. They rarely exceed 60 cm in depth or 3 m in width, and only persist for short periods due to high rates of evaporation. However, 2 – 5 mm of rain provides sufficient run-off from bare rock to fill most of the pools.

III Vegetation and Flora

K.R. Newbey & R.J. Hnatiuk

Vegetation

The structural formations have been described and mapped at a scale of 1:1,000,000 (Beard 1975). During the survey 121 sites were sampled using plotless sites on a systematic basis. The selection of sites and the parameters recorded are detailed in Biological Surveys Committee (1984). The sites are broadly classified, on structure and species composition of the upper stratum, into 39 types. Two of the types are referred to as vegetation complexes (dune and granite) as their structure and species composition changed greatly over a few metres. A typical site for each of the 39 types is described in Appendix I, together with relevant data on geology, landforms and soils.

Briefly, low woodlands (5 – 8m) dominated the Study Area and were only absent from Granite Exposures, Hills and most Salt Lake Features. Mallees (2.5 – 4m) occurred on extensive sand sheets on the Calcareous Plains, low ridges of the Fraser Range and rarely on aprons of Granite Exposures. Hills and outer aprons of Granite Exposures supported tall shrublands (1.5 – 2.7 m), as do some Salt Lake Features. Low shrublands (0.3 – 0.5 m), consisting almost entirely of halophytes, occurred on many Salt Lake Features. Complexes of shrubs, perennial grasses and herbs were recorded on the skeletal and shallow soils of Granite Exposures. The other complex of mallees, shrubs, perennial grasses and herbs, occurred on salt lake dunes.

The occurrences of vegetation types, by landform units, are outlined below and summarized in Table 3. The correlations between geology, landforms, soils and vegetation, are shown in Table 2.

The most common shrubs, perennial grasses and annuals are listed for each vegetation type. Six annual species occurred on all landform units other than saline soils and they are not listed: *Calotis hispidula, Chthonocephalus pseudevax, Erodium crinitum, Isoetopsis graminifolia, Menkea australis* and *Plantago debilis.* Few of the species occurring in the Study Area have accepted common names. They are listed where the species first occurs in the text. An asterisk indicates an introduced species.

Breakaway (B): The only breakaway sighted during field work supported a vegetation complex. On the summit were scattered trees of *Eucalyptus stricklandii* (Strickland Gum); tall shrubs of *Eremophila alternifolia;* low shrubs of *Prostanthera* sp. (KRN 8541) and *Sclerolaena obliquicuspis;* and annuals of *Gnephosis burkittii, Brachycome pusilla* and *Helipterum pygmaeum.* On the scree slopes were scattered trees of *E. stricklandii* and low shrubs of *Ptilotus helichrysoides.*

Granite Exposure (G): Granite Complex occurred on neutral and gritty loamy sands of the soil sheets on granite exposures and their peripheral inner apron. Shrubs were rare and the vegetation consisted of perennial grasses (*Eragrostis dielsii, Aristida contorta* and *Tripogon loliiformis*) and annuals of *Chrysocoryne pusilla, Centrolepis* sp. (KRN 7122), *Calandrinia granulifera,* and *Goodenia havilandii.* Some small areas tended to be waterlogged for most of the winter and supported annuals of *Isolepis congrua, Schoenus sculptus, Triglochin calcitrapa,* and *Gnephosis* aff. *pygmaea.*

The most common vegetation on the outer apron was *Acacia acuminata* (Jam) Tall Shrubland with other tall shrubs of *Melaleuca uncinata* (Broombush) and *Allocasuarina campestris* ssp. *campestris;* low shrubs of *Prostanthera aspalathoides, Dodonaea boroniifolia* and *Mirbelia microphylla;* perennial grasses of *Aristida contorta;* and annuals of *Helipterum laeve, Chrysocoryne pusilla* and *Podolepis lessonii.* Occasionally in the north-eastern section *Acacia acuminata* Tall Shrubland was replaced by *Acacia tetragonophylla* Tall Shrubland, with other tall shrubs of *Acacia quadrimarginea* and *Pittosporum phylliraeoides;* low shrubs of *Dodonaea lobulata* and *Ptilotus obovatus* var. *obovatus,* and annuals of *Gnephosis burkittii* and *Helipterum pygmaeum.*

Also occurring, but rarely, on the outer apron, in the western section, was *Eucalyptus loxophleba* (York Gum) or *E. grossa* (Coarse-leaved Mallee) Mallee. Tall shrubs associated with *E. loxophleba* were *Pittosporum phylliraeoides* (Weeping Pittosporum) and *Eremophila decipiens,* low shrubs of *Rhagodia drummondii* and annuals of *Podolepis lessonii.* Tall shrubs with *E. grossa* included *Trymalium* aff. *ledifolium, Beyeria lechenaultii* and *Melaleuca uncinata;* and low shrubs of *Dodonaea microzyga* with few annuals.

Of rare occurrence on shallow soils over granite was either *Acacia* sp. (KRN 7568) or *Acacia* sp. (KRN 8497) Tall Shrublands. Also present with *Acacia* sp. (KRN 7568) were tall shrubs of *Allocasuarina helmsii* and *Melaleuca lateriflora,* with low shrubs of *Prostanthera aspalathoides* over hummock grasses of *Triodia scariosa.* Occurring with *Acacia* sp. (KRN 8497) were tall shrubs of *M. coccinea* and *M. uncinata* over *Triodia scariosa* and annuals of *Chrysocoryne pusilla.*

(a) *Hill, granite* (HG): The only hill sighted during field work was Erayinia Hill, 10 km south-east of Karonie. *Acacia quadrimarginea* Tall Shrubland was growing on neutral and gritty loamy sand. Also present were mallees of *Eucalyptus petraea;* tall shrubs of *Dodonaea lobulata* and *Eremophila clarkei sens.lat.;* low shrubs of *Ptilotus obovatus* var. *obovatus;* and annuals of *Helipterum pygmaeum, H. battii, Gnephosis burkittii, Parietaria debilis, Toxanthes perpusillus* and **Vulpia myuros.*

(b) *Hill, basic granulite* (HR): The hill was covered with *Acacia quadrimarginea* Tall Shrubland with other tall shrubs of *Acacia acuminata, Dodonaea lobulata, Eremophila oppositifolia* and *E. alternifolia;* low shrubs of *Helichrysum ambiguum, Ptilotus obovatus* var. *obovatus, Prostanthera wilkieana* and *Dampiera latealata;* and annuals of *Helipterum strictum, H. hyalospermum* and *Blennospora drummondii.*

(c) *Hill, quartzite* (HS): Only one site was sampled on the southern end of the Woodline Hills. Growing on coarse and siliceous sand was *Baeckea* sp. (KRN 7010) Tall Shrubland. Other tall shrubs present included *Acacia quadrimarginea, Allocasuarina helmsii, A. campestris* ssp. *grossa* and *Melaleuca uncinata;* low shrubs of *Cryptandra pungens;* and an occasional mallee of *Eucalyptus websteriana* (Webster's Mallee) on the crest.

Salt Lake Features (L): The floors of most salt lakes were almost bare with only small patches of *Halosarcia* Low Shrubland (Samphire) growing around the margin. Occasionally, the floors of some small salt lakes, and saline flats, were covered with the same vegetation. From 2 to 7 species of *Halosarcia* have been recorded at the same locality. Commonest species were *H. syncarpa, H. peltata, H. halocnemoides* ssp. *halocnemoides, H. doleiformis* and *H. indica* ssp. *leiostachya.* Also present were low shrubs of *Atriplex* sp. (KRN 6110), *Sclerolaena eurotioides, Disphyma clavellatum* and *Maireana glomerifolia,* and annuals including *Pogonolepis stricta.*

Table 3 Distribution of Vegetation types by Landform units, representation in reserved areas, and adequacy of fauna sampling.

F	Association	Landform Unit										Cons.	
		B	G	HG	HR	HS	L	P	UN	UR	V	B	N
BREAKAWAY													
C	Breakaway	41.	...	...	...	...	...	...	...	...	...	.	.
GRANITE EXPOSURE													
M	*Eucalyptus grossa*	...	11X	...	...	...	...	...	...	...	...	.	.
M	*Eucalyptus loxophleba*	...	11X	...	...	...	...	...	...	...	...	.	.
T	*Acacia* sp. (KRN 7568)	...	12.	...	...	...	...	...	...	...	...	.	.
T	*Acacia* sp. (KRN 8497)	...	12.	...	...	...	...	...	...	...	...	.	.
T	*Acacia acuminata*	...	42X	...	...	...	...	...	...	...	...	.	P
C	Granite complex	...	41X	...	...	...	...	...	...	...	...	P	.
HILL, GRANITE & BASIC GRANULITE													
T	*Acacia quadrimarginea*	...	...	42.	43.	...	...	...	11.	...	...	P	.
HILL, QUARTZITE													
T	*Baeckea* sp. (KRN 7010)	...	...	...	...	54.	...	...	...	...	...	.	.
SALT LAKE FEATURES													
L	*Eucalyptus platycorys*	...	...	...	...	...	22.	...	...	...	...	.	.
L	*Callitris columellaris*	...	...	...	...	...	22.	...	...	...	...	.	.
T	*Melaleuca*	...	...	...	...	...	11.	...	...	...	...	.	.
T	*Myoporum platycarpum*	...	...	...	...	...	34X	...	...	...	...	.	.
S	*Atriplex vesicaria*	...	...	...	...	...	33.	22.	12.	...	...	.	P
S	*Cratystylis subspinescens*	...	...	...	...	...	22.	...	...	...	...	.	.
S	*Halosarcia*	...	...	...	...	...	42X	...	...	...	...	.	.
C	Dune	...	...	...	...	...	42.	...	...	...	...	.	.
CALCAREOUS PLAIN													
W	*Eucalyptus salmonophloia*	...	...	...	...	...	...	32X	32.	...	21.	P	P
L	*Casuarina cristata* ssp. *pauper*	...	...	...	...	...	...	12.	22.	...	...	.	.
L	*Eucalyptus dundasii*	...	...	...	...	...	...	12.	...	...	...	.	.
L	*Eucalyptus lesouefii*	...	...	...	...	...	11.	32X	42.	11.	...	.	P

Table 3 (cont.)

F	Association	Landform Unit B	G	HG	HR	HS	L	P	UN	UR	V	Cons. B	N
L	*Eucalyptus longicornis*	...	...	...	...	...	...	32X	...	...	...	.	.
L	*Eucalyptus* mixed	...	...	...	...	...	...	23X	...	...	...	.	.
L	*Eucalyptus oleosa*	...	...	...	22.	...	...	34X	...	12.	...	.	.
L	*Eucalyptus salubris*	...	...	...	...	...	...	52X	...	12.	...	.	.
M	*Eucalyptus cylindrocarpa*	...	...	...	...	...	...	33X	...	...	21.	.	.
M	*Eucalyptus gracilis*	...	...	...	...	...	...	22.	...	...	...	.	.
M	*Eucalyptus transcontinentalis*	...	...	...	...	...	...	14.	...	...	...	.	.
T	*Dodonaea lobulata*	...	...	...	...	...	...	12.	...	...	...	.	.
UNDULATING PLAIN, GREENSTONE													
L	*Eucalyptus stricklandii*	...	...	...	...	...	...	...	21.	...	...	.	.
L	*Eucalyptus torquata*	...	...	...	...	...	...	...	42.	...	...	.	P
S	*Maireana sedifolia*	...	...	...	...	...	...	...	33.	...	...	.	.
UNDULATING PLAIN, BASIC GRANULITE													
M	*Eucalyptus griffithsii*	...	...	...	...	...	...	...	42X	...	11.	.	.
M	*Eucalyptus uncinata*	...	...	...	...	...	...	...	...	32X	...	.	.
T	*Allocasuarina campestris* ssp. *campestris*	...	...	...	...	...	...	...	...	12.	...	.	.
T	*Melaleuca uncinata*	...	...	...	...	...	...	...	...	11.	...	.	.
H	*Triodia scariosa*	...	...	...	...	...	...	...	...	12X	...	.	.
BROAD VALLEY													
L	*Eucalyptus transcontinentalis*	...	...	...	...	...	...	22.	...	...	43.	.	.
M	*Eucalyptus eremophila*	...	...	...	...	...	...	...	...	...	42.	.	.
	Fauna surveys	.	A	.	.	.	M	A	.	A	.		
	Approx. % of Region	+	0.5	+	0.1	0.1	6.0	78	8.8	5.0	1.5		

Table 3 (cont.)

The order of vegetation types is the same as in Appendix I.

F = Vegetation formation
C = Complex, H = Hummock Grassland, L = Low Woodland (<15 m), M = Mallee, T = Tall Shrubland (>1 m), S = Low Shrubland (<1 m), W = Woodland (>15 m)

Landform Unit
B = Breakaway, G = Granite Exposure, HG = Hill, granite, HR = Hill, basic granulite, HS = Hill, quartzite, L = Salt Lake Features, P = Calcareous Plain, UN = Undulating Plain, greenstone, UR = Undulating Plain, basic granulite, V = Broad Valley.

Three attributes are presented:
(1) Abundance – . = absent, 1 = rare, 2 = scattered, 3 = frequent, 4 = common
(2) Average size of individual areas – . = absent, 1 = <1 ha, 2 = 1-5 ha, 3 = 6.50 ha, 4 = >50 ha.
(3) Fauna site – . = no, X = yes.

Cons. = Conservation areas
B = Binaronca Rock Nature Reserve, N = Ngalbain Nature Reserve

Representation of vegetation type: . = absent, P = poor, A = adequate

Fauna surveys (adequacy): . = absent, M = moderate, A = adequate

The loose and fine sands or sandy loams of lake dunes support low woodlands of *Eucalyptus platycorys* (Boorabbin Mallee) or *Callitris columellaris*, or a Dune Complex. Present with *E. platycorys* were *E. foecunda* (Narrow-leaved Red Mallee) over tall shrubs of *Melaleuca uncinata, Dodonaea angustissima* and *Callitris preissii* ssp. *verrucosa* (western section only); low shrubs of *Bertya cuppressoidea* with *Triodia scariosa* hummock grasses and sedges of *Lepidosperma drummondii* (western section only).

Callitris columellaris Low Woodland contained tall shrubs of *Melaleuca uncinata;* low shrubs of *Atriplex* sp. (KRN 6110) and *Disphyma clavellatum,* and annuals of *Gunniopsis quadrifida, Calocephalus angianthoides* and *Senecio glossanthus.*

The Dune Complex had a variable structure and included mallees of *E. gracilis* (Yorrell); tall shrubs of *Melaleuca uncinata* and *M.* sp. (KRN 8506), over hummock grasses of *Triodia scariosa. Darwinia diosmoides* was sometimes present on the lower lake slope.

Peripheral dunes were absent from the western margins of salt lakes formed over greenstone. The lakes were eroding horizontally into the greenstone resulting mainly in steep stony slopes where the salinity only influenced the vegetation to within *ca* 60 cm above the lake floor. On scattered areas with a gentle slope were low woodlands of *Eucalyptus lesouefii* (Goldfields Blackbutt) with low shrubs of *Sclerostegia disarticulata, Atriplex vesicaria, Disphyma clavellatum,* and annuals of *Pogonolepis stricta* and **Pentaschistis airoides.*

Growing on the non-saline or slightly saline alluvium of damp flats was *Melaleuca* Tall Shrubland with only tall shrubs of *Melaleuca uncinata* and *M.* sp. (KRN 8506).

The largest areas of well-drained flats were covered with *Myoporum platycarpum* (Sugarwood) Tall Shrubland with low shrubs of *Maireana sedifolia, Atriplex vesicaria* and *Rhagodia crassifolia;* hummock grasses of *Triodia scariosa* and annuals of *Crassula exserta, Gnephosis burkittii* and *Helipterum roseum.* Some areas had soils with a higher clay content and more prone to waterlogging, which supported *Cratystylis subspinescens* Low Shrubland. Associated with it were shrubs of *Rhagodia drummondii* and *Sclerolaena diacantha,* and annuals of *Brachycome pusilla.* Where the well-drained flats extended to the lake margin, there was a zone 40 – 70 m wide of *Atriplex vesicaria* Low Shrubland with associated low shrubs of *Halosarcia pruinosa, Disphyma clavellatum* and *Frankenia cinerea.*

Calcareous Plains (P): The flat plains consisted almost entirely of soils with calcareous B horizons. The A horizon had textures varying from sand to clay loam, and pH ranging from neutral to highly calcareous. The soil types were often intermixed without distinct boundaries. As a result, vegetation types could not always be clearly defined and ecotones were common.

The main vegetation types on the western section were low woodlands of *Eucalyptus salubris* (Gimlet) and *E. longicornis* (Morrel) (pH 8.0 – 8.25), and *E. lesouefii* (pH 8.5). *E. dundasii* (Dundas Blackbut) Low Woodland, on stony calcareous soils, was uncommon and confined to the south-western section. Tall shrubs of *Melaleuca* aff. *pauperiflora* were common in all of these woodlands. Annuals were always present and range from rare to frequent. Other species commonly present with *E. salubris* were tall shrubs of *Eremophila scoparia* and *E. ionantha;* and low shrubs of *Cratystylis conocephala* (Grey Bush), *Atriplex vesicaria* and *Cassia nemophila* var. *nemophila.* Between Lake Cowan and Lake Lefroy, small sections of the plain appeared to be slightly saline and support *Eucalyptus salubris* Low Woodland with low shrubs of *Sclerostegia disarticulata* and *Maireana sedifolia* (Blue Bush);

and the annual *Angianthus tomentosus.* On colluvial flats, where the clay content of soils was higher, were scattered areas of *E. salmonophloia* (Salmon Gum) Woodland with low shrubs of *Cratystylis conocephala, Atriplex vesicaria, Rhagodia drummondii* and *Scaevola spinescens.*

Growing with *E. longicornis* were the low shrubs *Cratystylis conocephala* and *Scaevola spinescens* and the annual *Zygophyllum ovatum.* Occurring with *E. lesouefii* were low shrubs of *Halgania* aff. *rigida* and *Acacia hemiteles.* Growing with *E. dundasii* were the low shrubs *Halgania rigida* and *Atriplex vesicaria.* In central parts of the Study Area, *E. longicornis* Low Woodland also occurred on Shallow Calcareous Earths over silcrete.

Important aspects of woodland vegetation of the eastern section were the absence of *Melaleuca* aff. *pauperiflora,* the replacement of *Atriplex vesicaria* by *A. vesicaria* (a form), and the progressive west to east replacement of *Cratystylis concocephala* by *Maireana sedifolia.* The section was dominated by *E. oleosa* (Giant Mallee) Low Woodland with tall shrubs of *Acacia hemiteles, Eremophila scoparia, E. dempsteri* and *E. paisleyi;* and low shrubs of *Maireana sedifolia, Cratystylis conocephala* and *Atriplex vesicaria* (a form). In a few areas with a sandier A horizon, *Triodia scariosa* was common with fewer shrubs.

Two other low woodlands (*Eucalyptus salubris, E. lesouefii)* and *E. salmonophloia* Woodland occurred in small and isolated areas. Compared to the western section, the major species change was that the low shrubs of the *E. salmonophloia* Woodland were dominated by *Maireana sedifolia.*

Growing on stony and calcareous soils were small areas of *Casuarina cristata* spp. *pauper* Low Woodland with tall shrubs of *Dodonaea lobulata,* and low shrubs of *Eremophila decipiens* and *Rhagodia drummondii.* Of rare occurrence were small areas of *Dodonaea lobulata* Tall Shrubland with *Acacia acuminata* and low shrubs of *Maireana sedifolia.* On a single area of lithified calcareous dunes covered with shallow sand, *E. transcontinentalis* (Redwood) Mallee was growing with tall shrubs of *Eremophila dempsteri* over *Triodia scariosa.*

Extensive sheets of Aeolian Sands 20 – 30 cm thick over deep calcareous soils, supported a mallee vegetation dominated by *Eucalyptus cylindrocarpa* (Woodline Mallee) and included tall shrubs of *Eremophila scoparia, E. paisleyi,* and *Melaleuca uncinata.* Also present were low shrubs of *Grevillea pectinata, Acacia camptoclada* and *Daviesia benthamii* ssp *benthamii;* and hummock grasses of *Triodia scariosa.* Occasional small dunes supported *Eucalyptus gracilis* Mallee with tall shrubs of *Callitris preissii* ssp. *verrucosa* and low shrubs of *Bertya cupressoidea.* In western sections of the Study Area sedges of *Lepidosperma drummondii* and *Lomandra effusa* were present. Towards Zanthus, *Eucalyptus transcontinentalis* Low Woodland was also recorded on Aeolian Sands but a site was not sampled. The few tall shrubs present were mainly *Eremophila paisleyi,* over hummock grasses of *T. scariosa.*

Between Buningonia Spring and Uraryie Rock, was a shallow depression *ca* 25 m across that would only hold 10 cm of fresh water when full. There was no natural catchment for the depression so it would only be filled by heavy falls of rain. Being filled each year is unlikely. Some species recorded in this depression were not, or rarely, recorded elsewhere in the Study Area: *Limosella curdeiana, Myosurus minimus, Ranunculus pentandrus* var. *platycarpus* and *Triglochin minutissima.*

Claypans were a physical feature seen once during field work, Swan Lake near "Cowarna",

and three were also noted while mapping the vegetation of the Woodline survey site (Figure 4). Swan Lake has permanent freshwater (Mr. B. Gorrie, manager "Cowana", pers. comm.) and supported *Melaleuca* Tall Shrubland. Two of the small claypans in the Woodline survey site appeared to have almost bare floors. Similar claypans in nearby Study Areas supported *Muehlenbeckia cunninghamii* Low Shrubland. The other claypan appeared to supported *Melaleuca* spp. Tall Shrubland.

(a) *Undulating Plain, greenstone* (UN): Although the vegetation is discussed in two sections (western and eastern), there was actually a gradual change between the two. The western section had numerous small hills and low ridges with skeletal calcareous soils usually supporting *Eucalyptus torquata* (Coral Gum) Low Woodland. Also present were tall shrubs of *Eremophila oppositifolia, E. alternatifolia, E. glabra* (silvery form) and *Acacia tetragonophylla* (on stony areas); low shrubs of *Ptilotus obovatus* var. *obovatus* and *Scaevola spinescens,* and annuals of *Crassula exserta.* Occasionally on the hills were low woodlands of *Eucalyptus stricklandii* over tall shrubs of *Dodonaea lobulata;* low shrubs of *Eremophila caerulea, E. glabra* (silvery form) and *Ptilotus obovatus* var. *obovatus;* and annuals that included *Helipterum oppositifolia.*

On Deep Calcareous Earths of narrow colluvial flats were low woodlands of *Eucalyptus lesouefii* over tall shrubs of *Eremophila oppositifolia, E. scoparia* and *Acacia merrallii;* and low shrubs of *Cratystylis conocephala, Maireana appressa* and *Westringia rigida.* Broader colluvial flats support *Eucalyptus salmonophloia* Woodland and *Atriplex vesicaria* Low Shrubland. Growing under *E. salmonophloia* were tall shrubs of *Atriplex nummularia* (Old Man Saltbush), *Acacia jennerae* and *A. hemiteles;* low shrubs of *Atriplex vesicaria* and *Ptilotus obovatus* var. *obovatus,* and annuals of *Helipterum pygmaeum.* Also present in *Atriplex vesicaria* Low Shrubland were *Cratystylis subspinescens,* and annuals of *Helipterum pygmaeum, H. strictum, Senecio glossanthus* and *Menkea lutea.*

The landform of the eastern section was greatly subdued being reduced to a flat colluvial plain of Deep Calcareous Earths with occasional low rises. In most areas the vegetation had been greatly modified by cutting of trees for firewood, mining timbers etc., and grazing by stock for at least 90 years. The colluvial flats, prime grazing areas for stock, were once covered with *Eucalyptus salmonophloia* Woodland but now supported *Maireana sedifolia* Low Shrubland. An area of *E. salmonophloia* Woodland which appeared by the size of the trees, not to have been cut-over for at least 50 years, had tall shrubs of *Acacia hemiteles* and *Exocarpos aphyllus,* and low shrubs of *Cassia nemophila* var. *nemophila, Ptilotus obovatus* var. *obovatus* and *Maireana sedifolia.* The area had only experienced light grazing (Mr. B. Gorrie, manager of "Cowarna", 1981). *Maireana sedifolia* Low Shrubland had only the single dominant shrub species; perennial grasses of *Stipa eremophila,* and annuals of *Toxanthes perpusillus.* Within 15 – 25 m of major drainage channels, *M. sedifolia* was largely replaced by *M. pyramidata.*

Casuarina cristata ssp. *pauper* Low Woodland was the main vegetation on the low rises covered with Shallow Calcareous Earths. Associated with it were tall shrubs of *Eremophila alternifolia;* low shrubs of *Olearia muelleri* and *E. glabra;* and annuals of *Zygophyllum ovatum.* A few small areas of the rises were covered with *Eucalyptus lesouefii* Low Woodland with a similar species composition to western areas of Undulating Plain. A small ridge of bedrock, more similar to granite than greenstone, supported *Acacia quadrimarginea* Tall Shrubland on neutral stony loam. Also present were the mallee *E. websteriana;* tall shrubs of *A. tetragonophylla* and *Eremophila alternifolia;* low shrubs of *Ptilotus obovatus* var.

obovatus; and annuals of *Podolepis lessonii* and *Senecio glossanthus.*

(b) *Undulating Plain, basic granulite* (UR): The vegetation pattern graded from north to south in relation to rainfall and the degree of grazing by sheep, rabbits and kangaroos. Mallees, mainly on the low ridges, were common on the northern section and scattered in the middle and small southern sections. Low woodlands were scattered on low ridges in the northern section and tended to replace mallees in the other sections. The colluvial flats appeared to have experienced frequent burning in the past as part of the grazing management by pastoralists. The northern flats supported mainly scattered mallees over *Triodia scariosa,* small areas of hummock grassland, and numerous areas of herblands that included scattered tall shrubs of *Acacia acuminata.* Flats in the central areas were mainly herblands. Very little natural vegetation remained on the small southern sections. The flats, and low hills, supported stands of introduced weeds dominated by noxious weeds i.e. Wild Turnip (**Brassica tournefortii*) and Double Gee (**Emex australis*). The few remaining shrubs on stony hills in this section indicated that their original vegetation was *Dodonaea microzyga* Tall Shrubland. This badly degenerated vegetation was not sampled.

On the low ridges covered with gritty sands were *Eucalyptus griffithsii* (Victoria Desert Mallee) Mallee with tall shrubs of *Acacia acuminata, Allocasuarina helmsii* and *Eremophila dempsteri* over hummock grasses of *Triodia scariosa,* and annuals of *Zygophyllum aurantiacum* and *Senecio lautus* ssp. *dissectifolius.* Less common on the ridges was *Eucalyptus uncinata* (Hooked-leaved Mallee) Mallee with tall shrubs of *Melaleuca uncinata,* low shrubs of *Atriplex vesicaria* (a form), over *T. scariosa* with additional annuals of *Tetragonia eremaea* and *Asteridea athrixioides.* The eucalypts and shrubs were confined almost entirely to the rounded crests and upper slopes of ridges, while *T. scariosa* and annuals tended to dominate the lower slopes and adjacent, narrow colluvial flats.

Some low ridges appeared to have developed over a bedrock that was more mafic than basic. Low woodlands of *Eucalyptus lesouefii* on Shallow Calcareous Earths were common. They had tall shrubs of *Eremophila scoparia* and *E. paisleyi,* but no low shrubs or annuals with populations large enough to list. Less common on similar soils were low woodlands of *Eucalyptus oleosa* (heavily grazed by stock) with low shrubs of *Atriplex vesicaria* (a form), *Maireana sedifolia* and *Sclerolaena diacantha.* In some areas the first two shrubs were replaced by *Cratystylis conocephala.* Growing on the flats of Deep Calcareous Earths, which had been mainly cleared for grazing, were low woodlands of *Eucalyptus salubris.* The apparently untouched area which was sampled had the shrub stratum dominated by low shrubs of *Eremophila* sp. (KRN 8103) and a few annuals that included *Zygophyllum ovatum.*

The bedrock of a few ridges was more similar to granite than basic granulite, and this was reflected by the vegetation. *Melaleuca uncinata* Tall Shrubland was present on neutral and gritty loamy sands that included tall shrubs of *Allocasuarina helmsii,* and low shrubs of *Melaleuca fulgens* over scattered *Triodia scariosa* with annuals of *Millotia tenuifolia.* On a few ridges were remnants of a typical lateritic soil profile developed over granite. Growing in well-drained Gravelly Sands was *Allocasuarina campestris* ssp. *campestris* Tall Shrubland with other tall shrubs of *Melaleuca uncinata* over *Triodia scariosa.*

It was not possible to sample the vegetation fully on the colluvial flats as they had been grazed by stock to varying degrees. The loamier soils of the northern flats supported herblands that contained bare areas of compacted loams, and scattered and degenerated shrubs of *Acacia acuminata.* The main annual was *Tetragonia eremaea.* A single area of *Triodia scariosa* hummock grassland on Meta-granitic Soils was sampled. The few annual

species present had small populations. In the middle and southern sections, the soils of many flats had a higher clay content and supported herblands dominated by *Menkea lutea, Gnephosis burkittii* and *Cephalipterum drummondii.* The soil types strongly indicated that the vegetation, prior to leasing for grazing stock, consisted of low woodlands of *Eucalyptus salubris* and *E. oleosa* with some small areas of *E. lesouefii.* The vegetation of other flats varied between these types. Large numbers of kangaroos and numerous rabbits were observed grazing the flats (August 1980).

Broad Valley (V): The main vegetation, on sandy loams over a calcareous B horizon, was a low woodland of *Eucalyptus transcontinentalis* over tall shrubs of *Melaleuca pauperiflora.* Some small areas of valley colluvium had soils with a higher clay content and supported *Eucalyptus salmonophloia* Woodland with tall shrubs of *Alyxia buxifolia* and low shrubs of *Scaevola spinescens* and *Cassia nemophila* var. *nemophila.* Areas of colluvial loamy sand supported *Eucalyptus eremophila* (Tall Sand Mallee) Mallee over *Melaleuca uncinata. Lepidosperma drummondii* occurred where the A horizon exceeded 30 cm.

Discussion

The Study Area is wholly within the Coolgardie Botanical System of the South-western Interzone (Beard 1980). Much of the Study Area consisted of typical woodland and low woodland on calcareous or undulating plains. Similar vegetation was extensive to the south and north of the Study Area.

Two unusual and therefore important areas of vegetation were recorded. The first was the Fraser Range with its pattern of mallees, low woodlands, shrublands and herblands. The range also extends approximately 35 km south into the Norseman – Balladonia Study Area. However, the vegetation pattern of this portion is similar only to that of the southern section within the present Study Area. The second was *Baeckea* sp. (KRN 7010) Tall Shrubland occurring on the Woodline Hills of Proterozoic quartzite. These quartzite hills are unique within the Eastern Goldfields, and the closest similar exposures are near Israelite Bay (Mt. Ragged, Russell Range etc.). The latter also support tall shrubland but with a very different species composition. More than one vegetation type may be present on the Woodline Hills. Only one site was sampled and the vegetation of a small section (southern) was mapped (Figure 4).

One small area, not typical of the South-western Interzone, was the Broad Valleys in the south-western part of the Study Area. They supported vegetation with strong affinities to the Southwestern Botanical Province (Beard, 1980).

Flora

The Study Area's flora has not been previously systematically recorded and documented. Consequently, the ranges of many species are extended. For instance, no species of orchid had been recorded previously in the Study Area, but during the survey six species and two varieties were collected. The number of orchid species decreases from south-west to north-east.

During the survey, 6 species of ferns and 536 species, 12 subspecies and 16 varieties of flowering plants were recorded. These are listed in Appendix II with an indication of frequency and abundance in each landform unit. Families with the largest number of species were Asteraceae (81), Chenopodiaceae (61) and Myrtaceae (57). Genera with the most species were *Eucalyptus* (35), *Acacia* (31), *Eremophila* (20) and *Maireana* (16).

Four species were collected for the first time (based on specimens housed in the Western Australian Herbarium): *Lasiopetalum* aff. *ogilvieanum* (KRN 7101), an undescribed genus of Caryophyllaceae with affinity to *Silene* (KRN 7235A), *Prostanthera* sp. (KRN 8541) and an undescribed genus of Asteraceae (KRN 8559). Two species have since been collected near to the Study Area. *Lasiopetalum* aff. *ogilvieanum* was collected on the southern section of the Fraser Range. The undescribed genus of Caryophyllaceae was collected south of the Study Area. The other two species are only known from single collections.

Three other collections were first records for Western Australia; all were collected on or near the Fraser Range. *Prostanthera serpyllifolia* ssp. *serpyllifolia* (single collection) was previously known only from the southern end of Eyre and Yorke Peninsulas in South Australia (B.J. Conn pers. comm. 1983). *Limosella curdieana*, an aquatic, was collected in shallow pools, both on Calcareous Plain and on a Granite Exposure. The species is known from South Australia, Victoria, New South Wales and New Zealand. It was later recorded south of Balladonia. **Herniaria hirsuta*, an introduced weed from the Mediterranean region, was recorded near pastoral buildings (single collection). The species was known from South Australia and Victoria. The collections of *Prostanthera serpyllifolia* ssp. *serpyllifolia* and *Limosella curdieana* suggest that the Fraser Range and its surrounds may be an important outlier for some Eastern States species.

Some of the species recorded had been poorly collected previously. *Astartea* sp. (KRN 8486) was collected at Kambalda; previous collections were also from this area. Other species were *Menkea lutea, Harmsiodoxa brevipes, Erodiophyllum elderi, Grevillea* sp. (KRN 6905), *Abutilon* sp. (KRN 7544) and an apparently undescribed genus of Rhamnaceae (KRN 7073).

Some notable extensions of distribution were recorded. *Helipterum tietkensii* and *Menkea lutea*, previously collected in the Blackstone Range, were collected in the Fraser Range. *Eucalyptus effusa* had a range extension from along the Eyre Highway in the Fraser Range, to near "Cowarna". *Brachysema daviesioides* had its range extended from *ca* 30 km west of Norseman to the Fraser Range. *Thysanotus speckii*, collected 27 km south of Binaronca Rock, previously had not been recorded east of Bullfinch.

Four species appear to be restricted to the Study Area: *Astartea* sp. (KRN 8486), *Grevillea* sp. (KRN 6905), *Prostanthera* sp. (KRN 8541) and an undescribed genus of Asteraceae (KRN 8559). Four other species appear to be almost confined to the Study Area: *Helichrysum cassiope*, Rhamnaceae (KRN 7073), *Eucalyptus brachyphylla* and *E. kruseana*. The latter two species are Gazetted Rare Flora (Patrick & Hopper 1982).

A number of species of the south-western flora occurred only on the Broad Valleys e.g. *Muehlenbeckia adpressa, Acacia lasiocalyx, A. sessilispica* and *Caladenia sigmoidea*. The abrupt and widespread change in soils from neutral to calcareous appears to be a major barrier to distribution.

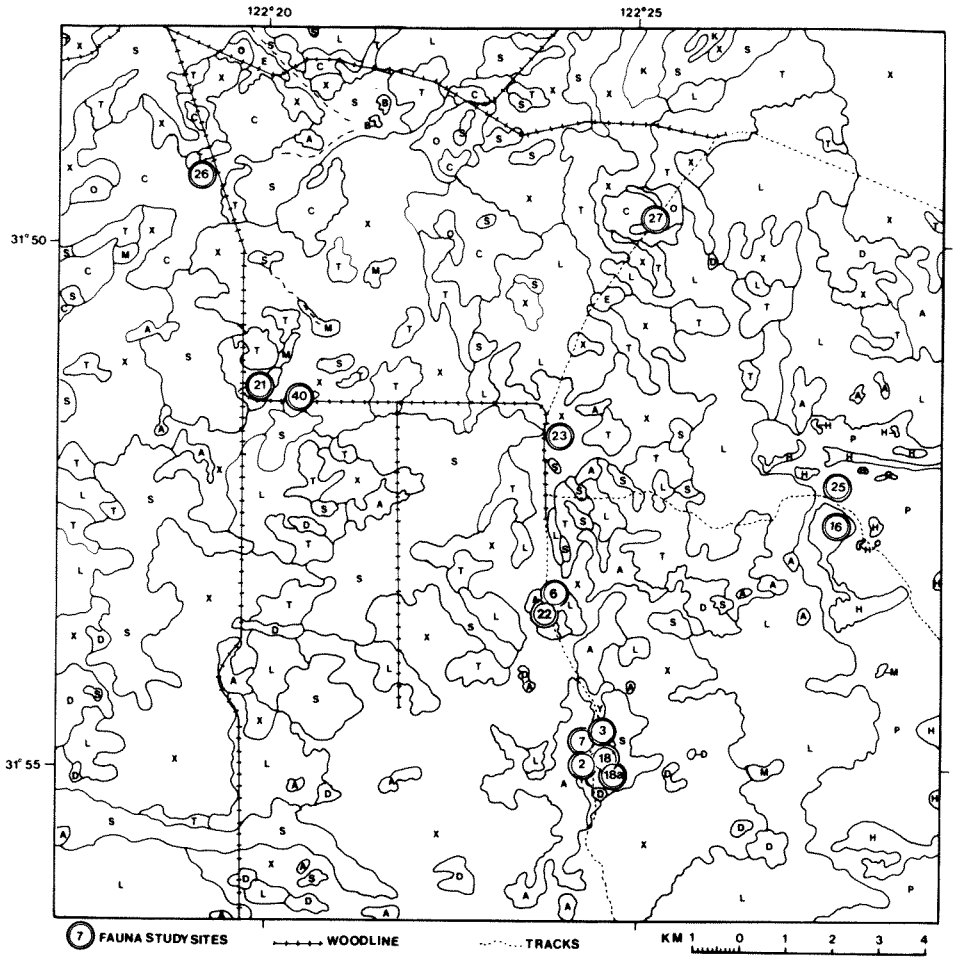


Figure 4 Map showing the distribution of vegetation types and location of fauna sample sites and other sites in the Woodline (WL) survey area. The number in brackets is the WZ number for description of plant formation (Appendix I), apart from 18a and 40 (Appendix III). The vegetation types mapped are: A – *Acacia acuminata* Tall Shrubland (6), B – Claypan Complex (not described), C – *Eucalyptus cylindrocarpa* Mallee (26), D – *E. dundasii* Low Woodland (20), E – *E. lesouefii* Low Woodland (21), G – *E. gracilis* Mallee (27), H – *Halosarcia* Low Shrubland (16), K – *Baeckea* sp. (KRN 7010) Tall Shrubland (9), L – *E. longicornis* Low Woodland (22), M – *Melaleuca* Tall Shrubland (12), O – *E. oleosa* Low Woodland (24), P – *E. salubris/Cratystylis conocephala* Low Woodland (25), S – *E. salmonophloia* Woodland (18), T – *E. salubris/Eremophila* spp. Low Woodland (25), X – *Eucalyptus* (mixed) Low Woodland, sometimes including Mallee (23), Y – *E. loxophleba* Mallee (3). One vegetation type mapped but obscured by fauna site symbol is Granite Complex (7); another occurred in areas too small to map – *E. grossa* Mallee (2).

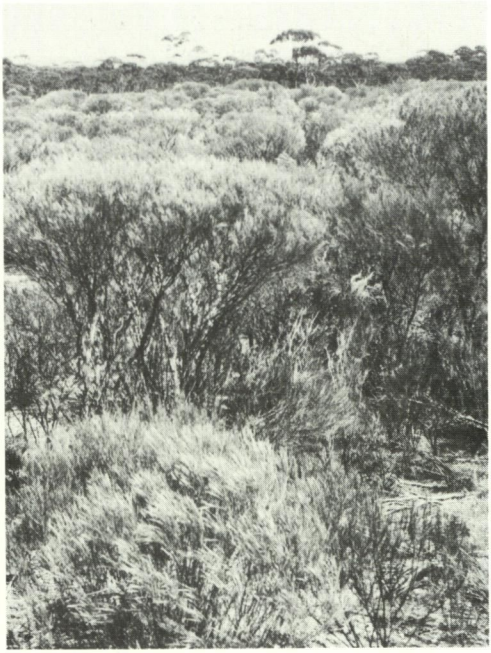


Plate 1: Vegetation type WZ18. *Eucalyptus salmonophloia* Woodland over *Maireana sedifolia* and *Eremophila scoparia*, 3.5 km west of Eryinia Hill. August 1980.

Plate 2: Vegetation type WZ6. *Acacia acuminata* Tall Shrubland at Woodline survey area. November 1978.

Plate 3: Vegetation type WZ7. Granite Complex at Woodline survey area. Tall shrubs are *Acacia* aff. *duriuscula* and *Thryptomene australis*. August 1980.

Plate 4: Vegetation type WZ25. *Eucalyptus salubris* Low Woodland over *Cratystylis conocephala* and *Eremophila scoparia*, 6 km south-east of Widgiemooltha. August 1981.

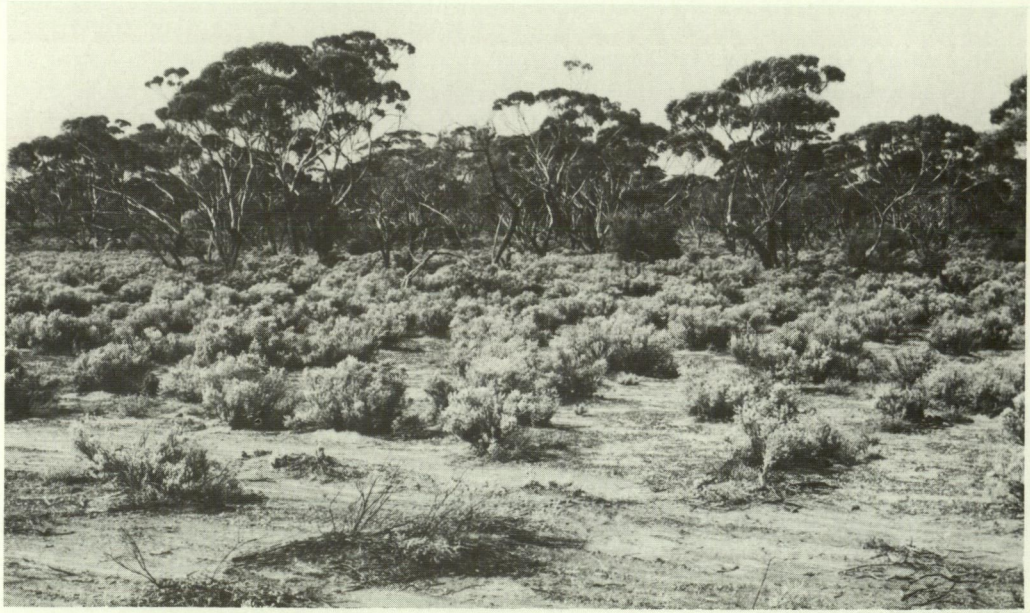


Plate 5: Vegetation type WZ22. *Eucalyptus longicornis* Low Woodland over *Cratystylis conocephala* near Pioneer Tank, Fraser Range. August 1980.

Plate 6: Vegetation type WZ34. *Triodia scariosa* colluvial flat with occasional *Eucalyptus uncinata* and *Acacia acuminata*, near Buningonia Spring. August 1980.

Plate 7: Heavily grazed southern Fraser Range. Flats formerly *Eucalyptus salubris* and *E. oleosa* Low Woodlands but now herblands. November 1978.

Plate 8: Regenerated *Eucalyptus salubris* among old timber drays at Woodline camp abandoned *ca* 35 years ago. August 1980.

Plate 9: Part of vegetation type WZ32a. Peripheral dune of Harris Lake complex with *Halosarcia* and *Sclerostegia* spp. *Eucalyptus oleosa* Low Woodland in background. After rain August 1980.

IV Vertebrate Fauna

J. Dell & R.A. How

The vertebrate fauna of the Widgiemooltha – Zanthus Study Area was documented by intensive sampling within two survey areas and by opportunistic recording at other locations within the Study Area. The selection of the two survey areas was made on the basis of examining as much of the environmental heterogeneity as possible within the Study Area.

The Woodline (WL) survey area (31°54'S, 122°24'E) was selected because of its location on vacant crown land, its variety of landforms, and its position near the terminus of the Lakewood railway line enabled sampling of disturbed and undisturbed vegetation.

The survey area is part of an extensive Calcareous Plain with a string of Salt Lake Features, and an occasional small Granite Exposure. The entire survey area lies within the Binneringe Vegetation System of the Coolgardie Botanical District (Beard 1975). The distribution of vegetation types is shown by Figure 4. Time was not available to sample all the vegetation types present.

The Buningonia Spring (BS) survey area (31°26'S, 123°33'E) lies on vacant crown land at the northern end of the Fraser Range. The survey area consists mainly of Calcareous Plain with large areas of Undulating Plain, basic granulite (Fraser Range) and Salt Lake Features, and rare Granite Exposures. The only extensive grazing by stock appears to have been on the colluvial flats of the Fraser Range many years ago. Cutting of timber is not known to have occurred in the area.

The survey area is within the Coolgardie Botanical District but is at the junction of the Fraser Range and Zanthus Vegetation Systems (Beard 1975). The latter system contains strong elements of the Eremaean Botanical Province.

The methods employed in sampling vertebrates have been detailed by the Biological Surveys Committee (1984). Sampling was intensive at sample sites where fenced pitlines, traplines and quadrats were used, and largely opportunistic at other sites. The selection of sample sites was intentionally non-random as all major vegetation types were to be sampled irrespective of their area. Other sites were chosen to supplement data from major vegetation types either by replication (e.g. WZ40) or by investigating minor vegetation types (e.g. WZ2). Detailed descriptions of the vegetation structure, floristics and soils of the sites sampled for fauna are presented in Appendices I and III, the latter including data from sites that were not described as typical of vegetation types in Appendix I. The co-ordinates of sampling sites, brief vegetation descriptions, field codes and period of sampling are shown for the Woodline area in Table 4, and for Buningonia Spring in Table 5. Sampling was carried out during November 1978, August 1980 and April 1981.

Representative specimens of most reptile and amphibia species are lodged in the Western Australian Museum and catalogued as R65367 – 65659 (November), R72310 – 72554 (August) and R74476 – 74597 (April). Representative specimens of small mammal species are lodged in the Western Australian Museum as M17523 – 17535 (November), M17969 – 17996 (August), and M20159 – 20200 (April).

The relative efficacies of sampling are illustrated in Figures 5 – 9. Figure 5 shows little difference between the cumulative number of species and the total individuals of reptiles and amphibians at the two survey sites. It indicates that during the first study period (November) 91% of species recorded from BS were sampled compared to 83% during the first survey at

WL. The final survey (April) at BS added no further species while one extra species was collected at WL.

Figures 6 and 7 indicate the cumulative number of bird species and the total number of individuals recorded during each survey period at WL and BS respectively. Combined, the quadrat and opportunistic recordings indicated 80% of species sampled were recorded during the first survey at WL compared to 65% of species at BS.

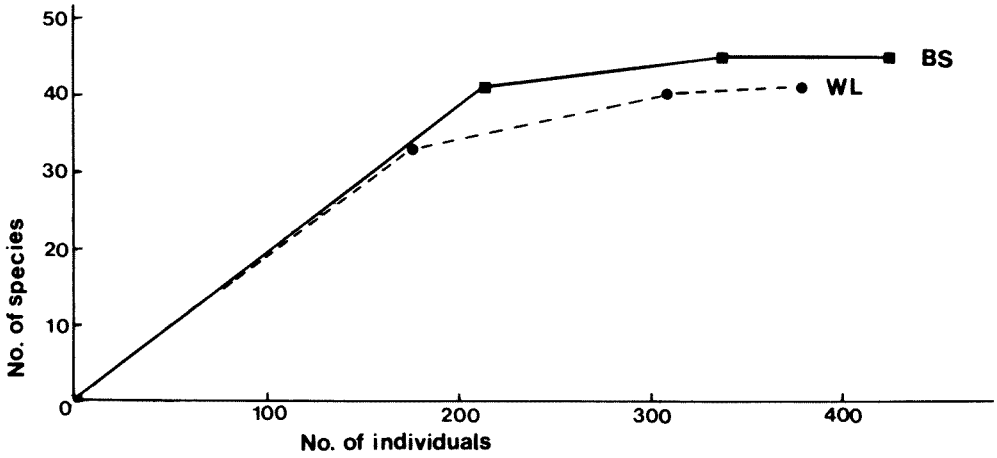


Figure 5 Number of reptile and amphibian species and the number of individuals caught at Woodline (WL) and Buningonia (BS) survey areas. The data are cumulative for the three study periods.

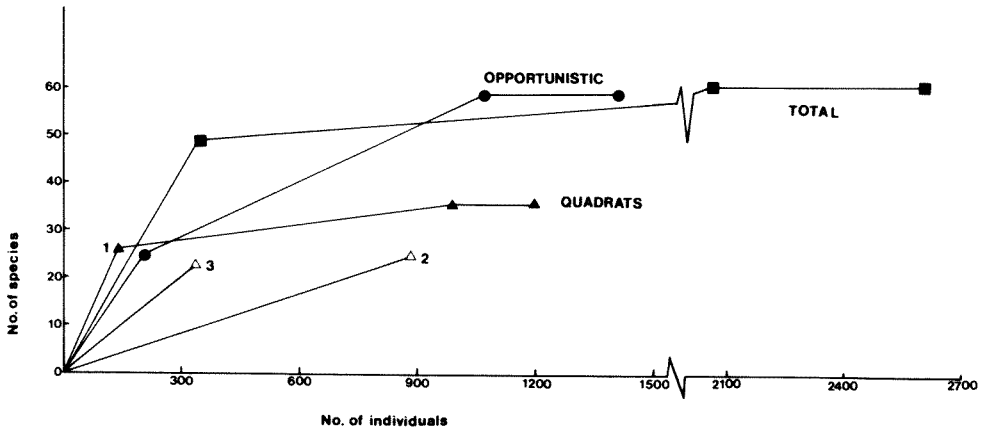


Figure 6 Cumulative number of bird species and number of individuals recorded for the three study periods at Woodline (WL). Data collected on bird quadrats are indicated separately for each study period (1,2 & 3) and combined as quadrat totals. Data collected opportunistically are indicated and also combined with quadrat data.

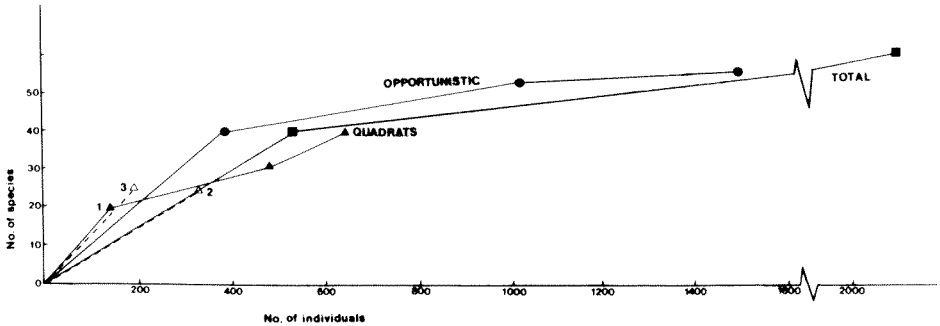


Figure 7 Cumulative number of bird species and number of individuals recorded for the three study periods at Buningonia Spring (BS). Data collected on bird quadrats are indicated separately for each study period (1, 2 & 3) and combined as quadrat totals. Data collected opportunistically are indicated and also combined with quadrat data.

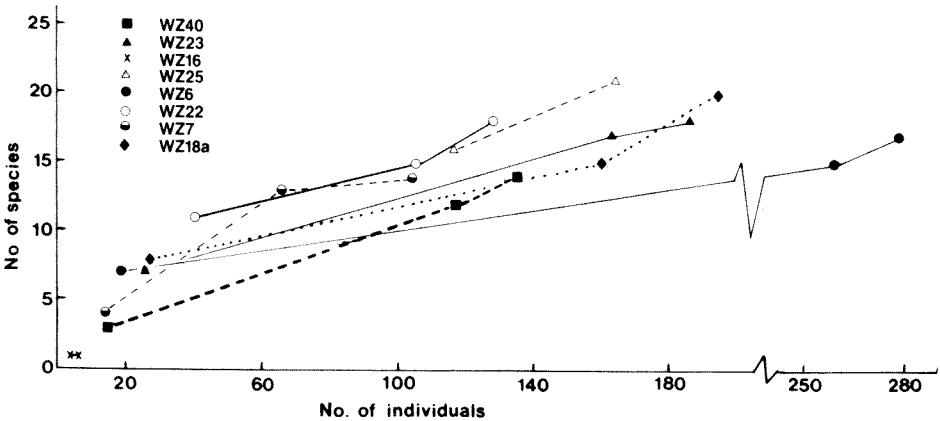


Figure 8 Accumulation during the three study periods of number of bird species and total number of individuals at each of the census quadrats at Woodline (WL) survey area.

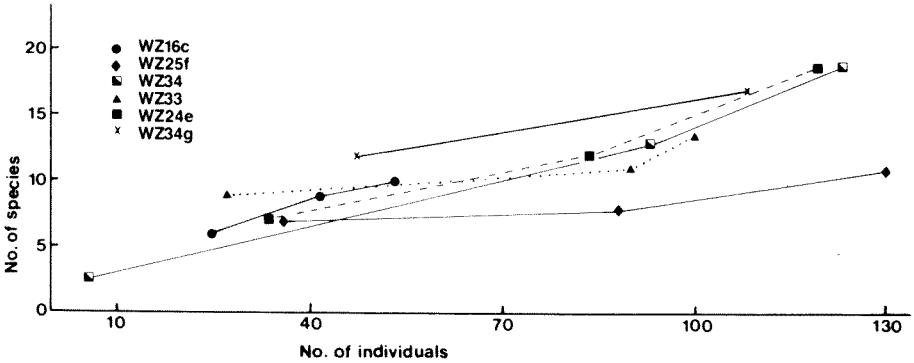


Figure 9 Accumulation during the three study periods of number of bird species and total number of individuals at each of the census quadrats at Buningonia Spring (BS) survey area.

Table 4 Fauna Sites of the Woodline Survey Area (WL)

Site No.	Field No. (WL)			Site Co-ordinates						Vegetation	Site Type	Fauna Survey FP 123	TL 123	BQ 123	OP 123
GRANITE EXPOSURE (G)															
WZ2	M7			31	54	50	122	24	20	*Eucalyptus grossa* Mallee	O	. . .	X . .	. . .	XX .
WZ3	M3	R3		31	54	20	122	24	30	*Eucalyptus loxophleba* Mallee	S	XX .	XX .	. . .	XXX
WZ6	M4	R4	B5	31	53	30	122	23	50	*Acacia acuminata* Tall Shrubland	S	XX .	XX .	XXX	XXX
WZ7			B7	31	54	40	122	24	20	Granite Complex	S	. . .	. . .	XXX	XXX
SALT LAKE FEATURES (L)															
WZ16	M8	R8	B3	31	52	00	122	27	20	*Halosarcia* Low Shrubland	S	. X .	. X .	. XX	XXX
CALCAREOUS PLAIN (P)															
WZ18	M2	R2		31	54	40	122	24	40	*Eucalyptus salmonophloia* Woodland	S	XXX	XX .	. . .	XXX
WZ18a			B8	31	54	40	122	24	50	*Eucalyptus salmonophloia* Woodland	S	. . .	. . .	XXX	. . .
WZ22	M5	R5	B6	31	52	50	122	23	40	*Eucalyptus longicornis* Low Woodland	S	XX .	XX .	XXX	XXX
WZ23			B2	31	51	20	122	24	00	*Eucalyptus* mixed Low Woodland	S	. . .	. . .	XXX	XXX
WZ25	M9	R9	B4	31	52	00	122	26	40	*Eucalyptus salubris* Low Woodland	S	. XX	. X .	. XX	XXX
WZ40			B1	31	51	00	122	20	20	*Eucalyptus salubris* Low Woodland	S	. . .	. . .	XXX	XXX
WZ26	M1	R1		31	48	10	122	19	30	*Eucalyptus cylindrocarpa* Mallee	S	XX .	XX .	. . .	XXX
WZ27		R10		31	49	40	122	25	30	*Eucalyptus gracilis* Mallee	O	. . X	. . .	. . .	. XX

Field No.: M = mammal, R = reptile, B = bird. Site Type: O = other site, S = sample site. Fauna Survey: FP = Fenced pitline, TL = Trapline, BQ = Bird quadrat, OP = Opportunistic sightings. Numbers indicate period of survey: 1 = 1st survey (November 1978), 2 = 2nd survey (August 1980), 3 = 3rd survey (April 1981). Site numbers ending with a lower case letter, and Site WZ40, differ from typical vegetation sites. Their differences are presented in Appendix III.

Table 5 Fauna Sites of the Buningonia Spring Survey Area (BS)

Site No.	Field No. (BS)			Site Co-ordinates						Vegetation	Site Type	Fauna Survey FP 123	TL 123	BQ 123	OP 123
GRANITE EXPOSURE (G)															
WZ7a				31	11	20	123	25	30	Granite Complex	O	. . .	. . .	. . .	XX.
SALT LAKE FEATURES (L)															
WZ13	M7	R7		31	20	30	123	37	20	*Myoporum platycarpum* Tall Shrubland	S	.X.	.X.	. . .	XXX
WZ16a	M1	R1	B1	31	21	20	123	36	10	*Halosarcia* Low Shrubland	S	XX.	XX.	XXX	XXX
WZ32a		R9		31	19	30	123	36	30	*Maireana sedifolia* Low Shrubland	O	. .X	. . .	. . .	XXX
CALCAREOUS PLAIN (P)															
WZ24a	M5	R5	B5	31	24	40	123	34	20	*Eucalyptus oleosa* Low Woodland	S	XX.	XX.	XXX	XXX
WZ25a	M2	R2	B2	31	28	10	123	36	00	*Eucalyptus salubris* Low Woodland	S	XX.	XX.	XXX	XXX
UNDULATING PLAIN, BASIC GRANULITE (UR)															
WZ33	M4	R4	B4	31	26	00	123	33	40	*Eucalyptus griffithsii* Mallee	S	XX.	XX.	XXX	XXX
WZ34	M3	R3	B3	31	26	50	123	31	20	*Eucalyptus uncinata* Mallee	S	XXX	XX.	XXX	XXX
WZ34a	M8	R8	B8	31	26	30	123	31	40	*Eucalyptus uncinata* Mallee	S	.X.	. . .	.XX	XXX
WZ37a	M6			31	26	20	123	32	10	*Triodia* Hummock Grassland	O	. . .	XX.	. . .	XXX

See Table 4 for explanation.

At BS the six bird quadrats included 65% of the 61 species recorded in the area. The eight quadrats at WL included only 59% of the 61 species recorded there. This was due in part to the lower chance of encountering some species in small study quadrats considering their low population level in these areas. For example, of the 61 species recorded at WL, less than 10 individuals were recorded for 23 species.

Comparisons between the number of bird species and the total number of individuals in the sample site quadrats at WL and BS are shown in Figures 8 and 9. Each shows a steady accumulation of species during the three study periods. Comparative richness of different sample sites and seasonality are discussed below.

Amphibians and Reptiles

Three amphibians and 52 reptiles were recorded from the Woodline and Buningonia Spring areas. One amphibian and 29 reptiles were common to both (Table 6).

These areas represent the only known Western Australian localities of the skink *Hemiergis millewae* which was previously known from the Eyre Peninsula in South Australia and from Western Victoria (Coventry 1976). This species was associated with the dense clumps of hummock grass *Triodia scariosa*) characteristic of sandy sites in the area.

A comparison of herpetofauna documented during the current study with that of the Nullarbor Plain to the east (Brooker & Wombey 1978), of the Great Australian Bight Hinterland to the south and south-east (Storr *et al.* 1981), and of Queen Victoria Spring to the north (Morris & Rice 1981), illustrates that many species were near the limits of their range at our survey areas. Species at the most easterly inland extremes of their distribution were *Diplodactylus intermedius* (BS), *Oedura reticulata* (BS), *Delma australis* (BS), *D. fraseri* (WL), *Pygopus lepidopodus* (WL), *Typanocryptis adelaidensis* (WL), *Egernia carinata* (WL), *Hemiergis initialis* (BS), *Lerista terdigitata* (BS) and *Rhinoplocephalus gouldii* (WL); while at their most southerly or near-coastal extremes were *Diplodactylus elderi* (BS), *Ctenophorus inermis* (BS), *C. isolepis* (BS), *C. reticulatus* (BS), *C. scutulatus* (BS) and *Rhinoplocephalus monachus* (BS). The latter group of species represent an arid element of the fauna which had extended southwards over the *Triodia* dominated red sands in the Buningonia Spring area.

The record of *Pseudechis australis* from Buningonia Spring is based on sightings during a reconnaisance trip in May 1978, and in August 1980. On each occasion an individual basking on the well surrounds (Buningonia Spring) disappeared behind timbers of the shaft lining when approached. During November 1978 on the southern part of the Fraser Range a dark varanid was pursued and it climbed 15 metres up a stout eucalypt; it is probable that this was *Varanus tristis.*

The numbers in Table 6 show that in certain habitats some species were common, although only representative specimens were collected. The most species-rich habitats for herpetofauna were those in which hummock grass *(Triodia scariosa)* dominated the understory (e.g. WZ26, WZ34) although eucalypt woodlands (e.g. WZ18, WZ25a) also had numerous species with geckos forming an important component of the herpetofauna.

There were major differences in the herpetofauna of eucalyptus woodlands at Buningonia Spring and adjacent *Triodia* dominated communities which reflected principally the conjunction of arid and southwestern elements of the fauna.

Table 6. List of amphibians and reptiles at Woodline and Buningonia indicating number caught in each sample site. The first figure indicates the number caught in fenced pitfall traps; the second figure indicates the number caught opportunistically; single figures indicate opportunistic collecting. The figures are combined for the three survey periods.

	Woodline													Buningonia Spring								
Landform Unit:	G	G	G	G	L	P	P	P	P	P	P	P	G	L	L	L	P	P	UN	UR	UR	UR
Vegetation Code (WZ):	2	3	6	7	16	18	22	23	25	26	27	40	7a	13	16a	32a	24a	25a	33	34	34a	37a
LEPTODACTYLIDAE																						
Neobatrachus centralis			1/0			1/0								1/0	0/1	1						
N. sutor			0/1								0/2											
Pseudophryne occidentalis		3/1	0/1	2		2/1																
GEKKONIDAE																						
Diplodactylus elderi																2				2/1		1
D. granariensis						1/4			3/0								0/1	1/1	1/0			
D. intermedius						0/1					0/1					1		0/1				
D. maini		0/3				2/24	1/0							0/1	1/0	2	0/1	8/0				1
D. pulcher		0/2		1		0/1	1/0									1	7/0	1/1	1/0	4/0		2
Gehyra variegata	3	0/7	0/1			4/21	2/1		0/10	2/1	0/1			0/1	0/1	4		3/9	0/1	0/1	1/1	1
Heteronotia binoei		0/2	0/2	1		1/3	2/2	19		0/6			1			1		0/2				1
Oedura reticulata									0/21									1/9				
Phyllurus milii				1		0/5		2		0/3					0/2	1		0/2				
PYGOPODIDAE																						
Delma australis														1/2						2/0		1
D. fraseri								1														
D. nasuta										1/2									2/2	16/1	0/1	
Lialis burtonis										1/0									1/1	1/0		1
Pygopus lepidopodus			0/1																			
AGAMIDAE																						
Ctenophorus cristatus		0/1	0/1	1		0/1	0/3	2	0/6	0/1							0/5	1/0			0/1	
C. inermis													1									5
C. isolepis gularis																				2/8		5
C. reticulatus																1	1/0					
C. salinarum					3/1										7/5	10						
C. scutulatus																	0/3					

Table 6 (cont.)

	Woodline													Buningonia Spring									
Landform Unit	G	G	G	G	L	P	P	P	P	P	P	P	G	L	L	L	P	P	UN	UR	UR	UR
Vegetation Code (WZ):	2	3	6	7	16	18	22	23	25	26	27	40	7a	13	16a	32a	24a	25a	33	34	34a	37a
AGAMIDAE cont.																						
Diporiphora reginae															1/0	1				2/4		3
Moloch horridus		0/1				1/0			0/1													
Pogona minor			0/1						0/2	2/1							0/3			1/0	0/2	
Tympanocryptis adelaidensis								1/0														
SCINCIDAE																						
Cryptoblepharus plagiocephalus		1/1				1/0	1/0		1/1	2/0							0/4					
Ctenotus atlas						5/0				5/1									3/1	5/0		
C. leonhardii															4/0							1
C. pantherinus																			1/1	1/0		
C. schomburgkii		1/0	1/0				4/0	4	1/0	3/1				1/1			2/2	0/1	0/1			
Egernia carinata		0/3	0/1			0/1	1/0															
E. inornata											1/1						0/4					2
E. multiscutata bos		1/0				0/1	0/1				0/1											
Eremiascincus richardsonii															0/4							
Hemiergis initialis			0/2				0/3		0/5	0/1							0/12	0/6	0/1			
H. millewae										1/1				1/7		6			0/2	1/13	0/11	14
Lerista muelleri		1/0	2/1	1		3/4	2/3		0/2	0/3							2/4	2/4	0/2	2/0		2
L. picturata							1/2		0/1								0/1	2/1		1/0		
L. terdigitata										1/0					1/0					2/0		
Menetia greyii		1/2	0/1	1		0/1				1/2					1/0	1			1/1	2/5	0/2	5
Morethia butleri	1	0/1		1		1/3		2		0/1							0/2	1/0				
M. obscura								1		0/1												
Omolepida branchialis			0/2							0/1						2			1/3	3/1	0/2	16
Tiliqua rugosa					1/2			1	0/1								0/2	0/1		0/1	0/2	
VARANIDAE																						
Varanus gouldii										0/1												
TYPHOLOPIDAE																						
Ramphotyphlops bituberculata		0/1													1/0							

Table 6 (cont.)

	Woodline												Buningonia Spring								
Landform Unit:	G	G	G	G	L	P	P	P	P	P	P	P	G	L	L	L	P	P	UN	UR	UR	UR
Vegetation Code (WZ):	2	3	6	7	16	18	22	23	25	26	27	40	7a	13	16a	32a	24a	25a	33	34	34a	37a
ELAPIDAE																						
Demansia reticulata																					0/1	
Pseudechis australis																	0/1					
Pseudonaja modesta															1/0							
Rhinoplocephalus gouldii		0/1	1/0				0/1	3														
R. monachus																						1
Vermicella bertholdi									0/1				1					1/1				
V. semifasciata		1/0																		2/0		
No. of species	2	17	15	8	2	18	14	9	13	19	5		3	6	12	14	16	16	13	19	9	17
Pit nights	–	180	165	–	108	205	165	–	138	258	30		–	108	198	–	165	180	150	285	105	–

Birds

A total of seventy-eight species of birds was recorded during surveys of the Woodline and Buningonia Spring areas. These comprised 25 non-passerines and 53 passerines of which 16 and 32 species respectively were common to both areas. Tables 7 and 8 list these species and indicate the number of sightings and total number of individuals in each vegetation type during each survey. Coding indicates breeding data which are included in the text. Common names (Storr & Johnstone 1979) are included on Tables 7 and 8.

All species were within their known range. As was the case with the herpetofauna, there was a mixture of Southwestern (Bassian) and arid (Eremaean) species. Characteristic southwestern species at WL but not further north at BS included *Platycercus icterotis, Eopsaltria australis, Pachycephala pectoralis, Malurus pulcherrimus, Climacteris rufa, Meliphaga leucotis, Melithreptus brevirostris* and *Anthochaera carunculata.* Southwestern species at both areas included *Zosterops lateralis, Meliphaga ornata* and *Artamus cyanopterus.* Four arid country species *(Peltohyas australis, Aphelocephala leucopsis, Acanthiza iredalei* and *Climacteris affinis)* were recorded at BS but not further south at WL.

In both areas the passerine assemblage was considerably richer than the non-passerines. At WL the 22 non-passerines included only 426 individuals of which more than half were *Glossopsitta porphryocephala* with 227 individuals. The 39 passerines included 2208 individuals of which 5 species predominated – *Smicrornis brevirostris* (409 individuals), *Acanthiza apicalis* (127), *Pardalotus striatus* (136), *Meliphaga ornata* (665) and *Anthochaera carunculata* (178).

At BS the 19 non-passerines included only 285 individuals of which 109 were *Cacatua roseicapilla,* a species not recorded at WL. The 44 passerines at BS included 1382 individuals of which *Smicrornis brevirostris* was well represented with 279 individuals. *Manorina flavigula* had 190 and a transient flock of *Artamus personatus* consisted of *ca* 200 individuals.

Although there was little difference between the number of species at the two sites, the total populations were quite different with WL having 58% more individuals recorded for approximately the same recording effort. The reason for this was evident when comprisons were made between the greater density of vegetation and the larger number of different vegetation associations at WL compared to those at BS (Newbey & Hnatiuk, this publication). Recher (1969) considered that habitat diversity was a good predictor of species diversity in Australia and elsewhere. In our survey areas the difference in biomass affected the number of individuals but not the number of species.

The difference in seasonality of passerine birds at WL and BS was quite marked in some species. Considerably higher numbers of *Coracina novaehollandiae, Pardalotus striatus, Phylidonyris albifrons, Anthochaera carunculata* and *Artamus personatus* were recorded in August and November compared with April. *Epthianura albifrons* at BS was a common breeding species only after heavy rains when they fed on caterpillars associated with the luxuriant growth of annuals.

Some differences between seasonal counts were probably temporary changes in activity or short term population increase during breeding. The large numbers of *Smicrornis brevirostris* at BS in August occurred when breeding was recorded, many of them may have been young already out of the nest. *Oreoica gutturalis* tends to be overlooked unless calling.

Data on non-passerines were inadequate to make any meaningful comparison between the two areas. In general, non-passerines in the Eastern Goldfields are not as numerous as

passerines and are less likely to indicate correlations between bird assemblages and habitat parameters. A similar situation was apparent further west in the wheatbelt (Kitchener *et al.* 1982).

Woodlands at WL contain the richest bird assemblage with the following number of species per site: WZ40 (15), WZ23 (16), WZ25 (19), WZ22 (21) and WZ18a (21). The number of bird species increased in woodlands when there are more plant species, and the structure and density of the understorey increases.

Shrublands have the highest population density although this may be only seasonal when nectarivores aggregate to feed on flowering plants. For example in site WZ6, 60% of individuals were *Meliphaga ornata* in August, compared to one individual in November and none in April. The floristically depauperate samphire lake margin site, WZ16, as expected, had the lowest diversity with only one species, *Anthus novaeseelandiae.*

The same trend in woodlands at BS was evident with sites WZ24a and WZ34 having the highest diversity. The lake system site, WZ16a, had the lowest diversity but unlike the samphire site at WL there were a number of emergent shrubs and trees which provided habitat for additional species.

Other species are known from the Study Area. We have recorded *Tadorna tadornoides, Chenonetta jubata, Hirundo neoxena* and *Grallina cyanoleuca* on or associated with dams and other freshwater in the Fraser Range area in May 1978 and August 1980. *Cincloramphus cruralis* was present in grazed areas of the Fraser Range in August 1980 and empty burrows of *Chaeramoeca leucosterna* were on the sandy margins of Lake Harris and in sandy cuttings on the Eyre Highway 30 km west of Fraser Range in August 1980. Several sightings of *Corvus orru* were made between Sinclair Soak and Buningonia Spring in May 1978. Hunter (1980) recorded *Neophema splendida* east of Lake Cowan in 1949; this is the southern-most record in Western Australia. This species was also recorded in the northern part of the Study Area near Coonana (Calaby 1959).

Computer printouts from the Atlas of Australian Birds for 1977 – 81 indicated the presence of 25 additional species for the degree squares around WL and BS Study Areas. Nearly half of these were nomadic or migratory waterfowl and littoral species which utilise salt lakes during periods of inundation.

Most additional species were recorded by B. Newbey (pers. comm.). Near the south-western corner of the Study Area were *Accipiter fasciatus* (March 1980) and *Haliastur sphenurus* (October 1980). Within 40 km of Erayina Hill were *Haliastur sphenurus, Falco peregrinus* (gazetted rare species), *Leipoa ocellata* and *Malurus splendens* (August 1981). On dams in the pastoral areas were *Ardea novaehollandiae, Charadrius melanops, Fulica atra, Anas superciliosa,* and *Podiceps poliocephalus.* The last three species were also recorded at Swan Lake near "Cowarna", together with *Anas gibberifrons, Malacorhynchus membranaceus, Cygnus atratus, Himantopus himantopus, Tringa hypoleucos, Grallina cyanoleuca* and *Tadorna tadornoides.* The claypan is the largest area of permanent freshwater in the Study Area, and one of the few in the Eastern Goldfields. Close to Uraryie Rock (August 1980) was *Gerygone fusca.* At the southern end of the Fraser Range (August 1980) were *Cincloramphus mathewsi* and *Epthianura tricolor.*

Breeding data were obtained for 9 species at BS in August 1980. These were: *Vanellus tricolor* (2 chicks hatched *ca* 17 August), *Aquila audax* (1 egg 15 August), *Falco berigora* (2 eggs 15 August), *Cuculus pallidus* ♂ feeding ♀ 17 August), *Anthus novaeseelandiae* (2 small chicks 16 August), *Smicrornis brevirostris* (young being fed in nest 16 August; 3 nests being

built 17 August; nest with 1 egg, and young being fed in nest 19 August), *Pardolatus striatus* (carrying nest material to hollow 15 August), *Manorina flavigula* (adult brooding 14 August; 3 building nests, pair copulating 19 August), *Epthianura albifrons* (3 tiny chicks 15 August; 2 large chicks 16 August; 2 small chicks and 1 infertile egg 17 August; 4 large chicks 18 August; 3 large chicks, and nest being built 19 August).

Breeding data were obtained for 4 species at WL in August 1980: *Glossopsitta porphyrocephala* (6 pairs entering nest hollows 10 August), *Pachycephala pectoralis* (gathering nest material 10 August), *Smicrornis brevirostris* (gathering nest material 12 August), and *Anthochaera carunculata* (2 eggs 8 August; nest building 9 August). Breeding data for 5 species were obtained in November: *Falco cenchroides* (4 eggs 12 November), *Merops ornatus* (active burrow 11 November), *Acanthiza apicalis* (adult feeding fledgling 11 November; pair feeding fledgling 12 November), *Malurus pulcherrimus* (pair feeding 2 fledglings 12 November), *Artamus cyanopterus* (pair feeding 3 fledglings 12 November).

Other breeding data for the Woodline area were recorded by Hunter in his diary for 1949. On 15 August, Hunter recorded *Coracina novaehollandiae* nesting, *Petroica goodenovii, Cinclosoma castanotum, Pomatostomus superciliosus* and *Epthianura albifrons* with nestlings, *Acanthiza chrysorrhoa, Cracticus tibicen* and *Epthianura tricolor* breeding; on 29 August, *Eopsaltria australis* had 1 egg; on 6 August *Acanthiza apicalis* had 3 eggs, *Meliphaga ornata* had 2 freshly hatched young, *Anthochaera carunculata* had 2 eggs and *Melithreptus brevirostis* was breeding; on 12 September *Acanthiza apicalis* had 2 large nestlings; in late August *Pardalotus striatus* had 4 eggs; and on 12 September *P. striatus* had 2 other nests.

B. Newbey (pers. comm.) recorded the following breeding records: near south-western corner of Study Area *Microeca leucophaea* (feeding nestlings) and *Dromaius novaehollandiae* with 9 chicks *ca* 12 weeks old (7 October 1980); near Uraryie Rock *Phylidonyris albifrons* nest with 1 egg (17 August 1980); Swan Lake – broken egg shells of *Cygnus atratus.*

Mammals

Twenty four species of mammals were recorded at the WL and BS areas (Table 9). Fifteen species were common to both survey areas.

Buningonia Spring represents one of only two Western Australian localities where both ningauis, *Ningaui ridei* and *N. yvonneae,* have been recorded although the specific hummock grass habitats are *ca* 11 kilometres apart.

Very little information was available on the mammalian fauna of the Study Area prior to this survey, and only *Canis familiaris, Macropus robustus* and *M. rufus* were recorded by Kitchener & Vicker (1981) for these areas. All mammals recorded by Brooker (1977) for the Nullarbor were recorded at these sites with the exception of *Sminthopsis ooldea,* so too were those reported by Morris & Rice (1981) from Queen Victoria Spring. However, Burbidge *et al.* (1976) included 5 species in the Queen Victoria Spring area which were not collected in our Study Area, viz. *S. ooldea, S. hirtipes, Notomys alexis, N. mitchellii,* and *Eptesicus pumilis.* The taxonomy of the *Sminthopsis murina* – complex is currently under revision (Kitchener pers. comm.); the individuals collected during this survey and by Morris & Rice may yet prove to be the same species.

Large numbers of *Macropus fuliginosus* were recorded particularly on the Fraser Range during the period of our survey but *M. robustus* was sighted infrequently and *M. rufus* was

sighted only once. While travelling through the Fraser Range from Buningonia Spring to the southern boundary of the Study Area, *cà* 320 *M. fuliginosus* were sighted (August 1980) and a mob of *ca* 40 *M. rufus* were sighted on "Cowarna" (August 1981, B. Newbey pers. comm.). Small terrestrial mammals were infrequently caught. Bats were generally fairly common and particularly so at the deeper pools on Granite Exposures where collecting was concentrated. Apart from the ningauis, none of the species recorded was near the limits of its distribution as determined by Kitchener & Vicker (1981).

Table 7. List of birds at Woodline survey area indicating number seen in each sample site. The intensive sample sites (quadrats) are shown in the first 8 columns followed by opportunistic observations. The first figure indicates the total number of individuals, the second figure indicates the number of observations. The three survey periods (November 1978, August 1980 and April 1981) are indicated as column 1, 2, and 3 respectively for each sample site. The number of observation days for the quadrat data are indicated. The number of observation days for the opportunistic data were 7, 7 and 4 respectively for each sample site. X indicates recorded <50 m. from quadrat in same vegetation while quadrat data was being recorded.

Site	WZ6	WZ7	WZ16	WZ18a	WZ22	WZ23	WZ25	WZ40	WZ3	WZ6	WZ7	WZ16	WZ18a	WZ22	WZ23	WZ25	WZ26	WZ27	WZ40
Quadrat Days	3 5 3	2 5 3	0 5 3	1 5 3	2 5 3	2 5 3	0 5 3	2 5 3											
CASUARIIDAE *Dromaius novaehollandiae* Emu	2 1	T			X			T	T		9 1	T							
ACCIPITRIDAE *Lophoictinia isura* Square-tailed Kite								1 1						1 1 1 1	2 2				
Accipiter cirrocephalus Collared Sparrowhawk		1 X 1		X							1 1		1 3 1 3						
Aquila audax Wedge-tailed Eagle																	1 1		
Aquila morphnoides Little Eagle																	1 1		
FALCONIDAE *Falco berigora* Brown Falcon				1 1									1 1				1 1		1 1
Falco cenchroides Australian Kestrel																1 B 1			
TURNICIDAE *Turnix velox* Little Button-quail		1 1																	
CHARADRIIDAE *Vanellus tricolor* Banded Plover											*								
COLUMBIDAE *Phaps chalcoptera* Common Bronzewing		1 34 1 10									2 1 1 1		1 1						

Table 7 (cont.)

Site	WZ6	WZ7	WZ16	WZ18a	WZ22	WZ23	WZ25	WZ40	WZ3	WZ6	WZ7	WZ16	WZ18a	WZ22	WZ23	WZ25	WZ26	WZ27	WZ40
Quadrat Days	3 5 3	2 5 3	0 5 3	1 5 3	2 5 3	2 5 3	0 5 3	2 5 3											
PSITTACIDAE *Glossopsitta porphyrocephala* Purple-crowned Lorikeet	2 1	13 1		23 X 12	2 4 1 2	3 21 2 7	9 4	7 4	7 2	1 4* 1 1			8 35 12 2 9 8	7 41 3 11	7 9 1 2 4 1		2 1		6 2
Polytelis anthopeplus Regent Parrot	1 1			4 1		X				1 1			1 21 1 2		2 1				
Playtcercus icterotis Western Rosella								X		S									2 2
Platycercus zonarius Ring-necked Parrot		12 7		X X			3 1	2 1		1 1	3 2		4 9 14 2 5 4		1 2 1 1	2 1			
CUCULIDAE *Cuculus pallidus* Pallid Cuckoo					1 1				2 2				1 1	2 2			2 1		
Chrysococcyx basalis Horsfield's Bronze Cuckoo	X					1 1	X	X		1 1	1 1		3 2		1 1	1 1			3 3
Chrysococcyx osculans Black-eared Cuckoo	1 1			X		1 1		2 2	2 1	2 2	1 1		1 1		1 1				
STRIGIDAE *Ninox novaeseelandiae* Boobook Owl													5 2 2 3 2 2						
PODARGIDAE *Podargus strigoides* Tawny Frogmouth																			1 1
AEGOTHELIDAE *Aegotheles cristatus* Australian Owlet-nightjar									1 1				1 1						
CAPRIMULGIDAE *Eurostopodus guttatus* Spotted Nightjar													1 1						
MEROPIDAE *Merops ornatus* Rainbow Bee-eater														2 1 B	2 1		1 1		
HIRUNDINIDAE *Hirundo nigricans* Tree Martin				8 1									6 1						

Table 7 (cont.)

Site	WZ6	WZ7	WZ16	WZ18a	WZ22	WZ23	WZ25	WZ40	WZ3	WZ6	WZ7	WZ16	WZ18a	WZ22	WZ23	WZ25	WZ26	WZ27	WZ40
Quadrat Days	3 5 3	2 5 3	0 5 3	1 5 3	2 5 3	2 5 3	0 5 3	2 5 3											
MOTACILLIDAE *Anthus novaeseelandiae* Richard's Pipit			4 1 4 1									4 3							
CAMPEPHAGIDAE *Coracina novaehollandiae* Black-faced Cuckoo-shrike	X	2 1		1 1 1 1	X		1 1	X		1 1			1 1	1 1 1 1	1 1				1 2 1 2
PACHYCEPHALIDAE *Microeca leucophaea* Jacky Winter	1 1			1 1			3 2	X					1 1			2 3 1 2	1 1	1 1 1 1	1 1
Petroica goodenovii Red-capped Robin		2 2		1 1	1 1		1 1	2 2			2 2								
Eopsaltria australis Yellow Robin					1 1 1 1									1 1					
Pachycephala inornata Gilbert's Whistler					X				1 1					1 1					
Pachycephala pectoralis Golden Whistler	3 5 3 3 5 3				1 1	1 1	1 1	1 1		5 3 3 3				1 1 1 1		3 3			1 1
Colluricincla harmonica Grey Shrike-thrush	2 2 X			1 X 1	X		1 1 X	X		3 1 2 1			1 1 1 1	2 3 2 3	1 1	3 2 3 2			1 2 1 2
Oreoica gutturalis Crested Bellbird	1 1 1 1	X 1 1	1 1	1 1	X		1 1 1 1	X X			1 1		3 3	1 1	1 4 1 4	2 1 2 1	1 1		1 1 2 1 1 2
MONARCHIDAE *Rhipidura leucophrys* Willie Wagtail											1 1		1 1				1 1	1 1	
ORTHONYCHIDAE *Cinclosoma castanotum* Chestnut Quail-thrush	2 2													5 3	1 1				
Pomatostomus superciliosus White-browed Babbler															2 3 1 1		7 2		

Table 7 (cont.)

Site	WZ6	WZ7	WZ16	WZ18a	WZ22	WZ23	WZ25	WZ40	WZ3	WZ6	WZ7	WZ16	WZ18a	WZ22	WZ23	WZ25	WZ26	WZ27	WZ40
Quadrat Days	3 5 3	2 5 3	0 5 3	1 5 3	2 5 3	2 5 3	0 5 3	2 5 3											
ACANTHIZIDAE *Smicrornis brevirostris* Weebill	1 1			1 X 2 1	13 31 7 7 14 4	7 19 11 4 10 5	59 33 20 10	9 37 1 5 20 1	3 1	5 2			20 15 7 6	2 11 8 1 4 3	3 15 7 1 6 3	29 10 11 4	7 6 3 2	3 8 1 3	5 16 5 2 6 3
Acanthiza apicalis Broad-tailed Thornbill	2 15 3 1 9 3	7 12 4 5		2 1 B X	3 5 2 3 X	5 3 2 3 2 2	10 3 6 2	18 4 9 4		2 2 1 1 1 1			2 2	2 1	2 3 6 1 2 4	1 1 1 1			10 1 5 1
Acanthiza uropygialis Chestnut-rumped Thornbill		X 5 3		X	5 1		10 3 5 1				2 1		6 2						
Pyrrholaemus brunneus Red throat	3 7 3 2 7 3	3 11 1 3 11 1		1 1	2 1 2 2 1 1	4 4 X	1 1	4 4 2 3 4 2	1 1	4 4 1 2 3 1	3 2		2 2		1 2 2 1 2 2	2 2			
MALURIDAE *Malurus pulcherrimus* Blue-breasted Fairy-wren	4 5 5 1 3 1					X				4 1 B 4 1					3 1				
DAPHOENOSITTIDAE *Daphoenositta chrysoptera* Australian Sittella					X		5 1 X							8 1		4 1			
CLIMACTERIDAE *Climacteris rufa* Rufus tree-creeper				1 1 X			1 1						4 2 2 2	1 1	3 2	1 1	3 2		
DICAEIDAE *Dicaeum hirundinaceum* Mistletoebird				X		1 1							4 2 2 2						1 1
PARDALOTIDAE *Pardalotus striatus* Striated Pardalote				1 1	4 3	4 10 3 4 X	7 5 X	12 6 9 2		4 1			22 2 8 1	1 9 1 3	11 5 5 2	16 6	4 1	2 5 1 2	2 9 1 5
ZOSTEROPIDAE *Zosterops lateralis* Grey-breasted White-eye		3 3			2 1														
MELIPHAGIDAE *Lichmera indistincta* Brown Honeyeater	24 13	5 3 X		4 1 X	4 3				15 8 4 2	22 5	17 1 4 1		1 8 8 1 2 4						
Meliphaga leucotis White-eared Honeyeater	1 4 1 4 X	X		3 3	2 2 1 1 2 1	X 1 1	X 1 1	1 1	1 1	5 1 4 1	1 1			2 1 2 1	3 2	4 3 3 3	1 2 1 1	2 2	2 2
Meliphaga ornata Yellow-plumed Honeyeater	1 164 1 20			16 63 14 10 32 8	4 12 5 3 6 4	45 9 29 6		21 4 11 3	7 2	21 5			8 91 64 2 26 7	4 45 9 2 13 3	4 28 1 6	4 1			21 1 7 1
Meliphaga virescens Singing Honeyeater						X									1 1				

Table 7 (cont.)

Site	WZ6	WZ7	WZ16	WZ18a	WZ22	WZ23	WZ25	WZ40	WZ3	WZ6	WZ7	WZ16	WZ18a	WZ22	WZ23	WZ25	WZ26	WZ27	WZ40
Quadrat Days	3 5 3	2 5 3	0 5 3	1 5 3	2 5 3	2 5 3	0 5 3	2 5 3											
MELIPHAGIDAE cont																			
Melithreptus brevirostris Brown-headed Honeyeater	2 2	1 1		X		3 1 3 1	9 5			5 1			2 2			6 2		2 1	
Phylidonyris albifrons White-fronted Honeyeater	1 5 1 3				1 1	3 2	1 1			2 1									
Manorina flavigula Yellow-throated Miner						5 2	X X	2 1					4 1		1 1	2 4 1 1			
Acanthagenys rufogularis Spiny-cheeked Honeyeater																			1 1
Anthochaera carunculata Red Wattlebird		15 X 5		2 28 6 2 18 4	X 6 5	14 8	1 1	1 1	2 1		10 1 2 1		6 25 15 1 10 7	2 20 1 9	1 9 1 8	4 2	3 1	4 1	3 3
Epthianura albifrons White-fronted Chat											2 1								
ARTAMIDAE																			
Artamus cyanopterus Dusky Woodswallow						4 1 X							6 4	2 2	5 1 B 4 2	1 1		2 1	1 1
Artamus personatus Masked Woodswallow													12 1						
CRACTICIDAE																			
Cracticus nigrogularis Pied Butcherbird	X	1 1		11 9 X						1 1 *	1 1		1 4 7 1 3 5						
Cracticus torquatus Grey Butcherbird	2 2			X X X X	1 1 X			1 1					1 6 1 5	2 2		1 2 2 1 2 2	2 2		1 1
Strepera versicolor Grey Currawong				1 1	1 1	1 1	2 1						1 3 1 3	1 1	1 1 1 1	2 11 2 7			
CORVIDAE																			
Corvus bennetti Little Crow																25 2 *			

T indicates tracks
* indicates overhead
B indicates breeding
S indicates remains

Table 8: List of birds at Buningonia Spring survey area. See Table 7 for explanation of data.

Site	WZ16a	WZ24a	WZ25a	WZ33	WZ34	WZ34a	WZ16a	WZ32a	WZ24a	WZ25a	WZ33	WZ34	WZ34a	WZ37a
Quadrat Days	5 5 3	5 5 3	5 5 3	5 5 3	5 5 3	0 5 3								
CASUARIIDAE *Dromaius novaehollandiae* Emu						T T		1 1						
ACCIPITRIDAE *Accipiter sp.*									2 1 2 1					
Aquila audax Wedge-tailed Eagle	X					X	4 * 3	1 B1 1	2 1	2 1			1 * 1	
Aquila morphnoides Little Eagle					X	X			1 1 1 1			1 * 1	3 1 * 3 1	
FALCONIDAE *Falco berigora* Brown Falcon	1 1	1 1	X		X	2 2		1 1	2 1	1 1	1 1	1 1	2 1 1 1 B2	1 1
Falco cenchroides Australian Kestrel	X X						1 2 1 1 2 1	1 1						1 1
CHARADRIIDAE *Vanellus tricolor* Banded Plover														17 1 9 1 B3
Peltohyas australis Australian Dotterel	2 1													
PSITTACIDAE *Glossopsitta porphyrocephala* Purple-crowned Lorikeet									1 1 1 1					
Platycercus zonarius Ring-necked Parrot	X	6 7 4 5	X X 1 1	X 3 2	2 1	4 3 X	1 1	2 8 1 4	11 8 5 5 4 4	2 3 1 2 2 1	5 1	1 1	4 2 2 2	6 2 1 1
Platycercus varius Mulga Parrot		1 2 1 1			4 2			4 2	14 4			4 1		
Cacatua roseicapilla Galah	11 2					X	44 2	8 5 1 1	3 2			2 1	1 1	7 5 34 2 2 2
CUCULIDAE *Cuculus pallidus* Pallid Cuckoo								4 3	1 1	2 1	1 1			
Chrysococcyx basalis Horsfield's Bronze Cuckoo		X		1 1	1 2 1 2	X		1 1	3 3			5 5	2 2	

Table 8 (cont.)

Site	WZ16a	WZ24a	WZ25a	WZ33	WZ34	WZ34a	WZ16a	WZ32a	WZ24a	WZ25a	WZ33	WZ34	WZ34a	WZ37a
Quadrat Days	5 5 3	5 5 3	5 5 3	5 5 3	5 5 3	0 5 3								
STRIGIDAE *Ninox novaeseelandiae* Boobook Owl								1 1						
PODARGIDAE *Podargus strigoides* Tawny Frogmouth							1 1		1 1					
AEGOTHELIDAE *Aegotheles cristatus* Australian Owlet-nightjar									1 1 1 1	2 2 2 2	1 1			
CAPRIMULGIDAE *Eurostopodus guttatus* Spotted Nightjar									1 1					
MEROPIDAE *Merops ornatus* Rainbow Bee-eater									1 1					
HIRUNDINIDAE *Hirundo nigricans* Tree Martin								6 1						
MOTACILLIDAE *Anthus novaeseelandiae* Richard's Pipit	8 10 B6 X 4 5						3 4 7 1 2 2	2 1				2 1		2 4 41 2 2 3
CAMPEPHAGIDAE *Coracina novaehollandiae* Black-faced Cuckoo-shrike		X	1 1		1 1	4 2			6 6 1 5 4 1		1 1	6 6	4 4	2 1
Lalage sueurii White-winged Triller									1 1					
PACHYCEPHALIDAE *Microeca leucophaea* Jacky Winter		2 X 1 1 1		3 1	6 5 4 5			3 2 1 2	5 3		4 3	8 8		
Petroica goodenovii Red-capped Robin					1 1	4 3			1 4 1 4					
Petroica cucullata Hooded Robin	2 1				4 4 4 4									
Pachycephala rufiventris Rufous Whistler		X							1 3 1 3					

Table 8 (cont.)

Site	WZ16a	WZ24a	WZ25a	WZ33	WZ34	WZ34a	WZ16a	WZ32a	WZ24a	WZ25a	WZ33	WZ34	WZ34a	WZ37a
Quadrat Days	5 5 3	5 5 3	5 5 3	5 5 3	5 5 3	0 5 3								
PACHYCEPHALIDAE cont. *Colluricincla harmonica* Grey Shrike-thrush		X	X X	1 1	X	1 1			2 2 2 2 2 2	2 1 1 2 1 1	1 1	1 1		
Oreoica gutturalis Crested Bellbird		X	X	2 X 2	2 2	X		1 2 1 2	9 2 9 2	1 2 1 2	3 3	9 9	5 5	
MONARCHIDAE *Rhipidura leucophrys* Willie Wagtail	X				1 1	1 2 1 1	1 1	2 1						
ORTHONYCHIDAE *Pomatostomus superciliosus* White-browed Babbler				X	3 1				8 2			4 1		
ACANTHIZIDAE *Aphelocephala leucopsis* Southern Whiteface					6 1									
Smicrornis brevirostris Weebill		22 30 12 8 16 5	25 34 11 7 16 4	2 43 6 1 22 2	7 4 2 2 X	8 16 5 3		6 2 B4	5 3 27 1 1 10	38 8 14 3	23 7 10 3	19 6 8 3	15 13 6 5	
Acanthiza apicalis Broad-tailed Thornbill		1 1				X			1 1				1 1	
Acanthiza uropygialis Chestnut-rumped Thornbill		2 4 1 1		4 13 X 1 6	X	9 15 5 4		2 4 1 1	1 17 1 5		7 2 3 1	3 1	9 2 4 1	
Acanthiza chrysorrhoa Yellow-rumped Thornbill	X	2 1			X	5 8 3 3	1 1	3 1				1 1		
Acanthiza iredalei Samphire Thornbill														
Pyrrholaemus brunneus Redthroat		1 1				X							1 1	
Calamanthus fuliginosus Striated Field-wren	X						1 1							
MALURIDAE *Malurus leucopterus* White-winged Fairy-wren	6 7 2 2						7 3	1 1 1 1						
DAPHOENOSITTIDAE *Dapheonositta chrysoptera* Australian Sittella		3 1		4 1				1 1	1 4 1 1		4 1			
CLIMACTERIDAE *Climacteris affinis* White-browned tree-creeper		1 1 1 1							1 3 5 1 2 4					

Table 8 (cont.)

Site	WZ16a	WZ24a	WZ25a	WZ33	WZ34	WZ34a	WZ16a	WZ32a	WZ24a	WZ25a	WZ33	WZ34	WZ34a	WZ37a
Quadrat Days	5 5 3	5 5 3	5 5 3	5 5 3	5 5 3	0 5 3								
DICAEIDAE *Dicaeum hirundinaceum* Mistletoe bird			1 1						1 1 1 1					
PARDALOTIDAE *Pardalotus striatus* Striated Pardalote		1 6 1 5 X	5 6 3 6 B6 X		3 1	3 2		1 1	8 17 8 5	7 9 2 4 7 1	2 1	1 1	2 2	
ZOSTEROPIDAE *Zosterops lateralis* Grey-breasted White-eye														
MELIPHAGIDAE *Lichmera indistincta* Brown Honeyeater														
Meliphaga virescens Singing Honeyeater		X	X		3 3							3 3		1 1
Meliphaga ornata Yellow-plumed Honeyeater		2 1		1 1					2 8 1 1					
Meliphaga leucotis White-eared Honeyeater		1 1	1 1	X					1 4 1 4	2 2	2 2			
Phylidonyris albifrons White-fronted Honeyeater		4 1		1 1		2 1								
Manorina flavigula Yellow-throated Miner	X	X 8 X 4	4 5 25 2 3 2	10 X 4	4 1 X 2 1	9 3 6 1	10 1	6 2	8 68 33 3 19 6	17 17 5 2 6 2	5 8 1 3	6 6 1 1	9 3 B5 2 1	
Acanthagenys rufogularis Spiny-cheeked Honeyeater	X			1 1	X 9 8	X 2 2		4 1 1 1	1 1 1 1	1 1	2 1	1 2 1 2	10 3 8 3	4 2
Anthochaera carunculata Red Wattlebird		2 2	6 2 4 2	3 1		2 1		2 2	2 2	2 6 2 5				
Epthianura albifrons White-fronted Chat					63 33 B6							7 3		30 1
ARTAMIDAE *Artamus cinereus* Black-faced Wood-swallow	X				9 2 X		3 2 1 1					2 2 2 2		15 1
Artamus cyanopterus Dusky Wood-swallow			6 1						7 3	6 1				
Artamus personatus Masked Wood-swallow	4 1								200* 1					

Table 8 (cont.)

Site	WZ16a	WZ24a	WZ25a	WZ33	WZ34	WZ34a	WZ16a	WZ32a	WZ24a	WZ25a	WZ33	WZ34	WZ34a	WZ37a
Quadrat Days	5 5 3	5 5 3	5 5 3	5 5 3	5 5 3	0 5 3								
CRACTICIDAE *Cracticus torquatus* Grey Butcherbird	X	X X 1 1	2 2 2 2 X	X 1 1	1 1 1 1	1 1 1 1	1 1 1 1	2 1 2 1	4 10 7 4 9 7	3 5 4 3 5 2	3 3	2 4 2 4	8 2 7 2	
Cracticus nigrogularis Pied Butcherbird	X						2 2	1 1				[i]2 1 2 1		
Cracticus tibicen Magpie	X X			X			6 1 1 1	2 2	1 1		8* 1		3 3	
Strepera versicolor Grey Currawong		X	1 X 1		X				3 3 2 2 3 2	2 1 3 2 1 2	1 1	1 1		
CORVIDAE *Corvus bennetti* Little Crow	1 1 X		X	1 1	1 1	2 1	6 16 3 2	1 1	19 1 5 1	10 2		2 24 1 4	2 2	13 2 2 3 1 1
Corvus coronoides (Australian Raven)									1 1					

T Tracks
* Overhead
B1 Nest 1 egg
B2+ Nest 2 eggs
B3+ 2 Tiny chicks
B4 Feeding nestlings
B5 Adult incubating
B6 Breeding data in text

Table 9 List of mammals recorded at Woodline and Buningonia indicating number trapped in each sample site. Tracks are indicated by T and animal sightings by S (S_1 =< 5; S_2 = 5-10; S_3 => 10 individuals). Total for the three survey periods (November 1978, August 1980 and March 1981) are included.

	Woodline															Buningonia Spring													
Landform Unit:	G	G	G	G	L	P	P	P	P	P	P	P	Month			G	L	L	L	P	P	UN	UR	UR	UR	Month		
Vegetation Code (WZ):	2	3	6	7	16	18	22	23	25	26	27	40	N	A	M	7a	13	16a	32a	24a	25a	33	34	34a	37a	N	A	M
TACHYGLOSSIDAE																													
Tachyglossus aculeatus							T	T																					
DASYURIDAE																													
Ningaui ridei																	1									–	1	–
N. yvonneae																							2			–	1	1
Sminthopsis crassicaudata			1		1					1			1	2	–		1	1					3			1	2	2
S.sp										1			–	1	–						1			3		–	4	–
MACROPODIDAE																													
Macropus fuliginosus		S_1			S_1	S_1	S_2	S_2	S_1	S_1		S_2	S_3	S_3	S_1		S_1	S_3	T	S_2			S_1		S_1	S_3	S_3	S_3	S_2
M. robustus				S_1		S_1							S_1	S_1	–						S_1		S_1			S_1	S_1	–
M. rufus													–	–	–										S_1	S_1	–	–
MOLOSSIDAE																													
Mormopterus planiceps																									3	–	–	3
Tadarida australis						1				2	1		–	–	4			1		1	2				4	1	1	6
VESPERTILIONIDAE																													
Chalinolobus gouldii						3				4	1		–	–	8										16	–	10	6
C. morio						1							–	–	1										1	–	–	1
Eptesicus regulus			1		1	1				5			1	1	6										1	–	–	1
Nycticeius balstoni																				3						–	3	–
Nyctophilus geoffroyii						1							–	–	1					1					2	–	2	1
N. major										1			–	–	1													
MURIDAE																													
Mus musculus						1							–	1	–			2							1	1	2	–
Pseudomys hermannsburgensis													–	–	–								1	1		1	1	–
P.sp.									1				–	1	–											–	–	–

Table 9 (cont.)

	Woodline															Buningonia Spring													
Landform Unit:	G	G	G	G	L	P	P	P	P	P	P	P	Month			G	L	L	L	P	P	UN	UR	UR	UR	Month		
Vegetation Code (WZ):	2	3	6	7	16	18	22	23	25	26	27	40	N	A	M	7a	13	16a	32a	24a	25a	33	34	34a	37a	N	A	M
CANIDAE																													
Canis familiaris						T													T										
Vulpes vulpes		T				T	T		T	T								T	T										
FELIDAE																													
Felis catus					T														T						1				
CAMELIDAE																													
Camelus dromedarius					T				T			T						S_1	S_1			T	T						
LEPORIDAE																													
Oryctolagus cuniculus				1	1	S_1				S_1			S_1	S_2	–		1	S_2	T			S_2		1		S_1	S_3	S_1

V Discussion

K.R. Newbey, J. Dell and R.A. How

The Widgiemooltha – Zanthus Study Area contains most of the landform units and sub-units encountered in the Eastern Goldfields. Four of the 10 recorded in the Study Area are of particular interest. The only quartzite Hills within the Eastern Goldfields are unique to the Study Area. Calcareous Plain and Undulating Plains, of both greenstone and basic granulite, cover substantial areas. Also, Lake Cowan and Lake Lefroy are two of the largest salt lakes in the Eastern Goldfields.

Sandplain, which covers extensive areas in other parts of the Eastern Goldfields, is absent from the Study Area. Another generally extensive unit, Broad Valley, is only represented by a small area in the south-western corner.

The entire Study Area is situated south of the mulga-eucalypt line and contains a major proportion of the low woodlands of the South-west Interzone (Beard 1975). This interzone is located almost entirely within the Eastern Goldfields.

The most detailed vegetation map covering the Study Area (Beard 1975) was assessed for reliability in the field. Considering the scale (1:1,000,000) of mapping, this map provides an adequate overview of the vegetation based on structure. However, separating low woodland types on black and white aerial photography was difficult while drafting Figure 4 (at the scale of 1:40,000). Photo interpretation was supplemented by ground traverses.

Man has modified large areas of the low woodlands by extensive cutting of timber for the woodline and by grazing stock. Quantitative comparison of modified with natural areas was not carried out. However, two broad impressions are that the cut-over vegetation has a sparser tree stratum and that tall shrubs *Melaleuca pauperiflora* and *M.* aff. *pauperiflora*) are less abundant.

The greatest modification has occurred on the southern section of the Fraser Range where almost all of the vegetation has been cleared for grazing. This area is now dominated by introduced weeds.

Mineral exploration and mining operations have been restricted to small and scattered areas within the Undulating Plains, greenstone.

Evidence of fire in low woodlands was only observed once during field work. An immature stand of *Eucalyptus salubris* Low Woodland (WZ40), seen near the Woodline survey area, appears to have been burnt about 30 years ago. Even under favourable climatic conditions, most areas of woodlands would have great difficulty in carrying a fire. Their structure is generally very open with little accumulation of litter. Chenopods, with low levels of combustion, dominate the low shrub stratum. Annuals and grasses are usually sparse. Low woodlands in the western half of the Study Area have not experienced a major fire since pastoralists first acquired leases in the area (M. Cotter, pers. comm.). *Halosarcia* Low Shrubland is dominated by succulent shrubs and has not been known to burn. The use of fire by aborigines in the Study Area is unknown.

Mallee and tall shrubland over *Triodia scariosa* are the vegetation types most likely to burn. The present herblands on the Fraser Range appear to have resulted from frequent burning, and possibly over-grazing, by pastoralists. Almost all of the *Acacia acuminata* shrubs in herblands were dead or degenerated. Their condition may have resulted from fire, the effects of drought or ring-barking by rabbits. Rabbit populations build up during good seasons

causing heavy grazing pressures during dry years.

The Study Area contains a major proportion of the low woodlands of the South-west Interzone but also contains elements of the South-west and Eremaean Botanical Provinces (Beard 1975). Species characteristic of the Interzone include *Eucalyptus lesouefii, E.torquata* and *Eremophila ionantha.* Mallees and tall shrublands are less evident than in most other Study Areas in the Eastern Goldfields.

South-west elements of the flora occur mainly in the south-western corner (Broad Valleys and Granite Exposures) and decrease in number in a north-easterly direction e.g. *Allocasuarina huegeliana, Rutidosis multiflora* and *Stypandra imbricata.* Soils of the South-west Botanical Province are largely neutral whilst those of the Study Area are mainly calcareous. Few areas with suitable soils for the South-west flora are present in the Study Area. Run-off from the bare rock of exposures helps to compensate for the rainfall that decreases and becomes more erratic from southwest to northeast.

Eremaean elements grade gradually from the east into those of the Interzone e.g. *Calotis multicaulis, Casuarina cristata* ssp. *pauper* and *Acacia oswaldii.* Soil types are similar in both the Interzone and the Eremaean botanical province.

Of the 39 vegetation types recorded during the survey, one is unique to the Eastern Goldfields, including the Study Area, this being tall shrubland on the Woodline Hills. Modification of the vegetation has been restricted to a few cut lines for mineral exploration.

A pattern of vegetation types that is largely confined to the Study Area occurs on the Fraser Range (Undulating Plain, basic granulite). The pattern is a lattice of low ridges that enclose colluvial flats. The low ridges support mallees over perennial grasses of *Triodia scariosa* or chenopod shrubs, or low woodlands. The flats support *T. scariosa* or herblands. The area, least modified by grazing, is the northern 65 km of the range that appears to have not been grazed for many years and has never been fenced.

Plant families of the Study Area have a higher proportion of species of Chenopodiaceae and Myrtaceae, and a lower proportion of Proteaceae and Leguminosae subfamily Papilionoideae, than for the Eastern Goldfields.

A number of plant species recorded during the survey are rare and their distributions need study as they may meet the requirements of Gazetted Rare Flora (Rye & Hopper 1981). The species are *Abutilon* sp. (KRN 7544), *Astartea* sp. (KRN 8486), Asteraceae genus (KRN 8559), *Boronia fabianoides,* Caryophyllaceae genus (KRN 7235A), *Grevillea* sp. (KRN 6905), *Helichrysum cassiope, Lasiopetalum* aff. *ogilvieanum, Prostanthera* sp. (KRN 8541) and Rhamnaceae genus (KRN 7073). The Western Australian population of *Prostanthera serpyllifolia* ssp. *serpyllifolia* is also in need of study.

The vegetation and flora of the central portion of the Study Area, the Woodline Hills and the herblands of the Fraser Range are in need of additional study. For a better understanding of the Study Area's flora, collecting is required at times of the year other than August and September and in the north-west section following good autumn or winter rains. Granite Exposures and Salt Lake Features are the landform units most likely to support additional species with high conservation values.

The vertebrates recorded are characteristic of much of the Eastern Goldfields. The species confined in Western Australia to the Study Area is the skink *Hemiergis millewae.* Elsewhere it occurs on the Eyre Peninsula and in western Victoria.

Areas of mallee over *Triodia scariosa* in the eastern section of the Study Area are of major

importance. They support a dominant element of herpetofauna that is a south-westerly extension of the arid zone fauna.

The vegetation is also part of the corridor around the north of the treeless Nullarbor Plain that provides a link with the semi-arid fauna of south-eastern Australia. Evidence of the link is provided by the distribution of the skink *Hemiergis millewae* and the dasyurid *Ningaui yvonneae.* Both occur in South Australia and western Victoria.

The corridor is also important for birds (Ford 1971). Previous to Ford's study, several species were believed to have a discontinuous range, having been recorded in south-western Australia and the Eyre Peninsula. A number of these species were recorded in the corridor. All are usually associated with eucalypts (mallee and woodland) of south-western Australia and Eyre Peninsula. Of the species recorded in the corridor, *Glossopsitta porphryocephala* and *Strepera versicolor* were recorded in both survey areas; and *Cinclosoma castanotum, Pachycephala inornata* and *Climacteris rufa* only at the Woodline.

Ford (1971) postulates that other south-western species could occur north of the Nullarbor but believed that they require either dense mallee, thick understoreys in eucalypt woodlands, or dense thickets with a continuous canopy. These vegetation types are absent from the Great Victoria Desert. Therefore, he concluded that these species were unlikely to occur north of the Nullarbor. Many of the species listed by Ford were recorded by us at Buningonia Spring, thus indicating the importance of the area in providing a range of habitats for south-western birds.

Only three Nature Reserves (flora and fauna) have been set aside in the Study Area (Figure 2 and Table 10). Added together, their area is only 0.17% of the Study Area. Two of these reserves (Binaronca Rock and Ngalbain) were surveyed botanically in moderate detail and their floristics recorded (Appendix II); none were surveyed for vertebrate fauna.

Table 10 Flora and Fauna Reserves of Study Area

Reserve No.	Name	Area (ha)	Purpose	Vesting
3211	Dordie Rock	121.4057	Water & Flora & Fauna	Min. for W.S.S.D.
32552	Binaronca Rock	185.9880	Flora & Fauna	W.A.W.A.
33300	Ngalbain	3680.0000	Flora & Fauna	W.A.W.A.

W.S.S.D. = Water Supply & Sewerage Department
W.A.W.A. = Western Australian Wildlife Authority

All the reserves are situated within Undulating Plain, greenstone; two also contain small areas of other landform units. Undulating Plain, greenstone, is confined to the Eastern Goldfields. Ngalbain Nature Reserve is important because it is the largest of the reserves on this unit. Almost all of the remaining areas of this unit are under pastoral lease or mineral claims.

Hill, basic granulite, is represented by only one hill in the small Binaronca Nature Reserve. Dordie Rock Nature Reserve was not surveyed but appears to be a small Granite Exposure surrounded by Undulating Plain, greenstone (Sofoulis 1966).

Table 11 Representation of the Vegetation Systems within the study area.

Vegetation System	Area (km^2) Total	Within Study Area	Reserves B	D	N
Binnèringe	5805	5805	0	0	0
Cave Hill	10820	590	0	0	0
Coolgardie	10865	5060	1.9	1.2	36.8
Dundas	5020	1190	0	0	0
Fraser Range	2475	1185	0	0	0
Harms	6060	1985	0	0	0
Randell	2885	1115	0	0	0
Zanthus	17165	6800	0	0	0
TOTAL		23730	1.9	1.2	36.8

Areas were calculated from Beard (1975, 1981). Reserves: B = Binaronca Rock, D = Dordie Rock, N = Ngalbain.

Almost all of the Binneringe Vegetation System is within the Study Area, as well as approximately half of the Coolgardie, Fraser Range and Randall Vegetation Systems (Beard 1975). However, only a small proportion of the Coolgardie Vegetation System is within the existing reserves (Table 11).

Only 8 of the 39 vegetation types are present in the Binaronca and Ngalbain Nature Reserves (Table 3). None of these types appear to be in areas large enough for long term survival of all of their component flora and fauna. Collectively, only 158 of the 569 plant taxa recorded in the Study Area have been recorded in the reserves (Appendix II). Neither of the gazetted rare flora, *Eucalyptus brachyphylla* and *E. kruseana,* are known to occur in the reserves. Margins of the larger salt lakes are poorly reserved with only one kilometre of Lake Lefroy present in Ngalbain Nature Reserve.

Two features with important conservation values occur on "Cowarna". The first is an enlarged claypan (Swan Lake); one of the few areas of permanent freshwater in the Eastern Goldfields. Nine species of water birds were recorded there at dusk one evening. The claypan is also an important source of stock water. The second is Erayina Hill, a large granite hill in an area which has only been lightly grazed by stock. A diverse flora was present (*ca* 93 spp.) as well as the fairy-wren *Malurus splendens.*

Landform units, vegetation and flora are poorly represented in Nature Reserves within the Study Area, highlighting the need for urgent consideration of the area's conservation requirements.

Only 4 of the 10 landform units and sub-units present in the Study Area were surveyed for vertebrate fauna (Table 3). The main vegetation types on three landform units (Granite Exposure, Calcareous Plain and Undulating Plain, basic granulite) were adequately surveyed. Salt Lake Features require the surveying of additional vegetation types i.e. *Callitris columellaris* Low Woodland. The most extensive landform unit not surveyed was Undulating Plain, greenstone. Hill, quartzite, covers a small area but requires sampling due

to its uniqueness. The remaining 4 units (Breakaway; Hill, granite; Hill, basic granulite; and Broad Valley) occur only as small areas in the Study Area. Only 15 of the 39 vegetation types were surveyed for vertebrate fauna (Table 3). Another 2 types were partially surveyed as part of the lake ecotone at Harris Lake (WZ32a). Twelve of the remaining types occur in small areas and were rarely sighted during field work.

Kitchener *et al.* (1980a, 1980b and 1982) documented reserves in the semi-arid Wheatbelt of Western Australia and related their findings to the Eastern Goldfields. Reserves should contain as wide a range as possible of local soil and vegetation types. Minimum areas in the Wheatbelt for herpetofauna and birds is 1,500 ha, and for regional reserves *ca* 40,000 ha. They consider that Nature Reserves in the Eastern Goldfields should be larger than in the Wheatbelt as the populations of many vertebrates (especially birds) are at a lower density in arid areas. Species diversity and densities recorded in the Study Area support this conclusion. Research is required to more accurately determine minimum areas for reserves in the Eastern Goldfields.

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Appendix I

Descriptions of Vegetation Sites

Listed below are descriptions of typical vegetation sites including data on geology, landforms and soils. If the vegetation structure and species composition are highly variable, the vegetation is referred to as a complex and named according to the characteristic bedrock or physical feature e.g. Granite or Dune Complex. The sites are ordered firstly by landform unit; within each unit from the tallest to the lowest formation; and within formations by alphabetical order of the most prominent species. *Indicates an introduced species.

Vegetation types are separated by structure and life form into seven broad classes: woodlands (>15 m), low woodlands (<15 m), mallees, tall shrublands (>1 m), low shrublands (<1 m), and hummock grasslands. MUIR = Muir (1977) notation. "Misc." (miscellaneous) plants includes annuals, climbers, ferns, perennial grasses, sedges and sedge-like (plants). Figures in brackets following plant names are per cent canopy cover (CC). Taxa with less than 0.1% CC are indicated by a (+) and, when several are present, are recorded under "other species" in the appropriate strata. "KRN" numbers are K.R. Newbey collecting numbers. The period since the last fire ("last burnt") is estimated from observations in nearby areas where the year of the last fire is known.

"Bedrock" refers to major rock type. "Geological surface" is that shown on 1:250,000 geological maps; (Wi) = Widgiemooltha (Sofoulis 1966), and (Za) = Zanthus (Doepel & Lowry 1970). Those surfaces listed in the vegetation descriptions are described briefly in Table 12. "Unit" refers to one of 10 landform units being devised by Newbey & Milewski to describe the landscapes of Eastern Goldfields District.

The cover of rock, stone and pavement was visually estimated. For explanation of litter see Muir (1977). Note that the present study divides leaves into broad, narrow and terete; Muir (1977) separates them only into broad or terete.

To sample the soil profile, a hole, 62 mm in diameter, was augered to a depth of 1 m where possible. Soil colour was determined in a moist condition using Fujihira Standard Soil Colour Charts. Munsell colour names are listed for most colours and used whenever possible. Where Munsell names are not listed, P.C.C.S. colour names listed on the charts are used and enclosed in "quotes." The degree of calcareousness is according to the system of Northcote (1971), but is only listed if pH is 8.0 or higher. pH is estimated to nearest 0.25 using Soil pH Testing Kit (Inoculo Laboratories, Melbourne). Soil nomenclature generally follows Northcote (1971). "Group" refers to Newbey (this publication). Northcote notations used are briefly described in Table 13. Comments on soil profiles more than 1 metre thick are based on observations nearby where similar profiles were exposed e.g. trenches for mineral exploration.

"Distribution" refers to within the Study Area. Major variations in the structure of lower vegetation strata, soil type, landform unit, or bedrock, observed within the Study Area are listed under Comments.

Table 12 Brief description of Geological Surfaces listed in Appendix I.

Symbol	Description
(Wi)	Widgiemooltha 1:250,000 sheet
Q	(Quaternary)
Qpg	Sandplain deposits of sand and gravelly sand on old plateau.
Qps	Extensive sheets of sandy loam.
Qrl	Saline alluvium of lake floors and lower drainage reaches.
Qra	Aeolian deposits associated with salt lakes, or on sandplain.
T	(Tertiary)
Tb	Siliceous duricrust mainly over non-crystalline sediments.
Tf	Ferruginous duricrust (laterite) capping deeply weathered rocks.
P	(Proterozoic)
Plw	Widgiemooltha Dyke Suite of gabbro and dolerite.
Pmg	Medium to coarse-grained granite.
Puw	Woodline Beds of quartzite, shale and phyllite.
A	(Archaean)
Ad	Metagabbro of "Younger Greenstones."
As	Metasedimentary deposits of granitic material.
(Za)	Zanthus 1:250,000 sheet
Q	(Quaternary)
Qe	Aeolian deposits of quartz sand in dunes and sheets.
Qo	Aeolian deposits of sand and silt from lakes forming sheets and dunes.
Qpe	Aeolian loams and silts containing sheet and nodular carbonates.
Qpc	Colluvium of sand, silt, clay and rock fragments.
Qpv	Alluvial clay to pebbles of present drainage.
Qre	Lacustrine deposits: saline and gypsiferous.
P	(Proterozoic)
Px	Fraser Complex of acid and basic granulites and acid gneisses.

For explanation of symbols and further details on Widgiemooltha 1:250,000 sheet see Sofoulis (1966), and Zanthus see Doepel & Lowry (1970).

Table 13 Brief description of Northcote Notations of soil types listed in Appendix I. For a more detailed explanation of terms see Northcote (1971).

Notation	Description
D = Duplex profile – at least 1.5 texture groups between A and B horizons.	
Db1.12	A horizon hardsetting; A2 horizon absent; B horizon brown, clayey; neutral soil reaction trend.
Dr1.53	A horizon with crust; A2 horizon absent; B horizon red, clayey; soil reaction trend alkaline.
Dr2.22	A horizon hardsetting; A2 horizon unbleached; B horizon red, clayey; soil reaction trend neutral.
G = Gradational profile – difference between horizons does not exceed 1.5 texture groups.	
Gc1.12	Calcareous throughout; B horizon with few peds, maximum clay and carbonate content.
Gc1.22	Calcareous throughout; B horizon highly pedal, maximum clay and carbonate content.
Gn2.12	Not calcareous throughout; A2 horizon absent; B horizon apedal, soil reaction trend neutral.
Gn2.13	Not calcareous throughout; A2 horizon absent; B horizon apedal, soil reaction trend alkaline.
Gn2.15	Not calcareous throughout; A2 horizon present but not bleached; B horizon apedal, soil reaction trend neutral.
Gn2.16	Not calcareous throughout, A2 horizon present but not bleached; B horizon apedal, soil reaction trend neutral.
KS– = The prefix indicates that the bulk of the soils profile consists of ironstone gravel. For KS-Uc1.23 see Uc1.23 for other details.	
U = Uniform profile – Small, if any texture difference between horizons.	
Uc1.13	Textures coarse; profile development little, if any; calcareous.
Uc1.2	Textures coarse; profile development little, if any; not calcareous.
Uc1.21	Similar to above.
Uc1.23	Similar to above.
Uc4.13	Textures coarse; profile well-developed; overlying calcrete.
Uc4.22	Textures coarse; profile well-developed; B horizon weakly coherent.
Uc5.22	B horizon without peds and earthy fabric.
Uf1.33	Textures fine; profile development little, if any; calcareous.
Uf4.21	Textures fine; profile developed; B horizon with few, if any, peds.
Um1.22	Textures medium, profile development, little, if any; not calcareous.
Um4.2	Textures medium; profile developed; B horizon has few, if any peds.
Um5.12	Little profile development; calcareous.
Um5.22	Profile developed and deep; not calcareous throughout.

BREAKAWAY (B)

COMPLEX

WZ1 Breakaway Complex

LOCATION: 30 km E. of Wigiemooltha (31° 33'40"S lat., 121° 53'30"E long.)
FAUNA SAMPLED: No DATE: 16-8-1981

VEGETATION MUIR: LAr.Sr.SDr.Jr

Stratum 1: Trees 5-6 m, CC = 1, clumping slight *Eucalyptus stricklandii* (1).

Stratum 2: Shrubs 2.1-2.3 m, CC = 5.3, clumping moderate *Eremophila alternifolia* (5), *Acacia tetragonophylla* (0.1), *Alyxia buxifolia* (0.1), *Santalum acuminatum* (0.1), *Dodonaea lobulata* (+).

Stratum 3: Shrubs 1.5-2.0 m, CC = +, clumping none *Acacia tetragonophylla* (+).

Stratum 4: Shrubs 0.6-1.0 m, CC = 0.2, clumping slight *Dodonaea lobulata* (0.1), *Prostanthera* sp. (KRN 8541) (0.1), *Olearia muelleri* (+), *Scaevola spinescens* (+).

Stratum 5a: Shrubs 0.0-0.5 m, CC = 3.7, clumping moderate *Ptilotus helichrysoides* (2), *Atriplex vesicaria* (0.5), *Sclerolaena obliquicuspis* (0.5), *Ptilotus obovatus* var. *obovatus* (0.2), *Calytrix tetragona* (0.1), *Chenopodium curvispicatum* (0.1), *Sclerolaena diacantha* (0.1), *Enchylaena tomentosa* (+), *Isotoma petraea* (+), *Sida calyxhymenia* (+); 2 other spp.

Stratum 5b: Misc. plants, CC = 6, clumping moderate. Annuals: *Gnephosis burkittii* (4), *Brachycome pusilla (1), Calotis hispidula* (0.2), *Helipterum pygmaeum* (0.2), *Calandrinia polyandra* (0.1), **Lophochloa pumila* (0.1), *Senecio glossanthus* (0.1), *Zygophyllum ovatum* (0.1), *Toxanthes perpusillus* (+), *Parietaria debilis* (+); 10 other spp.
Ferns: *Cheilanthes tenuifolia* (+), *Ophioglossum lusitanicum* (+).

No. of TAXA: 45 LAST BURNT: >50 years
MODIFICATION: Moderately grazed

LANDFORM
BEDROCK: Granite GEOLOGICAL SURFACE: (Wi) Tf
UNIT: Breakaway ELEMENT: Summit and slopes

SOIL
GROUP: Gritty Loams NORTHCOTE: Uml.22
MAIN ORIGIN: *In situ* weathering DRAINAGE: Good
PROFILE ATTRIBUTE: Shallow SURFACE: Hardsetting
ROCK: 5-15% cover, patchy
STONE: 5-15% cover of irregular laterite 2-7 cm long, patchy.
PAVEMENT: 10-90% cover of material 4-12 mm, even.
LITTER: Leaves broad, deposits 3 cm thick, 8-15 m apart.

SOIL PROFILE
A 0-8 cm Light brown clay loam; friable; 10-15% irregular to subangular lateritic concretions 5-18 cm long.

COMMENTS
DISTRIBUTION: Rare, restricted to western sector, 0.5-1 ha
PROFILE THICKNESS: 2-18 cm
GENERAL: The only species on the scree slopes were *Eucalyptus sticklandii* (1) and *Ptilotus helichrysoides* (2).

GRANITE EXPOSURE (G)

MALLEE

WZ2 *Eucalyptus grossa* Mallee

LOCATION: 23 km SE. of Sinclair Soak (31° 54'5"S lat., 122° 24'20"E long.)
FAUNA SAMPLED: Yes DATE: 11-8-1980

VEGETATION MUIR: KSi.Sr.SAi.SCr.SDr.Jr

Stratum 1: Mallees 2.1-3.2 m, CC = 25, clumping slight *Eucalyptus grossa* (25).
Stratum 2: Shrubs 2.1-2.7 m, CC = 2, clumping moderate *Melaleuca uncinata* (2), *Pimelea microcephala* (+), *Thryptomene australis* (+).
Stratum 3: Shrubs 1.6-2.0 m, CC = 13, clumping moderate *Eremophila scoparia* (10), *Beyeria lechenaultii* (3).
Stratum 4: Shrubs 1.1-1.5 m, CC = +, clumping none *E. serrulata* (+).
Stratum 5: Shrubs 0.6-1.0 m, CC = 4, clumping slight *Trymalium* aff. *ledifolium* (4).
Stratum 6a: Shrubs 0.0-0.5 m, CC = 2, clumping moderate *Dodonaea microzyga* (2), *Acacia erinacea* (+), *Enchylaena tomentosa* (+), *Sclerolaena diacantha* (+).
Stratum 6b: Misc. plants, CC = 3, clumping moderate. Annuals: *Bulbine semibarbata* (0.2), *Calandrinia polyandra* (0.1), *Helipterum strictum* (0.1), **Mesembryanthemum crystallinum* (0.1), *Senecio glossanthus* (0.1), *Stellaria filiformis* (0.1), *Stenopetalum filifolium* (0.1), *Crassula exserta* (+), *Drosera macrantha* ssp. *macrantha* (+), *Millotia tenuifolia* (+), *Nicotiana rotundifolia* (+), *Waitzia aurea;* 21 other spp. Sedges: *Lepidosperma brunonianum* (+).

No. of TAXA: 45 LAST BURNT: 60-70 years
MODIFICATION: None known or evident.

LANDFORM
BEDROCK: Granite GEOLOGICAL SURFACE: (Wi) Pmg
UNIT: Granite Exposure ELEMENT: Outer apron

SOIL
GROUP: Granitic Soils NORTHCOTE: Dr2.22
MAIN ORIGIN: *In situ* weathering DRAINAGE: Good
PROFILE ATTRIBUTE: Duplex SURFACE: Hardsetting
ROCK: 0-25% cover of material 5-18 mm long, patchy
STONE: 5-20% cover of subrounded granite 5-25 cm long, patchy.
PAVEMENT: 2-5% cover of material 5-18 mm long, patchy.
LITTER: Leaves broad, deposits 2 cm thick, averaging 4 m apart under mallees; leaves terete, deposits 1 cm thick, averaging 8 m apart under large shrubs.

SOIL PROFILE
A 0-7 cm Brown clayey sand; friable.
B21 7-47 cm Light brown sandy clay loam.
B22 47-100 cm Brownish red sandy clay; firm to very firm; 5-8% of angular feldspar 3-12 mm long, increasing in proportion with depth.

COMMENTS
DISTRIBUTION: Scattered in south-western sector, usually less than 0.5 ha
PROFILE THICKNESS: 1-1.6 m

WZ3 *Eucalyptus loxophleba* Mallee

LOCATION: 33 km SE. of Sinclair Soak (31° 54'20"S lat., 122° 24'30"E long.)
FAUNA SAMPLED: Yes DATE: 6-8-1980

VEGETATION MUIR: KTi.Sr.SAr.SCr.SDr.Jr

Stratum 1: Mallees 5-8 m, CC = 25, clumping slight *Eucalyptus loxophleba* (25).
Stratum 2: Shrubs 2.1-2.6 m, CC = 6, clumping slight *Pittosporum phylliraeoides (3), Acacia acuminata* (1), *A. jennerae* (1), *Pimelea microcephala* (1), *Exocarpos aphyllus* (+).
Stratum 3: Shrubs 1.6-2.0 m, CC = 4.2, clumping none *Eremophila decipiens* (3), *Myoporum desertii* (1), *Cassia nemophila* var. *nemophila* (0.2).
Stratum 4: Shrubs 1.1-1.5 m, CC = 1, clumping none *Olearia revoluta* (1), *E. scoparia* (+).
Stratum 5: Shrubs 0.6-1.0 m, CC = 4, clumping slight *Rhagodia drummondii* (4), *Scaevola spinescens* (+).
Stratum 6a: Shrubs 0.0-0.5 m, CC = 4, clumping slight *Atriplex vesicaria* (2), *Maireana* hybrid (KRN 6951) (1), *Ptilotus obovatus* var. *obovatus* (0.2), *Olearia muelleri* (0.1), *Sarcozona praecox* (+), *Sclerolaena diacantha* (+), *Sida* sp. (KRN 6968) (+), *Solanum nummularium* (+); 5 other spp.
Stratum 6b: Misc. plants, CC = 2, clumping slight. Annuals: *Actinobole uliginosum* (0.2), *Calandrinia polyandra* (0.1), *Calotis hispidula* (0.1), *Crassula exserta* (0.1), *Brachycome iberidifolia* (+), *Chthonocephalus pseudevax* (+), *Erodium crinitum* (+), *Senecio glossanthus* (+); 8 other spp.

No. of TAXA: 42 LAST BURNT: 40-50 years
MODIFICATION: None known or evident

LANDFORM
BEDROCK: Granite GEOLOGICAL SURFACE: (Wi) Pmg
UNIT: Granite Exposure ELEMENT: Outer apron

SOIL
GROUP: Granitic Soils NORTHCOTE: Gn2.16
MAIN ORIGIN: *In situ* weathering DRAINAGE: Good
PROFILE ATTRIBUTE: Shallow SURFACE: Hardsetting
ROCK: Nil STONE: Nil PAVEMENT: Nil
LITTER: Trunks few; branches few; leaves broad, deposits 2 cm thick, 8-12 m apart.

SOIL PROFILE
A 0-36 cm Dark reddish brown loamy sand; friable.
B 36-100 cm Red sandy clay loam; firm; not calcareous; pH 8.25.

COMMENTS
DISTRIBUTION: Rare, restricted to western sector, 1.5 ha
PROFILE THICKNESS: 1.2-1-6 m

TALL SHRUBLAND

WZ4 *Acacia* sp. (KRN 7568) Tall Shrubland

LOCATION: 33 km ESE. of Sinclair Soak (31° 50'10"S lat., 122° 33'10"E long.)
FAUNA SAMPLED: No DATE: 10-8-1980

VEGETATION MUIR: Si.SBr.SCr.Hc.

Stratum 1: Shrubs 2.2-3.2 m, CC = 13, clumping moderate *Acacia* sp. (KRN 7568) (10), *Allocasuarina helmsii* (3); *Acacia acuminata* (+), *Melaleuca uncinata* (+).
Stratum 2: Shrubs 1.1-1.5 m, CC = 2, clumping slight *Melaleuca lateriflora* (2); *Beyeria brevifolia* var. *truncata* (+), *Eremophila decipiens* (+).
Stratum 3: Shrubs 0.6-1.0 m, CC = 5, clumping none *Prostanthera aspalathoides (3), Cryptandra parvifolia* (2), *E. ionantha* (+).

Stratum 4a: Shrubs 0.0-0.5 m, CC = 1.1, clumping slight *Daviesia pachyloma* (1), *Mirbelia microphylla* (0.1), *Grevillea acuaria* (+).

Stratum 4b: Misc. plants, CC = 35.2, clumping slight. Annuals: *Helipterum laeve* (0.1), *Hydrocotyle* aff. *pilifera* (+), *Thysanotus patersonii* ssp. *patersonii* (+), *Wurmbea tenella* (+), *Zygophyllum apiculatum* (+).
Perennial grasses: *Triodia scariosa* (35).
Sedge-like: *Dianella revoluta* (+).

No. of TAXA: 20 LAST BURNT: 40-50 years
MODIFICATION: None known or evident.

LANDFORM
BEDROCK: Granite GEOLOGICAL SURFACE: (Wi) Pmg
UNIT: Granite Exposure ELEMENT: Shallow soil over granite

SOIL
GROUP: Granitic Soils NORTHCOTE: Uc1.21
MAIN ORIGIN: *In situ* weathering DRAINAGE: Good
PROFILE ATTRIBUTE: Shallow SURFACE: Crusting
ROCK: Nil STONE: Nil PAVEMENT: Nil
LITTER: Branches few; leaves narrow, deposits 3 cm thick, 10-23 m apart; leaves terete, deposits 1 cm thick, 4-8 m apart.

SOIL PROFILE
A21 0-3 cm Dusky red sandy loam; friable.
A22 3-20 cm Light red loamy sand; friable.
B 20-100 cm Light red loamy sand; friable; becoming gritty below 63 cm; 3-5% subangular feldspar and quartz 2-4 mm long.

COMMENTS
DISTRIBUTION: Rare, central southern sector, 1-2 ha
PROFILE THICKNESS: 70-110 cm

WZ5 *Acacia* sp. (KRN 8497) Tall Shrubland

LOCATION: 23 km SE. of Karonie (31° 08'40"S lat., 122° 40'30"E long.)
FAUNA SAMPLED: No DATE: 12-8-1981

VEGETATION MUIR: SAc.SDr.Hi.Jr

Stratum 1: Mallees 2.5-3.2 m, CC = 0.5, clumping moderate *Eucalyptus foecunda* (0.5).

Stratum 2: Shrubs 2.1-2.2 m, CC = 1, clumping slight *Acacia acuminata* (1).

Stratum 3: Shrubs 1.6-2.0 m, CC = 42, clumping slight *Acacia* sp. (KRN 8497) (20), *Melaleuca uncinata* (20), *M. coccinea* (2), *Eremophila serrulata* (+).

Stratum 4: Shrubs 1.1-1.5 m, CC = +, clumping none *Prostanthera aspalathoides* (+).

Stratum 5: Shrubs 0.6-1.1 m, CC = 1.1, clumping none *Melaleuca lateriflora* (1), *Allocasuarina helmsii* (0.1), *Eremophila glabra* (+), *Scaevola spinescens* (+).

Stratum 6a: Shrubs 0.0-0.6 m, CC = 2.4, clumping none *Cryptandra parvifolia* (1), *Dodonaea adenophora* (0.5), *Westringia rigida* (0.5), *Spyridium complicatum* (0.2), *Sida calyxhymenia* (+); 2 other spp.

Stratum 6b: Misc. plants, CC = 22, clumping slight. Annuals: *Chrysocoryne pusilla* (2), *Goodenia havilandii* (0.1).
Perennial grasses: *Triodia scariosa* (20).

No. of TAXA: 21 LAST BURNT: 25-30 years
MODIFICATION: None known or evident

LANDFORM
BEDROCK: Granite GEOLOGICAL SURFACE: (Wi) Pmg
UNIT: Granite Exposure ELEMENT: Shallow soil over granite

SOIL
GROUP: Granitic Soils NORTHCOTE: Uc4.13
MAIN ORIGIN: *In situ* weathering DRAINAGE: Good
PROFILE ATTRIBUTE: Neutral SURFACE: Hardsetting
ROCK: Nil STONE: Nil
PAVEMENT: 5-20% cover of subangular feldspar and quartz 2-5 mm across, patchy.
LITTER: Leaves terete, deposits 3 cm thick, 4-8 m apart, under large shrubs.
SOIL PROFILE
A 0-40 cm Dusky red sandy loam; friable; inclusions 5-8% subangular feldspar and quartz 2-3 mm long.
COMMENTS
DISTRIBUTION: Rare, restricted to central northern sector, 1-3 ha
PROFILE THICKNESS: 30-60 cm

WZ6 *Acacia acuminata* Tall Shrubland
LOCATION: 22 km SE. of Sinclair Soak (31° 53'30"S lat., 122° 23'50"E long.)
FAUNA SAMPLED: Yes DATE: 6-8-1980
VEGETATION MUIR: Sc.SCr.VLr
Stratum 1: Shrubs 2.1-2.6 m, CC = 35, clumping slight *Acacia acuminata* (15), *Allocasuarina campestris* ssp. *campestris* (15), *Acacia* sp. (KRN 7568) (3), *Melaleuca uncinata* (2), *Thryptomene australis* (+).
Stratum 2: Shrubs 1.6-2.0 m, CC = 0.1, clumping none *Eremophila serrulata* (0.1), *Alyxia buxifolia* (+).
Stratum 3: Shrubs 0.6-1.0 m, CC = 5, clumping slight *Grevillea* sp. (KRN 6905) (3), *Prostanthera aspalathoides* (2), *Cryptandra parvifolia* (+), *Leucopogon* sp. (KRN 6954) (+).
Stratum 4a: Shrubs 0.0-0.5 m, CC = 1.3, clumping slight *Baeckea carnosa* (1), *B. crispiflora* (0.2), *Mirbelia microphylla* (0.1).
Stratum 4b: Misc. plants, CC = 3, clumping slight Annuals: *Drosera andersoniana* (0.5), *Caladenia filamentosa* var. *tentaculata* (+), *D. macrantha* ssp. *macrantha* (+), *Thelymitra nuda* (+),
6 other spp.
Perennial grasses: *Amphipogon turbinatus* (0.2).
Sedges: *Lepidosperma viscidum* (2).
No. of TAXA: 26 LAST BURNT: 40-50 years
MODIFICATION: None known or evident.
LANDFORM
BEDROCK: Granite GEOLOGICAL SURFACE: (Wi) Pmg
UNIT: Granite Exposure ELEMENT: Outer apron
SOIL
GROUP: Granitic Soils NORTHCOTE: Uc1.21
MAIN ORIGIN: *In situ* weathering DRAINAGE: Good
PROFILE ATTRIBUTE: Shallow SURFACE: Hardsetting
ROCK: Nil STONE: Nil
PAVEMENT: 5-35% cover of subangular feldspar and quartz 5-16 mm long, even.
LITTER: Branches few; leaves terete, deposits 2 cm thick, 3-9 m apart.
SOIL PROFILE
A 0-10 cm Dark reddish brown loamy sand; friable.
B21 10-28 cm Reddish brown loamy sand; friable.
B22 28-48 cm Reddish brown loamy sand; friable; 20-30% ironstone gravel, semi-soft, 3-12 mm across.

C 48-63 cm Light brown coarse sand; friable; 10-15% subangular feldspar and quartz.

COMMENTS

DISTRIBUTION: Scattered over region west of Fraser Range, 0.5-3 ha

PROFILE THICKNESS: 50-80 cm

GENERAL:

(a) Stratum 1 CC varies from 5% to 40%. As CC decreased, the number of annual species, and their CC, tended to increase. Species richness tended to decrease from south-west to north-east.

(b) *Acacia* sp. (KRN 7568) was rarely present, and *Allocasuarina campestris* ssp. *campestris* (0-5).

(c) Sometimes present on shallow soils over granite without any associated bedrock exposure.

(d) Species richness varied from 23 to 59.

COMPLEX

WZ7 Granite Complex

LOCATION: 24 km SE. of Sinclair Soak (31° 54'40"S lat., 122° 24'20"E long.)

FAUNA SAMPLED: Yes DATE: 9-8-1980

VEGETATION MUIR: Si.SCr.Ji

Stratum 1: Trees 4-6 m, CC = 0.2, clumping none *Allocasuarina huegeliana* (0.1), *Eucalyptus loxophleba* (0.1).

Stratum 2: Shrubs 2.1-2.8 m, CC = 13.5, clumping strong *Acacia* aff. *duriuscula* (5), *Thryptomene australis* (5), *Acacia acuminata* (3), *Santalum spicatum* (0.2), *Melaleuca fulgens* (0.1), *Pimelea microcephala* (+).

Stratum 3: Shrubs 1.1-1.5 m, CC = 0.2, clumping none *Eremophila serrulata* (0.2).

Stratum 4: Shrubs 0.6-1.0 m, CC = 2.2, clumping moderate *Grevillea* sp. (KRN 6905) (2), *Dodonaea microzyga* (0.1), *Cassia nemophila* var. *nemophila* (+), *E. decipiens* (+), *Mirbelia microphylla* (+).

Stratum 5a: Shrubs 0.0-0.5 m, CC = 1, clumping none *Dampiera trigona* var. *latealata* (0.1), *Sarcozona praecox* (0.1), *Indigofera australis* (+), *Isotoma petraea* (+), *Pimelea thesioides* (+), *Sida* sp. (KRN 6968) (+); 4 other spp.

Stratum 5b: Misc. plants, CC = 5, clumping moderate. Annuals: *Drosera macrantha* ssp. *macrantha* (2), *Actinobole uliginosum* (0.2), *Arthropodium capillipes* (0.2), *Gonocarpus nodulosus* (0.2), *Hydrocotyle* aff. *pilifera* (0.2), *Chthonocephalus pseudevax* (0.1), *Parietaria debilis* (0.1), *Schoenus sculptus* (0.1), *Waitzia aurea* (0.1), *Calandrinia polyandra* (+), *Erodium crinitum* (+), *Helipterum hyalospermum* (+), *H. laeve* (+), *Nicotiana rotundifolia* (+), *Podolepis capillaris* (+), *Pterostylis nana* (+); 13 other spp.
Climbers: *Glycine clandestina* (+).
Ferns: *Ophioglossum lusitanicum* (0.1), *Cheilanthes tenuifolia* (+), *C.* sp. (KRN 8645) (+), *Marsilea* sp. (KRN 8479) (+).
Sedge-like: *Dianella revoluta* (+).

No. of TAXA: 59 LAST BURNT: 40-50 years

MODIFICATION: None known or evident

LANDFORM

BEDROCK: Granite GEOLOGICAL SURFACE: (Wi) Pmg

UNIT: Granite Exposure ELEMENT: Soil sheets on exposure

SOIL

GROUP: Granitic Soils NORTHCOTE: Ucl.13

MAIN ORIGIN: Colluvial DRAINAGE: Variable

PROFILE ATTRIBUTE: Skeletal SURFACE: Hardsetting

ROCK: 20-40% cover, patchy STONE: 5-10% cover, patchy.

PAVEMENT: 5-20% cover of material 3-12 mm long, patchy.
LITTER: Leaves narrow, deposits 2 cm thick, 6-12 m apart under larger shrubs.

SOIL PROFILE
A 0-18 cm Dusky red loamy fine sand; friable; no obvious weathering zone.

COMMENTS
DISTRIBUTION: Scattered from Fraser Range westwards, 0.2-2 ha.
PROFILE THICKNESS: 2-25 cm.
GENERAL:
(a) Vegetation was strongly clumped with large shrubs on thicker soils, and annuals on shallow soils.
(b) Wetter areas receiving much of the exposure run-off, usually supported some species limited to these areas i.e. *Centrolepis glabra, Heliotropium* sp. (KRN 6982), *Isolepis congrua, Microtis unifolia, Plagiobothrys australasicus* and *Triglochin centrocarpa.*
(c) Species richness (19-72) decreased from south-west to north-east.

(a) HILL, Granite (HG)

TALL SHRUBLAND

Acacia quadrimarginea Tall Shrubland – For description see WZ8 and Comments (a).

(b) HILL, basic granulite (HR).

TALL SHRUBLAND

WZ8 *Acacia quadrimarginea* Tall Shrubland

LOCATION: Binaronca Rock (31° 42′20″S lat., 121° 41′30″E long.)
FAUNA SAMPLED: No DATE: 17-8-1981

VEGETATION MUIR: Si.SBr.SCr.SDr.Ji

Stratum 1: Mallees 2.5-3.1 m, CC = +, clumping none *Eucalyptus oleosa* var. *borealis* (+).

Stratum 2: Shrubs 2.1-3.2 m, CC = 16.5, clumping slight *Acacia quadrimarginea* (8), *Eremophila alternifolia* (6), *A. acuminata* (2), *Melaleuca elliptica* (0.5), *A.* sp. (KRN 8572) (+), *Alyogyne hakeifolia* (+), *Pittosporum phylliraeoides* (+).

Stratum 3: Shrubs 1.6-2.0 m, CC = 0.1, clumping none *Santalum spicatum* (0.1).

Stratum 4: Shrubs 1.1-1.5 m, CC = 2.4, clumping slight *Beyeria lechenaultii* (2), *Scaevola spinescens* (0.2), *Alyxia buxifolia* (0.1), *Pimelea microcephala* (0.1).

Stratum 5: Shrubs 0.6-1.0 m, CC = 6.6, clumping slight *Dodonaea adenophora* (3), *Prostanthera wilkieana* (2), *Dampiera trigona* var. *latealata* (1), *Eremophila serrulata* (0.4), *Cassia nemophila* var. *nemophila* (0.2), *C. artemisioides* (+).

Stratum 6a: Shrubs 0.0-0.6 m, CC = 7.2, clumping slight *Ptilotus obovatus* var. *obovatus* (6), *Sclerolaena obliquicuspis* (0.5), *Helichrysum ambiguum* (0.3), *Enchylaena tomentosa* (0.1), *Pimelea thesioides* (0.1), *Sida calyxhymenia* (0.1), *Solanum lasiophyllum* (0.1), *Euphorbia tannensis* var. *eremophila* (+).

Stratum 6b: Misc. plants, CC = 6.4, clumping slight. Annuals: *Actinobole uliginosum* (1), *Chthonocephalus pseudevax* (1), *Calandrinia polyandra* (0.5), *Blennospora drummondii* (0.5), *Crassula exserta* (0.5), *Helipterum hyalospermum* (0.5), *Senecio glossanthus* (0.5), *Daucus glochidiatus* (0.2), *Helipterum roseum* (0.2), *Erodium crinitum* (0.1), **E. cicutarium* (0.1), *Helipterum demissum* (0.1), *H. laeve* (0.1), *H. strictum* (0.1), *Isoetopsis graminifolia* (0.1), *Parietaria debilis* (0.1), *Plantago debilis* (0.1), *Pterostylis nana* (0.1), *Waitzia acuminata* (0.1), **Anagallis arvenis* (+), *Nicotiana rotundifolia* (+), *Trachymene cyanopetala* (+).
Climbers: *Leichardtia australis* (+).
Ferns: *Cheilanthes lasiophylla* (0.1), *Ophioglossum lusitanicum* (0.1), *Pleurosorus rutifolius* (0.1), *C. tenuifolia* (+).
Perennial grasses: *Stipa elegantissima* (+), *S. trichophylla* (+).
Sedge-like: *Dianella revoluta* (+).

No. of TAXA: 57 LAST BURNT: 40-50 years
MODIFICATION: None known or evident
LANDFORM
BEDROCK: Basic Granulite GEOLOGICAL SURFACE: (Wi) Plw
UNIT: Hill ELEMENT: Slopes and summit
SOIL
GROUP: Granitic Soils NORTHCOTE: Uc4.13
MAIN ORIGIN: *In situ* weathering DRAINAGE: Excessive
PROFILE ATTRIBUTE: Skeletal SURFACE: Hardsetting
ROCK: 5-10% cover, even.
STONE: 20-30% cover of angular basic granulites 20-100 cm long, even.
PAVEMENT: 2-30% cover of assorted material 2-6 mm long, even.
LITTER: Branches few; leaves narrow, deposits 3 cm thick, 4-7 m apart.

SOIL PROFILE
A 0-14 cm "Dark greyish brown" loamy sand, friable, 5-10% subangular quartz sand 2-3 mm long; no obvious weathering zone.

COMMENTS
DISTRIBUTION: Rare, restricted to western sector, 2-10 ha
PROFILE THICKNESS: 5-35 cm
GENERAL:
(a) Also occurs on Granitic Soils on the slopes of a granite hill, Eryinia Hill (Pmg). Stratum 1: *Eucalyptus petraea* (1, 4 m high) replaced *E. oleosa* var. *borealis*. Stratum 2: *Acacia quadrimarginea* CC reduced to 5, only other major shrub *A. tetragonophylla* (1). Stratum 3: *Dodonaea lobulata* (1) and *Eremophila clarkei sens. lat.* (1) replace other spp. Stratum 4: *Melaleuca fulgens* (1) replaced other spp. Stratum 5: Almost absent. Stratum 6a: *Ptilotus obovatus* var. *obovatus* (3) replaced other major spp. Stratum 6b: Important additional annuals were *Gnephosis burkittii* (3), *Helipterum battii* (1) and *Toxanthes perpusillus* (1).
(b) Found on one area, too small (0.2 ha) to map geologically, on a low ridge on Undulating Plain (greenstone). Fewer species were present (24). Main species differences were: Stratum 1: *Eucalyptus websteriana* (3); Stratum 2: *Acacia quadrimarginea* (6), *A. tetragonophylla* (2); Stratum 3: absent; Stratum 4: *Scaevola spinescens* (1); Stratum 5: absent; Stratum 6b of few annuals dominated by *Podolepis capillaris* (1) and *P. lessonii* (1).
(c) Larger areas tend to have higher species richness than small areas. Species richness varied from 24 to 73.

(c) HILL, quartzite (HS)

TALL SHRUBLAND

WZ9 *Baeckea* sp. (KRN 7010) Tall Shrubland

LOCATION: Woodline Hills (31° 47'30"S lat., 122° 24'40"E long.)
FAUNA SAMPLED: No DATE: 11-8-1980

VEGETATION MUIR: Si.SAc

Stratum 1: Mallees 3-4 m, CC = 0.2, clumping strong *Eucalyptus websteriana* (0.2).

Stratum 2: Shrubs 2.1-2.7 m, CC = 14.6, clumping slight *Allocasuarina campestris* ssp. *grossa* (5), *Melaleuca uncinata* (5), *Acacia quadrimarginea* (2), *Allocasuarina helmsii* (2), *Acacia acuminata* (0.2), *Trymalium* aff. *ledifolium* (0.2), *Melaleuca fulgens* (0.1), *Alyxia buxifolia* (+), *Grevillea nematophylla* (a form) (+), *Melaleuca* aff. *pauperiflora* (+).

Stratum 3: Shrubs 1.6-2.0 m, CC = 35, clumping slight *Baeckea* sp. (KRN 7010) (35).

Stratum 4: Shrubs 1.1-1.5 m, CC = 1, clumping none *Grevillea* sp. (KRN 6905) (1).

Stratum 5: Shrubs 0.6-1.0 m, CC = 0.3, clumping none *Cryptandra pungens* (0.2), *Prostanthera aspalathoides* (0.1), *Calothamnus gilesii* (+), *Dodonaea stenozyga* (+), *Mirbelia microphylla* (+).

Stratum 6a: Shrubs 0.0-0.5 m, CC = +, clumping none *Pimelea thesiodes* (+).

Stratum 6b: Misc. plants, CC = 1.3, clumping slight. Annuals: *Caladenia filamentosa* var. *denticulosa* (0.1), *Drosera macrantha* ssp. *macrantha* (0.1), *Helipterum laeve* (0.1), * *Pentachistis airoides* (0.1), *Pterostylis nana* (0.1), *Senecio glossanthus* (+), *Thysanotus patersonii* ssp. *patersonii* (+); 4 other spp.
Sedges: *Lepidosperma brunonianum* (0.5).
Sedge-like: *Dianella revoluta* (0.1).

No. of TAXA: 32 LAST BURNT: 40-50 years

MODIFICATION: None known or evident

LANDFORM

BEDROCK: Quartzite GEOLOGICAL SURFACE: (Wi) Puw
UNIT: Hill ELEMENT: Slopes and crest

SOIL

GROUP: Gritty Sands NORTHCOTE: Uc1.2
MAIN ORIGIN: *In situ* weathering DRAINAGE: Excessive
PROFILE ATTRIBUTE: Stony SURFACE: Crusting
ROCK: 0-5% cover, patchy.
STONE: 0-5% cover of angular quartzite 8-20 cm long, patchy.
PAVEMENT: 5-20% cover of material 6-20 mm long, even.
LITTER: Leaves terete, deposits 1 cm thick, 3-6 m apart.

SOIL PROFILE

A 0-6 cm Light grey coarse sand; loose; 30-40% of angular quartzite 1-3 cm long.

COMMENTS

DISTRIBUTION: Rare, restricted to central sector, *ca* 5,000 ha
PROFILE THICKNESS: 5-10 cm
GENERAL: Exposed bedrock had many fissures along bedding planes. Fissures and cracks were probably present under the skeletal soil and penetrated by roots.

SALT LAKE FEATURES (L)

LOW WOODLAND

WZ10 *Callitris columellaris* Low Woodland

LOCATION: 53 km E. of Widgiemooltha (31° 33'30"S lat., 122° 08'10"E long.)
FAUNA SAMPLED: No DATE: 16-8-1981

VEGETATION MUIR: LAi.SAi.SDr.Jr

Stratum 1: Trees 5-6 m, CC = 12, clumping moderate *Callitris columellaris* (12).
Stratum 2: Shrubs 2.1-2.3 m, CC = +, clumping none *Acacia ligulata* (+).
Stratum 3: Shrubs 1.6-2.0 m, CC = 25.3, clumping moderate *Melaleuca uncinata* (25), *Dodonaea angustissima* (0.2), *A. gilesii* (+), *A. tetragonophylla* (+), *Jacksonia* sp. (KRN 5879) (+).
Stratum 4: Shrubs 1.1-1.5 m, CC = +, clumping none *Grevillea acuaria* (+).
Stratum 5: Shrubs 0.6-1.0 m, CC = 0.2, clumping slight *Rhagodia drummondii* (0.2).
Stratum 6a: Shrubs 0.0-0.5 m, CC = 5.2, clumping slight *Gunniopsis quadrifida* (2), *Atriplex* sp. (KRN 6110) (2), *Disphyma clavellatum* (0.5), *Mairaena amoena* (0.5), *A. vesicaria* (+), *Enchylaena tomentosa* (+), *Sclerolaena* aff. *convexula* (+), *S. diacantha* (+).
Stratum 6b: Misc. plants, CC = 4, clumping slight. Annuals: *Calocephalus angianthoides* (2), *Minuria gardneri* (1), *Calandrinia granulifera* (0.5), *Senecio glossanthus* (0.5), *Triglochin centrocarpa* (+), *Stenopetalum robustum* (+).
Perennial grasses: *Stipa elegantissima* (+).

No. of TAXA: 24 LAST BURNT: No evidence of burning
MODIFICATION: Moderately grazed by sheep

LANDFORM
BEDROCK: Unknown GEOLOGICAL SURFACE: (Wi) Qrl
UNIT: Salt Lake Features ELEMENT: Peripheral slope

SOIL
GROUP: Aeolian Sands NORTHCOTE: Uc1.23
MAIN ORIGIN: Aeolian DRAINAGE: Moderate
PROFILE ATTRIBUTE: Summer dampness SURFACE: Loose
ROCK: Nil STONE: Nil PAVEMENT: Nil LITTER: Nil

SOIL PROFILE
A 0-63 cm Red loamy fine sand; loose.
B 63-100 cm Red loamy fine sand; friable; not calcareous; pH 8.0.

COMMENTS
DISTRIBUTION: Scattered, restricted to western sector, 1-4 ha
PROFILE THICKNESS: 60-200 cm

Eucalyptus lesouefii Low Woodland – For description see WZ21 and Comments (d)

WZ11 *Eucalyptus platycorys* Low Woodland

LOCATION: 10.5 km ESE. of Widgiemooltha (31°31'40"S lat., 121°40'20"E long.)
FAUNA SAMPLED: No DATE: 17-8-1981

VEGETATION MUIR: LAi.Sr.SAr.SBr.SCr.Hi.VTi

Stratum 1: Trees 5-6 m, CC = 24, clumping none *Eucalyptus platycorys* (12), *E. foecunda* (12).

Stratum 2: Shrubs 2.1-3 m, CC = 5.6, clumping none *Acacia acuminata* (3), *Callitris preissii* ssp. *verrucosa* (2), *Hakea francisiana* (0.5), *Allocasuarina acutivalvis* (+), *Grevillea oncogyne* (+), *Santalum acuminatum* (+).

Stratum 3: Shrubs 1.6-2.0 m, CC = 3.1, clumping none *Eremophila paisleyi* (3), *Acacia eremophila* (0.1), *A. ligulata* (+), *Daviesia benthamii* ssp *benthamii* (+), *Melaleuca eleuterostachya* (+).

Stratum 4: Shrubs 1.1-1.5 m, CC = 2, clumping none *Leptospermum erubescens* (2), *Alyxia buxifolia* (+), *Eremophila ionantha* (+), *E. scoparia* (+).

Stratum 5: Shrubs 0.6-1.0 m, CC = 6.2, clumping none *Prostanthera campbellii* (3), *Bertya cuppressoidea* (2), *Cryptandra* sp. (KRN 8566) (1), *Exocarpos cupressiformis* (0.1), *Grevillea acuaria* (0.1), *Acacia camptoclada* (+), *A. merrallii* (+), *Phebalium filifolium* (+), *Westringia cephalantha* (+).

Stratum 6a: Shrubs 0.0-0.5 m, CC = 1.1, clumping none *Keraudrenia integrifolia* (1), *Westringia rigida* (0.1), *Eremophila decipiens* (+).

Stratum 6b: Misc. plants, CC = 30, clumping none. Annuals: *Menkea australis* (+), *Thysanotus patersonii* ssp. *patersonii* (+).
Perennial grasses: *Triodia scariosa* (15), *Eriachne mucronata* var. *desertorum* (+).
Sedges: *Lepidosperma drummondii* (15).
Sedge-like: *Dianella revoluta* (+).

No. of TAXA: 35 LAST BURNT: 40-50 years
MODIFICATION: None known or evident

LANDFORM
BEDROCK: Unknown GEOLOGICAL SURFACE: (Wi) Qrs
UNIT: Salt Lake Features ELEMENT: Dune peripheral to salt lake

SOIL
GROUP: Aeolian Sands NORTHCOTE: Uc1.23
MAIN ORIGIN: Aeolian DRAINAGE: Good
PROFILE ATTRIBUTE: Loose SURFACE: Loose
ROCK: Nil STONE: Nil PAVEMENT: Nil
LITTER: Leaves narrow, deposits 2 cm thick, averaging 3 m apart under trees and large shrubs.

SOIL PROFILE
A 0-100 cm Dark red loamy sand; loose.

COMMENTS
DISTRIBUTION: Scattered, associated with some salt lakes, 1-10 ha
PROFILE THICKNESS: 0.6-4.0 m.
GENERAL: Species richness (19-35) decreased eastwards as the number of annuals decreased.

TALL SHRUBLAND

WZ12 *Melaleuca* Tall Shrubland

LOCATION: 26 km SE of Karonie (31° 10'20"S lat., 122° 41'00"E long.)
FAUNA SAMPLED: No DATE: 12-8-1981

VEGETATION MUIR: Si.SAi

Stratum 1: Shrubs 2.1-3.5 m, CC = 30.1, clumping slight *Melaleuca* aff. *pauperiflora* (30), *M.* aff. *cuticularis* (0.1).

Stratum 2: Shrubs 1.6-2.0 m, CC = 30, clumping slight *Melaleuca uncinata* (30).

Stratum 3a: Shrubs 0.0-0.5 m, CC = 0.2, clumping none *Grevillea acuaria* (0.1), *Olearia muelleri* (+), *Sclerolaena diacantha* (+).

Stratum 3b: Misc. plants, CC = 0.2, clumping slight. Annuals: *Helichrysum tepperi* (+), *Isoetopsis graminifolia* (+), *Senecio lautus* ssp. *dissectifolius* (+); 3 other spp.

No. of TAXA: 12 LAST BURNT: 40-50 years

MODIFICATION: None known or evident

LANDFORM

BEDROCK: Unknown GEOLOGICAL SURFACE: (Wi) Qrs
UNIT: Salt Lake Features ELEMENT: Non-saline flat

SOIL

GROUP: Alluvium NORTHCOTE: Uf4.2
MAIN ORIGIN: Alluvial DRAINAGE: Poor
PROFILE ATTRIBUTE: Water-logging SURFACE: Crusting
ROCK: Nil STONE: Nil PAVEMENT: Nil
LITTER: Branches few; leaves narrow, deposits 2 cm thick, 25-35 m apart.

SOIL PROFILE

A 0-100 cm Grades from (a) the surface 20 cm to (b) the lower 15 cm as follows:
(a) Dark red clay loam; firm.
(b) Red light clay; very firm.

COMMENTS

DISTRIBUTION: Rare, restricted to northern sector, 0.1-1 ha
PROFILE THICKNESS: >1 m
GENERAL: Also recorded on Calcareous Plain while mapping the vegetation of the Woodline survey area (Figure 4.) but not seen during field traverses.

WZ13 *Myoporum platycarpum* Tall Shrubland

LOCATION: 11 km NNE. of Buningonia Spring (31° 20′30″S lat., 123° 37′20″E long.)
FAUNA SAMPLED: Yes DATE: 14-8-1980

VEGETATION MUIR: Sr.SCi.SDr.Hr.Jr

Stratum 1: Shrubs 4-8 m, CC = 2.5, clumping none *Myoporum platycarpum* (2), *Dodonaea angustissima* (0.5).

Stratum 2: Shrubs 1.1-1.5 m, CC = +, clumping none *Atriplex nummularia* (+).

Stratum 3: Shrubs 0.6-1.0 m, CC = 14, clumping moderate *Cratystylis subspinescens* (10), *Maireana pyramidata* (2), *Rhagodia crassifolia* (2).

Stratum 4a: Shrubs 0.0-0.5 m, CC = 2, clumping slight *Atriplex vesicaria* (a form) (2), *Chenopodium curvispicatum* (+), *Sclerolaena eurotioides* (+).

Stratum 4b: Misc. plants, CC = 14, clumping moderate. Annuals: *Tetragonia eremaea* (1), *Calandrinia polyandra* (0.5), *Chrysocoryne pusilla* (0.1), *Erodium crinitum* (0.1), *Senecio lautus* ssp. *dissectifolius* (0.1), *Brachycome lineariloba* (+), *Helipterum tenellum* (+), *Triglochin centrocarpa* (+), *Wurmbea tenella* (+), *Zygophyllum aurantiacum* (+); 6 other spp.
Perennial grasses: *Triodia scariosa* (10), *Tripogon loliiformis* (0.1).

No. of TAXA: 27 LAST BURNT: >40 years

MODIFICATION: Possibly grazed by sheep prior to *ca* 1944, but not evident; now grazed occasionally by few nomadic camels

LANDFORM
BEDROCK: Unknown GEOLOGICAL SURFACE: (Za) Qre
UNIT: Salt Lake Features ELEMENT: Aeolian flat

SOIL
GROUP: Aeolian Sands NORTHCOTE: Uc4.22
MAIN ORIGIN: Aeolian DRAINAGE: Mainly good
PROFILE ATTRIBUTE: Loose SURFACE: Loose
ROCK: Nil STONE: Nil PAVEMENT: Nil
LITTER: Leaves narrow, deposits 1 cm thick, 10-40 m apart.

SOIL PROFILE
A 0-100 cm Dark red loamy fine sand; loose.

COMMENTS
DISTRIBUTION: Commonly associated with large salt lake systems, 2-50 ha
PROFILE THICKNESS: 2-4 m
GENERAL:
(a) Some areas around Lake Cowan were without *Triodia scariosa* but had *Maireana sedifolia* 0.6 m high and CC = 15.
(b) Species richness varied from 27 to 33.

LOW SHRUBLAND

WZ14 *Atriplex vesicaria* Low Shrubland

LOCATION: 19 km SSW. of Karonie (31° 07'10"S lat., 122° 25'50"E long.)
FAUNA SAMPLED: No DATE: 13-8-1981

VEGETATION MUIR: SDc.Jr

Stratum 1a: Shrubs 0.0-0.5 m, CC = 27.7, clumping slight *Atriplex vesicaria* (15), *Disphyma clavellatum* (5), *Halosarcia pruinosa* (5), *Frankenia cinerea* (2), *Maireana glomerifolia* (0.5), *Frankenia* sp. (KRN 6592) (0.1), *A.* sp. (KRN 6110) (+), *H. undulata* (+), *Maireana brevifolia* (+), *Sclerolaena diacantha* (+), *S. eurotioides* (+).

Stratum 1b: Misc. plants, CC = 4.2, clumping slight. Annuals: *Erodium crinitum* (2), *Plantago debilis* (2), *Senecio glossanthus* (0.1), *S. lautus* ssp. *dissectifolius* (0.1).

No. of TAXA: 15 LAST BURNT: Unsuited for burning
MODIFICATION: None known or evident

LANDFORM
BEDROCK: Unknown GEOLOGICAL SURFACE: (Wi) Qrl
UNIT: Salt Lake Features ELEMENT: Peripheral raised flat

SOIL
GROUP: Aeolian Loams NORTHCOTE: Gn2.12
MAIN ORIGIN: Aeolian DRAINAGE: Good
PROFILE ATTRIBUTE: Sub-saline SURFACE: Crusting
ROCK: Nil STONE: Nil PAVEMENT: Nil LITTER: Nil

SOIL PROFILE
A 0-48 cm Red loamy fine sand; friable; not calcareous; pH 8.0.
B 48-100 cm Dark red clay loam; firm; not calcareous; pH 8.0.

COMMENTS
DISTRIBUTION: Common to scattered around larger salt lakes, 1-10 ha
PROFILE THICKNESS: 120-300 cm
GENERAL:
(a) Close to the Study Area's eastern boundary, on the Calcareous Plain (Za) Qpe, a similar vegetation occurred in occasional depressions on the plain now filled with colluvium. Main vegetation difference was the absence of *Halosarcia pruinosa* and *Frankenia* spp.
(b) A similar vegetation occurred on the same landform unit but on geological surface (Za) Qpv and on Deep Calcareous Earths.
(c) On the Undulating Plains (greenstone) it occurred on colluvial flats close to the salt lakes, on (Wi) Qra and Sub-saline Soils.
(d) Species richness varied from 9 to 15.

WZ15 *Cratystylis subspinescens* Shrubland

LOCATION: 14 km NNW. of Buningonia Spring (31° 19'S lat., 123° 29'E long.)
FAUNA SAMPLED: No DATE: 17-8-1980

VEGETATION MUIR: SCi.SDr

Stratum 1: Shrubs 2.1-6 m, CC = 0.4, clumping none *Myoporum platycarpum* (0.2), *Hakea kippistiana* (0.1), *Dodonaea angustissima* (+), *Santalum acuminatum* (+).

Stratum 2: Shrubs 0.6-1.0 m, CC = 12.5, clumping none *Cratystylis subspinescens* (12), *Eremophila decipiens* (0.5).

Stratum 3a: Shrubs 0.0-0.5 m, CC = 6.4, clumping none *Sclerolaena diacantha* (2), *Rhagodia drummondii* (2), *Atriplex vesicaria* (a form) (1), *Disphyma clavellatum* (1), *Maireana amoena* (0.2), *Frankenia cinerea* (0.1), *M. appressa* (+), *M. radiata* (+), *Sclerolaena eurotioides* (+).

Stratum 3b: Misc. plants, CC = 1, clumping slight. Annuals: *Brachycome pusilla* (0.2), *B. iberidifolia* (0.1), *Calandrinia polyandra* (0.1), *Crassula exserta* (0.1), *Podolepis capillaris* (0.1), *Chrysocoryne pusilla* (+), *Senecio glossanthus* (+), *S. lautus* ssp. *dissectifolius* (+), *Zygophyllum* aff. *fruticulosum* (+); 4 other spp.

No. of TAXA: 29 LAST BURNT: No evidence of burning.
MODIFICATION: None know or evident

LANDFORM
BEDROCK: Unknown GEOLOGICAL SURFACE: (Za) Qre
UNIT: Salt Lake Features ELEMENT: Damp flat

SOIL
GROUP: Sub-saline Soils NORTHCOTE: Gn2.12
MAIN ORIGIN: Aeolian DRAINAGE: Poor
PROFILE ATTRIBUTE: Waterlogging SURFACE: Crusting
ROCK: Nil STONE: Nil PAVEMENT: Nil LITTER: Nil

SOIL PROFILE
A 0-8 cm Dark red loamy fine sand; friable.
B 8-100 cm Red sandy clay loam; firm; slightly calcareous; pH 8.0.

COMMENTS
DISTRIBUTION: Northern sector, scattered on larger flats associated with salt lake systems, 0.2-1.0 ha.
PROFILE THICKNESS: >1 m

WZ16 *Halosarcia* Low Shrubland

LOCATION: 25 km ESE. of Sinclair Soak (31° 52'00"S lat., 122° 27'20"E long.)
FAUNA SAMPLED: Yes DATE: 6-8-1980

VEGETATION MUIR: SDi.Jr

Stratum 1: Shrubs 1.6-2.0 m, CC = +, clumping none *Lycium australe* (+).

Stratum 2a: Shrubs 0.0-0.5 m, CC = 21, clumping slight *Maireana glomerifolia* (20), *Halosarcia syncarpa* (7), *Atriplex* sp. (KRN 6110) (2), *Disphyma clavellatum* (1), *H. peltata* (1), *M. amoena* (0.1), *Sclerolaena eurotioides* (0.1), *H. doleiformis* (+).

Stratum 2b: Misc. plants, CC = 3, clumping slight. Annuals: *Brachycome lineariloba* (0.2), *Atriplex spongiosa* (0.1) *Menkea australis* (0.1), *Senecio glossanthus* (0.1), *S. lautus* ssp. *dissectifolius* (0.1), *Eriochiton sclerolaenoides* (+), *Isoetopsis graminifolia* (+), *Stenopetalum filifolium* (+); 7 other spp.

No. of TAXA: 24 LAST BURNT: No evidence of burning
MODIFICATION: None known or evident

LANDFORM
BEDROCK: Unknown GEOLOGICAL SURFACE: (Wi) Qrl
UNIT: Salt Lake Features ELEMENT: Lake margin

SOIL
GROUP: Saline Soils NORTHCOTE: Gn2.13
MAIN ORIGIN: Alluvial DRAINAGE: Waterlogged to damp
PROFILE ATTRIBUTE: Saline SURFACE: Crusting
ROCK: Nil STONE: Nil PAVEMENT: Nil LITTER: Nil

SOIL PROFILE
A 0-5 cm Yellowish red fine sandy loam; friable; not calcareous; pH 8.25.
B 5-53 cm Yellowish red fine sandy clay loam; clay content increasing with depth; firm; not calcareous; pH 8.0; water table at 50 cm.

COMMENTS
DISTRIBUTION: Common around salt lakes and salinas
PROFILE THICKNESS: Minimum recorded was 30 cm over greenstone. Maximum thickness was unknown but in Lake Cowan, just south of the Study Area, quartz bedrock was encountered at 115 m (Doepel 1973).
GENERAL:
(a) *Halosarcia* spp. CC = up to 30.
(b) The greatest number of *Halosarcia* spp. recorded at one site was 6, 4 km SE. of Widgiemooltha.
(c) *Frankenia* spp. was often present with CC = <2.
(d) Species richness varied from 7 to 25.

COMPLEX
WZ17 Dune Complex
LOCATION: 26 km SE. of Karonie (31° 10'20"S lat., 122° 41'20"E long.)
FAUNA SAMPLED: No DATE: 12-8-1981
VEGETATION MUIR: KSr.Hr

Stratum 1: Mallees 4-6 m, CC = 2, clumping none *Eucalyptus gracilis* (2).
Stratum 2: Shrubs 2.1-3.5 m, CC = 6, clumping slight *Melaleuca uncinata* (4), *M.* aff. *pauperiflora* (2), *Santalum acuminatum* (+).
Stratum 3: Shrubs 1.1-1.5 m, CC = 0.1, clumping none *Alyxia buxifolia* (0.1), *Acacia colletioides* (+).
Stratum 4: Shrubs 0.6-1.0 m, CC = 2, clumping none *Darwinia diosmoides* (1), *Acacia hemiteles* (0.5), *Exocarpos aphyllus* (0.1) *Scaevola spinescens* (0.1), *Grevillea acuaria* (+), *Myoporum desertii* (+).
Stratum 5a: Shrubs 0.0-0.5 m, CC = +, clumping none *Cratystylis conocephala* (+), *Sclerolaena diacantha* (+).
Stratum 5b: Misc. plants, CC = 5.2, clumping slight. Annuals: *Zygophyllum aurantiacum* (0.2), *Podolepis cappilaris* (+); see comments.
Perennial grasses: *Triodia scariosa* (4), *Stipa eremophila* (1).
Sedge-like: *Lomandra effusa* (+).

No. of TAXA: 19 LAST BURNT: Vegetation too sparse to burn
MODIFICATION: None known or evident
LANDFORM
BEDROCK: Unknown GEOLOGICAL SURFACE: (Wi) Qrs
UNIT: Salt Lake Features ELEMENT: Dune peripheral to salt lake
SOIL
GROUP: Aeolian Sands NORTHCOTE: Uc4.22
MAIN ORIGIN: Aeolian DRAINAGE: Good
PROFILE ATTRIBUTE: Loose SURFACE: Crusting
ROCK: Nil STONE: Nil PAVEMENT: Nil
LITTER: Leaves terete, deposits 2 cm thick, 10-25 m apart.
SOIL PROFILE
A 0-6 cm Dusky red fine sandy loam; loose.
B21 6-63 cm Dusky red fine sandy loam; very friable.
B 63-100 cm Dark red clay loam; friable.
COMMENTS
DISTRIBUTION: General, associated with most salt lakes, 1-10 ha
PROFILE THICKNESS: 1-3 m
GENERAL: Seedlings of 4 or 5 annuals were sighted but they were too immature for identification. When mature their CC would be expected to be less than 2%.

CALCAREOUS PLAIN (P)

WOODLAND

WZ18 *Eucalyptus salmonophloia* Woodland

LOCATION: 23 km SE. of Sinclair Soak (31° 54'40"S lat., 122° 24'40"E long.)
FAUNA SAMPLED: Yes DATE: 12-8-1980

VEGETATION MUIR: Mr.DSi.Jr

Stratum 1: Trees 16-20 m, CC = 5, clumping slight *Eucalyptus salmonophloia* (5).

Stratum 2: Shrubs 2.1-2.6 m, CC = 0.2, clumping moderate *Pittosporum phylliraeoides* (0.2), *Acacia acuminata* (+), *A. jennerae* (+), *Santalum spicatum* (+).

Stratum 3: Shrubs 1.6-2.0 m, CC = +, clumping none *Exocarpos aphyllus* (+), *Pimelea microcephala* (+).

Stratum 4: Shrubs 1.1-1.5 m, C = 1.1, clumping none *Eremophila decipiens* (1), *Atriplex nummularia* (+).

Stratum 5: Shrubs 0.6-1.0 m, CC = 0.5, clumping slight *Cassia nemophila* var. *nemophila* (0.5), *Cratystylis conocephala* (+), *Olearia revoluta* (+).

Stratum 6a: Shrubs 0.0-0.5 m, CC = 25, clumping slight *Scaevola spinescens* (15), *Atriplex vesicaria* (4), *Rhagodia drummondii* (3), *Enchylaena tomentosa* (1), *Ptilotus obovatus* var. *obovatus* (1), *Sclerolaena diacantha* (1), *Olearia muelleri* (0.2), *Sarcozona praecox* (0.1), *Maireana pentatropis* (+), *M. triptera* (+), *Solanum nummularium* (+).

Stratum 6b: Misc. plants, CC = 3, clumping moderate. Annuals: *Calotis hispidula* (1), *Senecio glossanthus* (0.5), *Crassula exserta* (0.2), *Helipterum strictum* (0.2), *Actinobole uliginosum* (0.1), *Bulbine semibarbata* (0.1), *Calandrinia polyandra* (0.1), *Erodium cygnorum* (0.1), *Helipterum pygmaeum* (0.1), *Triglochin calcitrapa* (0.1), *Erodium crinitum* (+), *Helichrysum tepperi* (+), *Isoetopsis graminifolia* (+), *Plantago debilis* (+); 5 other spp.

No. of TAXA: 42 LAST BURNT: 80-100 years
MODIFICATION: Partially cut over 1952-54

LANDFORM
BEDROCK: Unknown GEOLOGICAL SURFACE: (Wi) Qps
UNIT: Calcareous Plain ELEMENT: Colluvial flat

SOIL
GROUP: Deep Calcareous Earths NORTHCOTE: Gn2.16
MAIN ORIGIN: Colluvial DRAINAGE: Good
PROFILE ATTRIBUTE: Calcareous SURFACE: Crusting
ROCK: Nil STONE: Nil PAVEMENT: Nil
LITTER: Logs few; branches few; leaves broad, deposits 3 cm thick, 25-35 m apart, under trees.

SOIL PROFILE
A 0-46 cm Dark reddish brown sandy loam; friable.
B 46-100 cm Dark reddish brown sandy clay loam; firm; 3-5% carbonate nodules 5-12 mm diameter; slightly calcareous; pH 8.25.

COMMENTS
DISTRIBUTION: Scattered west of Fraser Range, 2-5 ha
PROFILE THICKNESS: >2 m
GENERAL:
(a) Close to exposures of granite bedrock, *Scaevola spinescens* usually *ca* CC = 5.
(b) Nodules may be absent in B horizon.
(c) In north eastern section on geological surface Qpv, *Maireana sedifolia* (10-12) replaced *Atriplex* spp. as main undershrub species.
(d) On the bottoms of Broad Valleys (geological surface (Wi) Qps) a similar vegetation occurred.

(e) Over greenstone of Undulating Plains (geological surface (Wi) Avu) the A horizon pH was 8.0, or higher; *Scaevola spinescens* rarely present; and *Atriplex* spp. (20).
(f) Species richness varied from 14 to 42.

LOW WOODLAND

WZ19 *Casuarina cristata* ssp. *pauper* Low Woodland

LOCATION: 50 km SSE. of Zanthus (31° 15'30"S lat., 123° 40'40"E long.)
FAUNA SAMPLED: No DATE: 18-8-1980

VEGETATION MUIR: LAi.SAr.SDi

Stratum 1: Trees 6-8 m, CC = 12, clumping none *Casuarina cristata* ssp. *pauper* (12).
Stratum 2: Shrubs 3.5-5.5 m, CC = +, clumping none *Heterodendrum oleifolium* (+).
Stratum 3: Shrubs 2.1-5 m, CC = 0.2, clumping none *Santalum acuminatum* (0.2), *Exocarpos aphyllus* (+).
Stratum 4: Shrubs 1.6-2.0 m, CC = 3, clumping none *Dodonaea lobulata* (2), *Alyxia buxifolia* (1).
Stratum 5: Shrubs 1.1-1.5 m, CC = 1.2, clumping none *Cassia nemophila* var. *nemophila* (1), *Acacia hemiteles* (0.2).
Stratum 6: Shrubs 0.6-1.0 m, CC = 10, clumping slight *Eremophila decipiens* (8), *Rhagodia drummondii* (2), *Acacia nyssophylla* (+), *Chenopodium curvispicatum* (+), *E. ionantha* (+).
Stratum 7a: Shrubs 0.0-0.5 m, CC = 0.6, clumping none *Atriplex vesicaria* (a form) (0.2), *Enchylaena tomentosa* (0.2), *Maireana triptera* (+), *Olearia muelleri* (+), *Scaevola spinescens* (+), *Sclerolaena diacantha* (+).
Stratum 7b: Misc. plants, CC = 0.3, clumping slight. Annuals *Zygophyllum apiculatum* (0.2), *Calandrinia polyandra* (+), *Crassula exserta* (+), *Eriochiton sclerolaenoides* (+).

No. of TAXA: 23 LAST BURNT: *ca* 100 years
MODIFICATION: None known or evident

LANDFORM
BEDROCK: Calcarenite GEOLOGICAL SURFACE: (Za) Qpe
UNIT: Calcareous Plain ELEMENT: Soil type specific

SOIL
GROUP: Deep Calcareous Earths NORTHCOTE: Gc1.22
MAIN ORIGIN: *In situ* weathering DRAINAGE: Good
PROFILE ATTRIBUTE: Calcareous SURFACE: Crusting
ROCK: Nil STONE: Nil
PAVEMENT: 1-20% cover of material 6-20 mm long, patchy.
LITTER: Logs few; branches few.

SOIL PROFILE
A 0-24 cm Dark reddish brown sandy loam; friable; not calcareous; pH 8.0.
B 24-62 cm Red sandy clay loam; friable; 40-60% carbonate nodules 5-25 mm diameter; highly calcareous; pH 8.25.

COMMENTS
DISTRIBUTION: Scattered, restricted to north eastern sector, 5-20 ha
PROFILE THICKNESS: 20-100 cm
GENERAL:
(a) Species richness appeared to be lower on shallow soils over silcrete.
(b) Tree stratum CC = 8-15 and the variation do not appear to be related to any soil or landform factors.

(c) Also occurring on occasional, gentle and lower slopes to salt lakes in north-eastern sector, on geological surface (Za) Qpe. Few shrubs were present and they were dominated by a 0.6-1.0 m high stratum of *Maireana sedifolia* (15).
(d) Occurred on Undulating Plains (greenstone) on geological surface (Wi) Tb on Shallow Calcareous Earths. Only 12 species were recorded. Main species differences were: stratum 2 absent; stratum 3: *Eremophila alternifolia* (2); stratum 4: *Acacia gilesiana* (3); stratum 5 absent; stratum 6: *E. glabra* (2); stratum 7a: *Olearia muelleri* (1); stratum 7b: *Zygophyllum ovatum* (0.1).
(e) Species richness varied from 7 to 23.

WZ20 *Eucalyptus dundasii* Low Woodland

LOCATION: 36 km ESE. of Sinclair Soak (31° 54'00"S lat., 122° 33'10"E long.)
FAUNA SAMPLED: No DATE: 8-8-1980

VEGETATION MUIR: LAi.Si

Stratum 1: Trees 9-13 m, CC = 20, clumping slight *Eucalyptus dundasii* (20).
Stratum 2: Shrubs 2.1-5 m, CC = 25, clumping strong *Melaleuca* aff. *pauperiflora* (25), *Exocarpos aphyllus* (+), *Santalum acuminatum* (+).
Stratum 3: Shrubs 1.1-1.5 m, CC = 0.2, clumping none *Atriplex nummularia* (0.2), *Eremophila scoparia* (+).
Stratum 4: Shrubs 0.6-1.0 m, CC = 1, clumping none *Halgania rigida* (1), *Cratystylis conocephala* (+), *Eremophila ionantha* (+).
Stratum 5a: Shrubs 0.0-0.5 m, CC = 1.1, clumping none *Atriplex vesicaria* (1), *Maireana pentatropis* (+), *Olearia muelleri* (+), *Sclerolaena diacantha* (+); 2 other spp.
Stratum 5b: Misc. plants, CC = 0.2, clumping none. Annuals: *Helichrysum tepperi* (0.1), *Stellaria filiformis* (+), *Senecio glossanthus* (+); 2 other spp.

No. of TAXA: 20 LAST BURNT: 80-100 years
MODIFICATION: None known or evident

LANDFORM
BEDROCK: Unknown GEOLOGICAL SURFACE: (Wi) Tb
UNIT: Calcareous Plain ELEMENT: Soil type specific

SOIL
GROUP: Deep Calcareous Earths NORTHCOTE: Gc1.12
MAIN ORIGIN: *In situ* weathering DRAINAGE: Good
PROFILE ATTRIBUTE: Calcareous SURFACE: Hardsetting
ROCK: Nil STONE: Nil
PAVEMENT: 1-20% cover of material 8-20 mm across, patchy.
LITTER: Logs few; branches few; leaves broad, deposits 2 cm thick and almost continuous under trees; leaves terete, deposits 1 cm thick, averaging 5 m apart under large shrubs.

SOIL PROFILE
A 0-17 cm Very dusky red loam; very friable; highly calcareous; pH 8.0.
B 17-100 cm Light brown clay loam; friable; 1-3% carbonate nodules 1-2 cm diameter; below 65 cm becoming darker in colour and the clay content increasing slightly; highly calcareous; pH 8.25.

COMMENTS
DISTRIBUTION: Scattered, restricted to south-western sector, 1-10 ha
PROFILE THICKNESS: >1.5 m

WZ21 *Eucalyptus lesouefii* Low Woodland

LOCATION: 13 km ESE. of Sinclair Soak (31° 50'50"S lat., 122° 19'40"E long.)
FAUNA SAMPLED: No DATE: 9-8-1980

VEGETATION MUIR: LAr.Si

Stratum 1: Trees 6-7 m, CC = 5, clumping strong *Eucalyptus lesouefii* (5), *E. longicornis* (+).
Stratum 2: Shrubs 3-4.5 m, CC = 30, clumping strong *Melaleuca* aff. *pauperiflora* (30), *Exocarpos aphyllus* (0.2), *Geijera linearifolia* (+).
Stratum 3: Shrubs 1.6-2.0 m, CC = + , clumping none *Eremophila scoparia* (+).
Stratum 4: Shrubs 0.6-1.0 m, CC = 1, clumping none *E. ionantha* (1), *Cassia nemophila* var. *nemophila* (+), *Santalum acuminatum* (+).
Stratum 5a: Shrubs 0.0-0.5 m, CC = 1.2, clumping none *Olearia muelleri* (1), *Zygophyllum glaucum* (0.1), *Acacia inamabilis* (+), *Cratystylis conocephala* (+), *Eremophila decipiens* (+), *Scaevola spinescens* (+).
Stratum 5b: Misc. plants, CC = 0.4, clumping moderate. Annuals: *Asteridea athrixioides* (0.1), *Calandrinia polyandra* (0.1), *Calotis hispidula* (+), *Menkea australis* (+), *Zygophyllum ovatum* (+); 3 other spp.

No. of TAXA: 23 LAST BURNT: No evidence of fire
MODIFICATION: Cut over 1952-56

LANDFORM
BEDROCK: Unknown GEOLOGICAL SURFACE: (Wi) Qps
UNIT: Calcareous Plain ELEMENT: Soil type specific

SOIL
GROUP: Deep Calcareous Earths NORTHCOTE: Uc4.22
MAIN ORIGIN: *In situ* weathering DRAINAGE: Good
PROFILE ATTRIBUTE: Calcareous SURFACE: Crusting
ROCK: Nil STONE: Nil PAVEMENT: Nil
LITTER: Trunks few; branches few; leaves broad, deposits 2 cm thick, 10-20 m apart.

SOIL PROFILE
A 0-57 cm Red sandy loam; friable; highly calcareous; pH 8.5; too dry to auger deeper.

COMMENTS
DISTRIBUTION: Common in western sector, scattered on southern Fraser Range.
PROFILE THICKNESS: >2 m
GENERAL:
(a) Upper stratum CC = 4-12. Almost all areas sighted had been cut over for mining timbers. *Melaleuca* aff. *pauperiflora* CC = 5-35. Many areas had been cut for fence posts.
(b) On the Undulating Plain over greenstone, the vegetation occurred on colluvial flats and low rises ((Wi) Qps) and low eroded ridges ((Wi) Av) on Shallow Calcareous Earths.
(c) On low ridges of Undulating Plain over basic granulite ((Za) Px), the vegetation occurred on Shallow Calcareous Earths.
(d) Around the margin of Lake Cowan were a few small areas with shallow, subsaline sandy loam over greenstone ((Wi) Qrl), which supported *Eucalyptus lesouefii* over *Sclerostegia disarticulata* (10-12).
(e) Species richness varied from 14 to 36.

WZ22 *Eucalyptus longicornis* Low Woodland

LOCATION: 23 km SE. of Sinclair Soak (31° 52'50"S lat., 122° 23'40"E long.)
FAUNA SAMPLED: Yes DATE: 6-8-1980

VEGETATION MUIR: LAr.Si.SAr.SCi

Stratum 1: Trees 6-8 m, CC = 5, clumping slight *Eucalyptus longicornis* (5), *E. dundasii* (+), *E. gracilis* (+).

Stratum 2: Shrubs 2.1-3.5 m, CC = 11, clumping strong *Melaleuca* aff. *pauperiflora* (10), *Santalum acuminatum* (1), *Eremophila pachyphylla* (+).

Stratum 3: Shrubs 1.6-2.0 m, CC = 5.2, clumping slight *Eremophila* sp. (KRN 6930) (5), *E. scoparia* (0.1), *Beyeria brevifolia* (+), *Cassia nemophila* var. *nemophila* (+), *Exocarpos aphyllus* (+).

Stratum 4: Shrubs 0.6-1.0 m, CC = 15%, clumping moderate *Cratystylis conocephala* (15), *Halgania* aff. *rigida* (+).

Stratum 5a: Shrubs 0.0-0.5 m, CC = 0.3, clumping moderate *Olearia muelleri* (0.1), *Scaevola spinescens* (0.1), *Maireana triptera* (+), *Rhagodia drummondii* (+), *Sclerolaena diacantha* (+), *Zygophyllum glaucum* (+).

Stratum 5b: Misc. plants, CC = 1, clumping moderate. Annuals: *Crassula exserta* (+), *Eriochiton sclerolaenoides* (+), *Helipterum pygmaeum* (+), *Menkea australis* (+), *Senecio glossanthus* (+), *Zygophyllum ovatum* (+); 7 other spp.

No. of TAXA: 32 LAST BURNT: 80-100 years
MODIFICATION: Cut over 1952-54

LANDFORM
BEDROCK: Unknown GEOLOGICAL SURFACE: (Wi) Qps
UNIT: Calcareous Plain ELEMENT: Soil type specific

SOIL
GROUP: Deep Calcareous Earths NORTHCOTE: Gc1.12
MAIN ORIGIN: Colluvial DRAINAGE: Good
PROFILE ATTRIBUTE: Calcareous SURFACE: Crusting
ROCK: Nil STONE: Nil PAVEMENT: Nil
LITTER: Logs few; branches few; leaves broad, deposits 2 cm thick under trees, 8-12 m apart; leaves terete, deposits 1 cm thick, 4-7 m apart under large shrubs.

SOIL PROFILE
A 0-20 cm Reddish brown sandy loam; very friable; not calcareous; pH 8.5.
B21 20-63 cm Red sandy clay loam; friable; 20-40% carbonate nodules 5-18 mm in diameter; highly calcareous; pH 8.25.
B22 63-100 cm Red sandy clay loam; mottling brown and white, the proportion of white increasing with depth; highly calcareous; pH 8.75.

COMMENTS
DISTRIBUTION: Widespread in western sector, 2-200 ha.
PROFILE THICKNESS: >2 m
GENERAL:
(a) Only small areas of woodland were seen which appeared not to have been cut over. Upper stratum CC = 5-20 (-30). The densest area sampled appeared to have been burnt *ca* 50 years ago.
(b) *Melaleuca* aff. *pauperiflora* (0-30); cutting for fence posts was evident in some areas.
(c) Occurred on Shallow Calcareous Earths over both silcrete ((Wi) Qpb) and Eocene limestone ((Wi) Tep).
(d) Species richness varied from 11 to 33.

WZ23 *Eucalyptus* (mixed) Low Woodland

LOCATION: 20 km ESE. of Sinclair Soak (31° 51'20"S lat., 122° 24'00"E long.)

FAUNA SAMPLED: Yes DATE: 9-8-1980

VEGETATION MUIR: LAr.Sr.SAr.SDr

Stratum 1: Trees 6-15 m, CC = 8.1, clumping moderate *Eucalyptus lesouefii* (3), *E. salubris* (2), *E. campaspe* (1), *E. longicornis* (1), *E. salmonophloia* (1), *E. flocktoniae* (0.1).

Stratum 2: Mallees 5-7 m, CC = 1, clumping slight *Eucalyptus calycogona* (1).

Stratum 3: Shrubs 2.1-3.6 m, CC = 6.1, clumping slight *Melaleuca* aff. *pauperiflora* (5), *Exocarpos aphyllus* (1), *Acacia enervia* (0.1).

Stratum 4: Shrubs 1.6-2.0 m, CC = 4, clumping moderate *Eremophila scoparia* (3), *Santalum acuminatum* (1), *Daviesia benthamii* ssp *benthamii* (+).

Stratum 5: Shrubs 1.1-1.5 m, CC = 3.5, clumping moderate *Beyeria lechenaultii* (3), *Cassia nemophila* var. *nemophila* (0.5).

Stratum 6: Shrubs 0.6-1.0 m, CC = 0.4, clumping moderate *Eremophila ionantha* (0.2), *E. decipiens* (0.1), *Scaevola spinescens* (0.1), *Cratystylis conocephala* (+).

Stratum 7a: Shrubs 0.0-0.5 m, CC = 9, clumping slight *Eremophila caerulea* (8), *Acacia erinacea* (0.5), *Westringia rigida* (0.2), *Olearia muelleri* (0.1), *Halgania* aff. *rigida* (+), *Zygophyllum glaucum* (+).

Stratum 7b: Misc. plants, CC = 0.8, clumping moderate. Annuals: *Asteridea athrixioides* (0.1), *Helichrysum tepperi* (0.1), *Isoetopsis graminifolia* (0.1), *Menkea australis* (0.1), *Stellaria filiformis* (0.1), *Zygophyllum ovatum* (0.1); *Calandrinia polyandra* (+), *Ptilotus holosericeus* (+), *Senecio quadridentatus* (+).

No. of TAXA: 34 LAST BURNT: More than 75 years

MODIFICATION: Cut over for mining-timber 1955-58

LANDFORM

BEDROCK: Unknown GEOLOGICAL SURFACE: (Wi) Qps

UNIT: Calcareous Plain ELEMENT: Soil specific

SOIL

GROUP: Deep Calcareous Earths NORTHCOTE: Gc1.22

MAIN ORIGIN: *In situ* weathering DRAINAGE: Good

PROFILE ATTRIBUTE: Calcareous SURFACE: Crusting

ROCK: Nil STONE: Nil

PAVEMENT: 5-40% cover of material 3-18 mm long, patchy.

LITTER: Branches few; leaves broad, deposits 3 cm thick, 12-16 m apart.

SOIL PROFILE

A 0-28 cm Red sandy loam; friable; 3-5% of subrounded ferrugineous sandstone 3-12 mm across; not calcareous; pH 8.25.

B 28-100 cm Red clay loam; firm; clay content increasing with depth; highly calcareous; pH 8.5

COMMENTS

DISTRIBUTION: Scattered in southwestern section; 1.5-10 ha in size.

PROFILE THICKNESS: >2 m

GENERAL: The vegetation consisted of a mosaic of low woodland types which graded into one and other, sometimes intermixed with small areas of mallee. Other *Eucalyptus* species recorded were *E. fraseri, E. celastroides,* and *E.* aff. *conglobata.*

WZ24 Eucalyptus oleosa Low Woodland
LOCATION: Buningonia Spring (31°25'50''S lat., 123°33'20''E long.)
FAUNA SAMPLED: Yes DATE: 19-8-1980
VEGETATION MUIR: LAi.Sr.SCi
Stratum 1: Trees 5-7 m, CC = 16, clumping moderate *Eucalyptus oleosa* (16).
Stratum 2: Shrubs 2.1-3 m, CC = 2, clumping none *Acacia hemiteles* (2), *Heterodendrum oleifolium* (+), *Santalum spicatum* (+).
Stratum 3: Shrubs 1.6-2.0 m, CC = +, clumping none *Exocarpos aphyllus* (+).
Stratum 4: Shrubs 0.6-1.0 m, CC = 11, clumping slight *Rhagodia drummondii* (5), *Cassia nemophila* var. *nemophila* (4), *Eremophila decipiens* (1), *Scaevola spinescens* (1), *Cratystylis conocephala* (+).
Stratum 5a: Shrubs 0.0-0.5 m, CC = 1, clumping none *Olearia muelleri* (1), *Ptilotus obovatus* var. *obovatus* (+).
Stratum 5b: Misc. plants, CC = 0.2, clumping slight. Annuals: *Calandrinia polyandra* (0.1), *Crassula exserta* (+), *Tetragonia eremaea* (+), *Zygophyllum ovatum* (+). Perennial grasses: *Stipa trichophylla* (+).
No. of TAXA: 17 LAST BURNT: 50-70 years
MODIFICATION: Lightly grazed before *ca* 1944
LANDFORM
BEDROCK: Unknown GEOLOGICAL SURFACE: (Za) Qpe
UNIT: Calcareous Plain ELEMENT: Soil type specific
SOIL
GROUP: Deep Calcareous Earths NORTHCOTE: Gn2.16
MAIN ORIGIN: Colluvial DRAINAGE: Good
PROFILE ATTRIBUTE: Calcareous SURFACE: Crusting
ROCK: Nil STONE: Nil PAVEMENT: Nil
LITTER: Branches few; leaves broad, deposits 2 cm thick, 8-12 m apart under trees.
SOIL PROFILE
A 0-27 cm Dusky red fine sandy loam; friable.
B21 27-51 cm Red sandy clay loam; friable; 20-40% carbonate nodules 5-18 mm in diameter; highly calcareous; pH 8.75.
B22 51-100 cm Reddish yellow sandy clay loam (more clay than above); friable; 2-3% carbonate nodules 2-3 mm diameter; highly calcareous; pH 8.75.
COMMENTS
DISTRIBUTION: Widespread in eastern sector, 2-1,000 ha.
PROFILE THICKNESS: >2 m
GENERAL:
(a) Upper stratum CC = 5-16.
(b) on Nullarbor Plain shrubs dominated by *Maireana sedifolia* (10-15, height 0.5 m), and covers extensive areas.
(c) Occurred on (Wi) Qps, and over *Triodia scariosa* (10-12) on Aeolian Sands ((Za) Qrs & Qo) in north-eastern sector. Rarely sighted and 2-5 ha in area.
(d) On low ridges of the Undulating Plain, over basic granulite ((Za) Px), the vegetation occurred on Shallow Calcareous Earths. Shrub layer consisted of stratum 2: *Eremophila dempsteri* (1); stratum 3: absent; stratum 4: *Maireana sedifolia* (6); stratum 5a: *Atriplex vesicaria* (a form) (6), *Sclerolaena diacantha* (4) and *Cratystylis conocephala* (2); stratum 5b: few annuals with small populations.
(e) Species richness varied from 12 to 23.

WZ25 *Eucalyptus salubris* Low Woodland

LOCATION: 24 km ESE. of Sinclair Soak (31° 52'00"S lat., 122° 26'40"E long.)
FAUNA SAMPLED: Yes DATE: 6-8-1980

VEGETATION MUIR: LAr.Si.SDi.Jr

Stratum 1: Trees 6-8 m, CC = 5, clumping none *Eucalyptus salubris* (5).

Stratum 2: Mallees 5-7 m, CC = 1.5, clumping slight *Eucalyptus* sp. (KRN 6959) (1), *E. gracilis* (0.5).

Stratum 3: Shrubs 2.2-4 m, CC = 15.4, clumping strong *Melaleuca* aff. *pauperiflora* (14), *Melaleuca pauperiflora* (1), *Exocarpos aphyllus* (0.2), *Myoporum desertii* (0.1), *Santalum acuminatum* (0.1).

Stratum 4: Shrubs 0.6-1.0 m, CC = 0.2, clumping none *Eremophila decipiens* (0.1), *E. scoparia* (0.1), *Acacia hemiteles* (+), *Geijera linearifolia* (+), *Rhagodia drummondii* (+).

Stratum 5a: Shrubs 0.0-0.5 m, CC = 28, clumping slight *Cratystylis conocephala* (25), *Atriplex vesicaria* (3), *Acacia enervia* (0.1), *Frankenia cinerea* (0.1), *Olearia muelleri* (0.1), *Scaevola spinescens* (+), *Sclerolaena diacantha* (+); 3 other spp.

Stratum 5b: Misc. plants, CC = 2, clumping slight. Annuals: *Zygophyllum ovatum* (0.1), *Plantago debilis* (0.1), *Asteridea athrixiodes* (+), *Calotis hispidula* (+), *Menkea australis* (+); 10 other spp.

No. of TAXA: 38 LAST BURNT: No evidence of burning
MODIFICATION: Cut over 1952-56

LANDFORM
BEDROCK: Unknown GEOLOGICAL SURFACE: (Wi) Qps
UNIT: Calcareous Plain ELEMENT: Colluvial flats

SOIL
GROUP: Deep Calcareous Earths NORTHCOTE: Gc1.12
MAIN ORIGIN: Colluvial DRAINAGE: Good
PROFILE ATTRIBUTE: Calcareous SURFACE: Crusting
ROCK: Nil STONE: Nil
PAVEMENT: 0-5% cover of rounded carbonates 8-20 mm diameter, patchy.
LITTER: Trunks few; branches few; leaves broad, deposits 3 cm thick, 7-12 m apart under trees and mallees; leaves terete, deposits 2 cm thick, 3-10 m apart.

SOIL PROFILE
A 0-23 cm Dark reddish brown sandy loam; friable; highly calcareous; pH 8.0.
B 23-54 cm Yellowish red sandy clay loam; firm; 30-50% carbonate nodules 1-2 cm diameter, increasing in proportion with depth; highly calcareous; pH 8.75.

COMMENTS
DISTRIBUTION: Scattered on the Fraser Range and common to the west.
PROFILE THICKNESS: >2 m
GENERAL:
(a) A horizon was not always calcareous, and sometimes with a higher clay content. *Cratystylis conocephala* cover tended to decrease with pH.
(b) Most western areas had been cut over and grazed; some eastern areas lightly grazed prior to *ca* 1944.
(c) A site on the Fraser Range, on Undulating Plain over basic granulite ((Za) Px), on a narrow colluvial flat, had the shrub layer dominated by *Eremophila* sp. (KRN 8103) 0.4 m high (25).
(d) Near Widgiemooltha, on a slightly saline flat, *Sclerostegia disarticulata* 0.4 m high and (15) was the dominant shrub.
(e) Species richness varied from 22 to 37.

Eucalyptus transcontinentalis Low Woodland – For description see WZ38 and Comments (a).

MALLEE

WZ26 *Eucalyptus cylindrocarpa* Mallee

LOCATION: 11 km E. of Sinclair Soak (31° 48'10"S lat., 122° 19'30"E long.)
FAUNA SAMPLED: Yes DATE: 6-8-1980

VEGETATION MUIR: KSi.Sr.SAr.SDr.Hi

Stratum 1: Trees 4-7 m, CC = 12, clumping moderate *Eucalyptus cylindrocarpa* (10), *E. gracilis* (2), *E. salubris* (+).

Stratum 2: Shrubs 2.1-3 m, CC = 5.1, clumping strong *Melaleuca pauperiflora* (5), *Daviesia benthamii* ssp. *benthamii* (0.1), *Eremophila paisleyi sens. lat.* (+).

Stratum 3: Shrubs 1.6-2.0 m, CC = 2, clumping slight *Eremophila scoparia* (2).

Stratum 4: Shrubs 0.6-1.0 m, CC = 1.2, clumping slight *Scaevola bursariifolia* (1), *Exocarpos aphyllus* (0.1), *Bossiaea leptacantha* (0.1).

Stratum 5a: Shrubs 0.0-0.5 m, CC = 2.1, clumping slight *Cratystylis conocephala* (1), *Acacia merrallii* (0.5), *Westringia rigida* (0.5), *Olearia muelleri* (0.1), *Grevillea huegelii* (+).

Stratum 5b: Misc. plants, CC = 20, clumping moderate
Perennial grasses: *Triodia scariosa* (20).

No. of TAXA: 16 LAST BURNT: 60-80 years
MODIFICATION: Cut over 1952-56

LANDFORM
BEDROCK: Unknown GEOLOGICAL SURFACE: (Wi) Qrs
UNIT: Calcareous Plain ELEMENT: Extensive soil sheet

SOIL
GROUP: Aeolian Sands NORTHCOTE: Gc1.12
MAIN ORIGIN: *In situ* weathering DRAINAGE: Good
PROFILE ATTRIBUTE: Calcareous SURFACE: Crusting
ROCK: Nil STONE: Nil
PAVEMENT: 1-5% cover of material 3-7 mm diameter, patchy.
LITTER: Branches few; leaves broad, deposits 2 cm thick, 6-10 m apart under mallees

SOIL PROFILE
A 0-22 cm Red fine sandy loam; loose; slightly calcareous; pH 8.0.
B 22-54 cm Brownish red clay loam; friable; 20-40% carbonate nodules 6-13 mm diameter; highly calcareous; pH 8.5.
C 54-100 cm Brown and white mottled clay loam; firm; slightly calcareous; pH 8.25.

COMMENTS
DISTRIBUTION: Scattered in central sector, 5-25 ha.
PROFILE THICKNESS: >2 m
GENERAL:
(a) The A horizon consisted primarily of fine sand wind-blown into extensive and thin sheets during a Recent arid period. Pavement consisted of carbonate concretions brought to the surface from the B horizon by fauna burrowings etc.
(b) Occurred on ((Za) Qo), and on Broad Valleys ((Wi) Qps) on Deep Calcareous Earths sometimes with a very thin covering of aeolian or colluvial sand.

WZ27 *Eucalyptus gracilis* Mallee

LOCATION: 21 km ESE. of Sinclair Soak (31° 49'40"S lat., 122° 25'30"E long.)
FAUNA SAMPLED: Yes DATE: 11-8-1980

VEGETATION MUIR: KTr.Sr.SCi.VTi

Stratum 1: Mallees 6-9 m, CC = 6, clumping slight *Eucalyptus gracilis* (6).
Stratum 2: Shrubs 3.0-3.7 m, CC = 6, clumping medium *Callitris preissii* ssp. *verrucosa* (6).
Stratum 3: Shrubs 1.1-1.5 m, CC = 0.1, clumping none *Acacia camptoclada* (+), *Grevillea oligantha* (+), *Santalum acuminatum* (+).
Stratum 4: Shrubs 0.6-1.0 m, CC = 14.1, clumping slight *Bertya cupressoidea* (13), *Cryptandra parvifolia* (1), *Grevillea pterosperma* (0.1), *Phebalium tuberculosum* var. *tuberculosum* (+).
Stratum 5a: Shrubs 0.0-0.6 m, CC = 0.2, clumping none *Styphelia intertexta* (0.1), *Westringia rigida* (0.1), Rhamnaceae sp. (KRN 7073) (+).
Stratum 5b: Misc. plants, CC = 12, clumping slight. Annuals: *Menkea australis* (+).
Sedges: *Lepidosperma drummondii* (12).
Sedge-like: *Lomandra effusa* (+).

No. of TAXA: 15 LAST BURNT: >75 years
MODIFICATION: None known or evident

LANDFORM
BEDROCK: Unknown GEOLOGICAL SURFACE: (Wi) Qrs
UNIT: Calcareous Plain ELEMENT: Dune on soil sheet

SOIL
GROUP: Aeolian Sands NORTHCOTE: Uc1.23
MAIN ORIGIN: Aeolian DRAINAGE: Good
PROFILE ATTRIBUTE: Loose SURFACE: Loose
ROCK: Nil STONE: Nil PAVEMENT: Nil
LITTER: Branches few; leaves broad, deposits 3 cm thick, 8-12 m apart; leaves terete, deposits 1 cm thick, 8-12 m apart.

SOIL PROFILE
A 0-100 cm Red loamy fine sand; loose; not calcareous; pH 8.25.

COMMENTS
DISTRIBUTION: Uncommon, section west of Fraser Range, 1-3 ha.
PROFILE THICKNESS: 1-5 m
GENERAL:
(a) Also occurred on wind-blown sheets of fine sand more than 25 cm thick.
(b) Species richness varied from 12 to 16.
(c) CC of *Lepidosperma drummondii* varied from 10-30%. It was absent from the north-eastern sector.

WZ28 *Eucalyptus transcontinentalis* Mallee

LOCATION: 22 km N. of Pioneer Tank (31° 37'00"S lat., 123° 53'30"E long.)
FAUNA SAMPLED: No DATE: 18-8-1980

VEGETATION MUIR: Ksi.Sr.Hi

Stratum 1: Mallees 5-6 m, CC = 15, clumping slight *Eucalyptus transcontinentalis* (15), *E.* sp. (KRN 7169) (+), *Amyema miquelii* parasitic on *E. transcontentalis* (+).
Stratum 2: Shrubs 2.1-2.3 m, CC = 2, clumping slight *Eremophila dempsteri* (2).
Stratum 3: Shrubs 1.1-1.5 m, CC = +, clumping none *Acacia* aff. *eremophila* (+).
Stratum 4: Shrubs 0.6-1.0 m, CC = 1, clumping slight *Dodonaea stenozyga* (1), *Daviesia benthamii* ssp *benthamii* (+).
Stratum 5a: Shrubs 0.0-0.5 m, CC = 0.1, clumping slight *Westringia rigida* (0.1), *Sclerolaena diacantha* (+).
Stratum 5b: Misc. plants, CC = 15, clumping slight. Perennial grasses: *Triodia scariosa* (15).

No. of TAXA: 10 LAST BURNT: 40-50 years
MODIFICATION: None known or evident

LANDFORM
BEDROCK: Calcarenite GEOLOGICAL SURFACE: (Za) Qe
UNIT: Calcareous Plain ELEMENT: Lithified limestone dunes

SOIL
GROUP: Shallow Calcareous Earths NORTHCOTE: Uc4.13
MAIN ORIGIN: Aeolian DRAINAGE: Good
PROFILE ATTRIBUTE: Shallow SURFACE: Loose
ROCK: Nil STONE: Nil PAVEMENT: Nil
LITTER: Leaves broad, deposits 2 cm thick, 20-30 m apart.

SOIL PROFILE
A 0-9 cm Dark reddish brown fine sand; loose; not calcareous; pH 8.0; no obvious weathering zone.

COMMENTS
DISTRIBUTION: A single occurrence recorded on eastern boundary, at least 20 ha.
PROFILE THICKNESS: 5-20 m
GENERAL:
(a) This site, although 5 km east of the Study Area, was recorded because the geological surface occurred within the Study Area. The vegetation type was not sighted within the Study Area but access is very limited in this general area.
(b) The dunes were formed sometime after the Nullarbor Plain was laid down, lithified, and the present skeletal covering of soil was being formed by *in situ* weathering.

TALL SHRUBLAND

WZ29 *Dodonaea lobulata* Tall Shrubland

LOCATION: 0.6 km S. of Uraryie Rock (31° 11'40"S lat., 123° 25'40"E long.)
FAUNA SAMPLED: No DATE: 15-8-1980

VEGETATION MUIR: Sr.SAi.SCr

Stratum 1: Trees 5-6 m, CC = 0.5, clumping none *Myoporum platycarpum* (1).
Stratum 2: Shrubs 2.1-3 m, CC = 1, clumping none *Acacia acuminata* (1), *Santalum spicatum* (+).
Stratum 3: Shrubs 1.6-2.0 m, CC = 15, clumping slight *Dodonaea lobulata* (15).
Stratum 4: Shrubs 0.6-1.0 m, CC = 2.3, clumping slight *Maireana sedifolia* (2), *Eremophila alternifolia (0.2), Rhagodia drummondii* (0.1), *Cassia artemisioides* (+), *Scaevola spinescens* (+).

Stratum 5a: Shrubs 0.0-0.5 m, CC = 0.5, clumping slight *Ptilotus obovatus* var. *obovatus* (0.1), *Sida* sp. (KRN 6968) (0.1), *Enchylaena tomentosa* (+), *Sclerolaena diacantha* (+), *S. obliquicuspis* (+), *Solanum lasiophyllum* (+); 3 other spp.

Stratum 5b: Misc. plants, CC = 1, clumping slight. Annuals: *Crassula exserta* (0.2), *Erodium crinitum* (+), *Ptilotus polystachyus* (+), *Zygophyllum ovatum* (+); 4 other spp.

No. of TAXA: 26 LAST BURNT: 40-50 years

MODIFICATION: Lightly grazed by livestock

LANDFORM

BEDROCK: Unknown GEOLOGICAL SURFACE: (Za) Qpc

UNIT: Calcareous Plain ELEMENT: Slight rise

SOIL

GROUP: Deep Calcareous Earths NORTHCOTE: Gc1.22

MAIN ORIGIN: *In situ* weathering DRAINAGE: Good

PROFILE ATTRIBUTE: Calcareous SURFACE: Crusting

ROCK: Nil STONE: Nil PAVEMENT: Nil

LITTER: Leaves narrow, deposits 2 cm thick, 20-35 m apart.

SOIL PROFILE

A 0-72 cm Red sandy loam; friable; highly calcareous; pH 8.0.

B 72-75 cm Dark red sandy clay loam; friable; 30-50% rounded carbonate nodules 5-30 mm diameter; highly calcareous; pH 8.75; too stony to auger deeper.

COMMENTS

DISTRIBUTION: Rare, restricted to north eastern sector, 2 ha

PROFILE THICKNESS: >100 cm

LOW SHRUBLAND

Atriplex vesicaria Low Shrubland – For description see WZ14 and Comments (d).

(a) UNDULATING PLAIN, greenstone (UN).

WOODLAND

Eucalyptus salmonophloia Woodland – For description see WZ18 and Comments (e).

LOW WOODLAND

Casuarina cristata ssp. *pauper* Low Woodland – For description see WZ 19 and Comments (d).

Eucalyptus lesouefii Low Woodland – For description see WZ21 and Comments (c).

WZ30 *Eucalyptus stricklandii* Low Woodland

LOCATION: 4.5 km SSE. of Widgiemooltha (31° 31'30"S lat., 121° 35'40"E long.)
FAUNA SAMPLED: No DATE: 17-8-1981

VEGETATION MUIR: LAr.SAr.SBr.SDr.Jr

Stratum 1: Trees 5-6 m, CC = 6, clumping none *Eucalyptus stricklandii* (4), *E. celastroides* (2).

Stratum 2: Shrubs 2.1-3.5 m, CC = 1.3, clumping none *Eremophila oppositifolia* var. *angustifolia* (1), *Acacia tetragonophylla* (0.2), *Santalum acuminatum* (0.1), *Eremophila saligna* (+), *Melaleuca* aff. *pauperiflora* (+).

Stratum 3: Shrubs 1.6-2.0 m, CC = 2, clumping none *Alyxia buxifolia* (2), *Santalum acuminatum* (+).

Stratum 4: Shrubs 1.1-1.5 m, CC = 3.2, clumping none *Dodonaea lobulata* (2), *Trymalium* aff. *ledifolium* (1), *Eremophila pachyphylla* (0.2), *Atriplex nummularia* (+).

Stratum 5: Shrubs 0.6-1.0 m, CC = 1.6, clumping none *Eremophila glabra* (1), *Grevillea acuaria* (0.2), *Acacia hemiteles* (0.1), *A. nyssophylla* (0.1), *Exocarpos aphyllus* (0.1), *Acacia erinacea* (+), *Cassia artemisioides* (+), *C. nemophila* var. *nemophila* (+), *Rhagodia drummondii* (+).

Stratum 6a: Shrubs 0.0-0.5 m, CC = 6, clumping none *Ptilotus obovatus* var. *obovatus* (2), *Eremophila caerulea* (1), *Scaevola spinescens* (1), *Olearia muelleri* (0.5), *Sclerolaena diacantha* (0.5), *Lepidium platypetalum* (0.5), *Maireana georgei* (0.1), *M. marginata* (0.1), *M. pentatropis* (+), *M. tomentosa* (+), *Ptilotus holosericeus* (+), *Solanum lasiophyllum* (+).

Stratum 6b: Misc. plants, CC = 8.6, clumping none. Annuals: *Helipterum oppositifolium* (3), *Calotis hispidula* (1), *Plantago debilis* (1), *Zygophyllum ovatum* (1), *Stellaris filifolius* (0.5), *Lepidium oxytrichum* (0.2), *Calandrinia polyandra* (0.1), *Crassula exserta* (0.1), *Isoetopsis graminifolia* (0.1), *Senecio glossanthus* (0.1), *Zygophyllum eremaeum* (0.1), *Brachycome iberidifolia* (+), *Eriochiton sclerolaenoides* (+); 2 other spp.
Climbers: *Leichardtia australis* (+).
Ferns: *Cheilanthes* sp. (KRN 7046) (1), *Cheilanthes lasiophylla* (0.1).
Perennial grasses: *Stipa elegantissima* (+).

No. of TAXA: 53 LAST BURNT: No evidence of burning
MODIFICATION: None known or evident

LANDFORM
BEDROCK: Greenstone GEOLOGICAL SURFACE: (Wi) As
UNIT: Undulating Plain ELEMENT: Slopes and crest

SOIL
GROUP: Shallow Calcareous Earths NORTHCOTE: Uf1.33
MAIN ORIGIN: *In situ* weathering DRAINAGE: Excessive
PROFILE ATTRIBUTE: Skeletal SURFACE: Hardsetting
ROCK: 10-15% cover, patchy
STONE: 30-50% cover of angular greenstone 2-15 cm long, even.

PAVEMENT: 5-15% cover of material 6-18 mm long, even.
LITTER: Nil
SOIL PROFILE
A 0-12 cm "Brown" heavy clay, friable to firm, apedal; 20-30% angular inclusions 5-40 mm long; slightly calcareous; pH 8.25; no obvious weathering zone.
COMMENTS
DISTRIBUTION: On a few small greenstone ridges in the Widgiemooltha area
PROFILE THICKNESS: 5-19 cm
GENERAL: Crests of steep ridges supported mainly shrubs e.g. *Dodonaea lobulata, Trymalium* aff. *ledifolium.*

WZ31 *Eucalyptus torquata* Low Woodland
LOCATION: 8.5 km W. of Kambalda West (31° 13'20"S lat., 121° 33'30"E long.)
FAUNA SAMPLED: No DATE: 9-8-1981
VEGETATION MUIR: LAi.Sr.SAr.SBr.SDr

Stratum 1: Trees 6-7 m, CC = 16, clumping slight *Eucalyptus torquata* (15), *E. gracilis* (1).
Stratum 2: Shrubs 2.1-2.4 m, CC = 4.5, clumping slight *Eremophila oppositifolia* var. *angustifolia* (3), *Acacia tetragonophylla* (1), *Santalum spicatum* (0.5).
Stratum 3: Shrubs 1.6-2.0 m, CC = 4.3, clumping slight *Acacia resinomarginea* (3), *Eremophila interstans* (1), *E. clarkei sens. lat.* (0.1), *E. glabra* (0.1), *E. alternifolia* (+), *Santalum spicatum* (+).
Stratum 4: Shrubs 1.1-1.5 m, CC = 2.1, clumping none *Atriplex nummularia* (1), *Dononaea lobulata* (1), *Alyxia buxifolia* (+), *Exocarpos aphyllus* (+), *Rhagodia crassifolia* (a form) (+).
Stratum 5: Shrubs 0.6-1.0 m, CC = 0.8, clumping none *Sida calyxhymenia* (0.5), *Cassia nemophila* var. *nemophila* (0.1), *Scaevola spinescens* (0.1), *Cassia artemisioides* (+), *Radyera farragei* (+), *Rulingia luteiflora* (+).
Stratum 6a: Shrubs 0.0-0.5 m, CC = 3.5, clumping slight *Ptilotus obovatus* var. *obovatus* (3), *Maireana pentatropis* (+), *Sclerolaena diacantha* (+), *Westringia rigida* (+); 6 other spp.
Stratum 6b. Misc. plants, CC = 0.2, clumping slight. Annuals: *Senecio glossanthus* (0.1), *Zygophyllum ovatum* (0.1).

No. of TAXA: 34 LAST BURNT: No evidence of burning
MODIFICATION: Moderately grazed
LANDFORM
BEDROCK: Greenstone GEOLOGICAL SURFACE: (Wi) Ad
UNIT: Undulating Plain ELEMENT: Ridge
SOIL
GROUP: Shallow Calcareous Earths NORTHCOTE: Uc4.13
MAIN ORIGIN: *In situ* weathering DRAINAGE: Excessive
PROFILE ATTRIBUTE: Shallow SURFACE: Hardsetting
ROCK: 2-10% cover, patchy
STONE: 2-20% cover of angular greenstone 6-12 cm long, patchy.
PAVEMENT: 2-20% cover of material 5-15 mm across, patchy.
LITTER: Logs few; branches few; leaves broad, deposits 4 cm thick, 6-10 m apart.
SOIL PROFILE
A 0-9 cm "Greyish brown" sandy loam; friable; 10-15% angular greenstone 0.5-3 cm long; not calcareous; pH 8.0; no obvious weathering zone.

COMMENTS
DISTRIBUTION: Common on greenstone belt in western sector.
PROFILE THICKNESS: 2-95 cm
GENERAL:
(a) Upper stratum CC = 8-20.
(b) Species richness varied from 25 to 36.
(c) *Eremophila glabra* (0-10) in stratum 3.

LOW SHRUBLAND

Atriplex vesicaria Low Shrubland – For description see WZ14 and Comments (c).

WZ32 *Maireana sedifolia* Low Shrubland

LOCATION: 18 km SSW. of Karonie (31° 06'40"S lat., 122° 26'40"E long.)
FAUNA SAMPLED: No DATE: 13-8-1981
VEGETATION MUIR: SDi.Ji
Stratum 1a: Shrubs 0.0-0.5 m, CC = 21, clumping none *Maireana sedifolia* (20), *Atriplex vesicaria* (1), *Frankenia* sp. (KRN 6592) (+), *Sclerolaena diacantha* (+).
Stratum 1b: Misc. plants, CC = 11, clumping slight. Annuals: *Toxanthes perpusillus* (6), *Erodium crinitum* (0.1), *Blennospora drummondii* (+).
Perennial Grasses: *Stipa eremophila* (5).
No. of TAXA: 8 LAST BURNT: 40-60 years
MODIFICATION: Grazed for over 100 years, light to moderate during recent years.
LANDFORM
BEDROCK: Greenstone GEOLOGICAL SURFACE: (Wi) Qps
UNIT: Undulating Plain ELEMENT: Colluvial flat
SOIL
GROUP: Deep Calcareous Earths NORTHCOTE: Um4.21
MAIN ORIGIN: Colluvial DRAINAGE: Good
PROFILE ATTRIBUTE: Calcareous SURFACE: Crusting
ROCK: Nil STONE: Nil PAVEMENT: Nil LITTER: Nil
SOIL PROFILE
A 0-38 cm Weak red loam; friable; highly calcareous; pH 8.0.
B21 38-61 cm Red clay loam; friable; inclusions of carbonate nodules grade with depth from 40-60% and 1-3 cm diameter, to 5-15% and 0.5-1 cm diameter; highly calcareous; pH 8.0.
B22 61-100 cm Mottled light brown and white clay loam; friable; highly calcareous; pH 8.0.
COMMENTS
DISTRIBUTION: Common along northern margin of Lake Lefroy, 5-1,000 ha
PROFILE THICKNESS: >1 m

(b) UNDULATING PLAIN, basic granulite (UR)

LOW WOODLAND

Eucalyptus lesouefii Low Woodland – For description see WZ21 and Comments (c).

Eucalyptus oleosa Low Woodland – For description see WZ24 and Comments (d).

Eucalyptus salubris Low Woodland – For description see WZ25 and Comments (c).

MALLEE

WZ33 *Eucalyptus griffithsii* Mallee

LOCATION: 1 km S. of Buningonia Spring (31°26'00"S lat., 123°33'40"E long.)
FAUNA SAMPLED: Yes DATE: 14-8-1980

VEGETATION MUIR: KSr.Sr.Hi

Stratum 1: Trees 3-4 m, CC = +, clumping none *Casuarina cristata* ssp. *pauper* (+).

Stratum 2: Mallees 2.3-3 m, CC = 3, clumping slight *Eucalyptus griffithsii* (3), *E. uncinata* (+).

Stratum 3: Shrubs 2.1-3.0 m, CC = 2, clumping strong *Acacia acuminata* (2), *A. hemiteles* (+), *Pittosporum phylliraeoides* (+).

Stratum 4: Shrubs 1.6-2.0 m, CC = 2, clumping slight *Eremophila paisleyi sens. lat.* (2).

Stratum 5: Shrubs 0.6-1.0 m, CC = +, clumping none *Cassia nemophila* var. *nemophila* (+), *Olearia revoluta* (+).

Stratum 6a: Shrubs 0.0-0.5 m, CC = 0.1, clumping none *Acacia erinacea* (+), *Olearia muelleri* (+), *Ptilotus obovatus* var. *obovatus* (+), *Sclerolaena diacantha* (+).

Stratum 6b. Misc. plants, CC = 20, clumping medium Annuals: *Calandrinia polyandra* (+), *C.* sp. (KRN 7113) (+), *Crassula exserta* (+), *Daucus glochidiatus* (+), *Menkea australis* (+), *Thysanotus patersonii* ssp. *patersonii* (+).
Ferns: *Ophioglossum lusitanicum* (+).
Perennial grasses: *Triodia scariosa* (20), *Stipa trichophylla* (+).

No. of TAXA: 22 LAST BURNT: 40-45 years
MODIFICATION: Possibly lightly grazed more than 35 years ago.

LANDFORM
BEDROCK: Granite GEOLOGICAL SURFACE: (Za) Px
UNIT: Undulating Plain ELEMENT: Low ridge

SOIL
GROUP: Metagranitic Soils NORTHCOTE: Dr1.53
MAIN ORIGIN: *In situ* weathering DRAINAGE: Good
PROFILE ATTRIBUTE: Calcareous SURFACE: Crusting
ROCK: Nil STONE: Nil PAVEMENT: Nil
LITTER: Broad leaves, deposits 2 cm thick, 10-12 m apart under mallees.

SOIL PROFILE

A 0-7 cm Dark reddish brown sandy loam; friable; 1-3% angular quartz 2-3 mm long; not calcareous; pH 8.0.

B 7-47 cm Dusky red sandy clay; firm; 3-5% angular feldspar 3-10 mm long; not calcareous; pH 8.0.

C 47-73 cm Red sandy clay loam; friable; 10-15% of decomposed granite; highly calcareous; pH 8.25; too stony to auger deeper.

COMMENTS
DISTRIBUTION: Scattered, Fraser Range to western margin, 1-5 ha.
PROFILE THICKNESS: 0.9-1.5 m
GENERAL:
(a) The vegetation was always on shallow soils, with pH 8.0, over granite, usually on slight rises. Occasionally the profile was gradational and not duplex.
(b) Upper stratum CC = 4-15.

(c) Annuals were not always present.
(d) Occurred on the lower slopes of Broad Valleys ((Wi) Qps), very rare.
(e) Species richness varied from 9 to 23.

WZ34 *Eucalyptus uncinata* Mallee
LOCATION: 4.5 km SW. of Buningonia (31° 26'50"S lat., 123° 31'20"E long.)
FAUNA SAMPLED: Yes DATE: 14-8-1980
VEGETATION MUIR: KSr.Hi

Stratum 1: Mallees 3-4 m, CC = 2, clumping strong *Eucalyptus uncinata* (2).
Stratum 2: Shrubs 2.1-2.7 m, CC = 1, clumping none *Acacia acuminata* (0.5), *Pittosporum phylliraeoides* (0.5).
Stratum 3: Shrubs 1.6-2.0 m, CC = 0.5, clumping none *Eremophila dempsteri* (0.5), *Pimelea microcephala* (+).
Stratum 4: Shrubs 1.1-1.5 m, CC = +, clumping none *Cassia nemophila* var. *nemophila* (+).
Stratum 5: Shrubs 0.6-1.0 m, CC = 0.1, clumping none *Rhagodia drummondii* (0.1), *Dodonaea stenozyga* (+).
Stratum 6a: Shrubs 0.0-0.5 m, CC = 0.2, clumping none *Atriplex vesicaria* (a form) (+), *Lawrencia repens* (+), *Solanum lasiophyllum* (+), *S. nummularium* (+).
Stratum 6b: Misc. plants, CC = 15.3, clumping slight. Annuals: *Calandrinia polyandra* (0.1), *Tetragonia eremaea* (0.1), *Erodium crinitum* (+), *Podolelis capillaris* (+), *Senecio lautus* ssp. *dissectifolius* (+), *Stenopetalum lineare* (+); 9 other spp.
Perennial Grasses: *Triodia scariosa* (15), *Stipa eremophila* (+).

No. of TAXA: 29 LAST BURNT: 30-40 years
MODIFICATION: Grazed prior to *ca* 1944
LANDFORM
BEDROCK: ?Granite GEOLOGICAL SURFACE: (Wi) Px
UNIT: Undulating Plain ELEMENT: Low ridge
SOIL
GROUP: Deep Calcareous Earths NORTHCOTE: Gn2.15
MAIN ORIGIN: *In situ* weathering DRAINAGE: Good
PROFILE ATTRIBUTE: None SURFACE: Hardsetting
ROCK: Nil STONE: Nil PAVEMENT: Nil
LITTER: Branches few; leaves broad, deposits 3 cm thick, 8-10 m apart.
SOIL PROFILE
A 0-42 cm Dusky red loamy sand; friable.
B 42-100 cm "Reddish brown" sandy clay loam; clay content increasing with depth; firm.
COMMENTS
DISTRIBUTION: Common in the Fraser Range, 2-20 ha.
PROFILE THICKNESS: 1.3-2 m
GENERAL:
(a) *Triodia scariosa* CC = to 25%.
(b) Species richness varied from 29 to 48.
(c) Occasionally with small bedrock outcrops and 5-70% cover of stone 2-8 cm long. Species richness was in upper half of range.

TALL SHRUBLAND

WZ35 *Allocasuarina campestris* ssp. *campestris* Tall Shrubland

LOCATION: 29 km SW. of Buningonia Spring (31° 35'00"S lat., 123° 19'00"E long.)
FAUNA SAMPLED: No DATE: 16-8-1980

VEGETATION MUIR: Si.Hi

Stratum 1: Shrubs 2.1-2.6 m, CC = 22, clumping none *Allocasuarina campestris* ssp. *campestris* (20), *Melaleuca uncinata* (2), *Santalum acuminatum* (+).

Stratum 2: Shrubs 0.6-1.0 m, CC = 0.1, clumping none *Acacia hemiteles* (+), *Grevillea nematophylla* (a form) (+), *Olearia* aff. *cassiniae* (+).

Stratum 3a: Shrubs 0.0-0.1 m, CC = 0.1, clumping none *Brachysema daviesioides* (+), *Dampiera tenuicaulis* var. *tenuicaulis* (+), *Lasiopetalum* aff. *ogilvieanum* (+), *Phebalium lepidotum* var. *lepidotum* (+).

Stratum 3b: Misc. plants, CC = 15, clumping slight. Perennial grasses: *Triodia scariosa* (15).

No. of TAXA: 11 LAST BURNT: 45-60 years

MODIFICATION: Possible light grazing more than 35 years ago.

LANDFORM

BEDROCK: Granite GEOLOGICAL SURFACE: (Za) Px
UNIT: Undulating Plain ELEMENT: Low laterized ridge

SOIL

GROUP: Gravelly Sands NORTHCOTE: KS-Uc1.23
MAIN ORIGIN: *In situ* weathering DRAINAGE: Good
PROFILE ATTRIBUTE: Gravel content SURFACE: Hardsetting
ROCK: Nil
STONE: 5-10% cover of irregular gravel 2-5 cm long.
PAVEMENT: 30-90% cover of gravel 5-20 mm long, even.
LITTER: Leaves terete, deposits 1 cm thick, 3-6 m apart.

SOIL PROFILE

A 0-5 cm Dark reddish brown loamy sand; friable; 40-60% of gravel 5-23 mm across; too stony and dry to auger deeper.

COMMENTS

DISTRIBUTION: Scattered in northern section of Fraser Range, 2-5 ha.
PROFILE THICKNESS: 1-3 m
GENERAL: The soil profile was a truncated laterite. It was expected that the A horizon would be 50-100 cm thick, overlying a B horizon of mottled sandy clay.

WZ36 *Melaleuca uncinata* Tall Shrubland

LOCATION: 33 km SW. of Buningonia Spring (31° 25'20"S lat., 123° 18'40"E long.)
FAUNA SAMPLED: No DATE: 16-8-1980

VEGETATION MUIR: Si.SCr.Hr.Jr

Stratum 1: Mallees 3-4 m, CC = 0.2, clumping none *Eucalyptus griffithsii* (0.2).

Stratum 2: Shrubs 2.1-2.7 m, CC = 15, clumping moderate *Melaleuca uncinata* (10), *Allocasuarina campestris* ssp. *campestris* (2), *A. helmsii* (2), *Trymalium* aff. *ledifolium* (1).

Stratum 3: Shrubs 1.6-2.0 m, CC = 0.2, clumping moderate *Acacia* aff. *eremophila* (0.2).

Stratum 4: Shrubs 1.1-1.5 m, CC = 0.2, clumping none *Eremophila serrulata* (0.1), *Acacia hemiteles* (+), *Dodonaea stenozyga* (+), *Santalum acuminatum* (+).

Stratum 5: Shrubs 0.6-1.0 m, CC = 5.2, clumping moderate *Melaleuca fulgens* (5), *Calothamnus gilesii* (+), *Cryptandra parvifolia* (+), *Dodonaea adenophora* (+), *D. microzyga* (+), *Grevillea teretifolia* (+).

Stratum 6a: Shrubs 0.0-0.5 m, CC = 0.6, clumping slight *Opercularia spermacocea* (0.2), *Acacia uncinella* (0.1), *Dodonaea lobulata* (+), *Prostanthera serpyllifolia* ssp. *serpyllifolia* (+); 2 other spp.

Stratum 6b: Misc. plants, CC = 9, clumping moderate. Annuals: *Chthonocephalus pseudevax* (0.5), *Millotia tenuifolia* (0.5), *Calotis hispidula* (0.2), *Calandrinia polyandra* (0.1), *Crassula exserta* (0.1), *Helipterum demissum* (0.1), *H. laeve* (0.1), *Isoetopsis graminifolia* (0.1), *Actinobole uliginosum* (+), *Centrolepis humillima* (+), *Pterostylis nana* (+), *Toxanthes perpusillus* (+); 15 other spp.
Perennial Grasses: *Triodia scariosa* (6).
Sedges: *Gahnia lanigera* (+), *Lepidosperma viscidum* (+).

No. of TAXA: 51 LAST BURNT: 40-50 years
MODIFICATION: None known or evident.

LANDFORM
BEDROCK: Granite GEOLOGICAL SURFACE: (Za) Px
UNIT: Undulating Plain ELEMENT: Low ridge

SOIL
GROUP: Metagranitic Soils NORTHCOTE: Uc1.23
MAIN ORIGIN: *In situ* weathering DRAINAGE: Good
PROFILE ATTRIBUTE: Shallow SURFACE: Crusting
ROCK: 0-20% cover, patchy
STONE: 0-60% cover of subangular granite 5-50 cm long, patchy.
PAVEMENT: Nil
LITTER: Branches few; leaves terete, deposits 1 cm thick, 3-6 m apart.

SOIL PROFILE
A 0-12 cm Dusky red sandy loam; friable; 5-20% of subangular weathered granite 1-3 cm long.

COMMENTS
DISTRIBUTION: Scattered on Fraser Range, 0.2-1 ha
PROFILE THICKNESS: 10-20 cm

HUMMOCK GRASSLAND

WZ37 *Triodia scariosa* Hummock Grassland

LOCATION: 14 km WSW. of Buningonia Spring (31°29′00″S lat., 123°25′30″E long.)
FAUNA SAMPLED: Yes DATE: 16-8-1980

VEGETATION MUIR: Hc

Stratum 1a: Shrubs 0.0-0.5 m, CC = 0.1, clumping slight *Heliotropium asperrimum* (0.1).

Stratum 1b: Misc. plants, CC = 45.3, clumping none Annuals: *Calandrinia polyandra* (0.1), *Crassula exserta* (0.1), *Calotis hispidula* (+), *Menkea australis* (+), *Wurmbea tenella* (+); 2 other spp.
Perennial grasses: *Triodia scariosa* (45).

No. of TAXA: 9 LAST BURNT: >10 years
MODIFICATION: None known or evident

LANDFORM
BEDROCK: Granite GEOLOGICAL SURFACE: (Za) Px
UNIT: Undulating Plain ELEMENT: Gentle slope

SOIL
GROUP: Metagranitic Soils NORTHCOTE: Gn2.13
MAIN ORIGIN: *In situ* weathering DRAINAGE: Good
PROFILE ATTRIBUTE: Shallow SURFACE: Hardsetting
ROCK: Nil STONE: Nil
PAVEMENT: 0-5% cover of material 2-4 mm long, patchy.
LITTER: Nil

SOIL PROFILE
A 0-10 cm "Dark greyish brown" loamy fine sand; friable.
C 10-12 cm Red clayey sand; firm; 10-15% highly weathered granite fragments 6-20 mm long; highly calcareous; pH 8.75.

COMMENTS
DISTRIBUTION: Rare, northern third of Fraser Range, 2-8 ha.
PROFILE THICKNESS: 10-14 cm

BROAD VALLEY (V)

WOODLAND

Eucalyptus salmonophloia Woodland – For description see WZ18 and Comments (d).

LOW WOODLAND

WZ38 *Eucalyptus transcontinentalis* Low Woodland

LOCATION: 35 km N. of Norseman (31° 55'40"S lat., 121° 38'10"E long.)
FAUNA SAMPLED: No DATE: 17-8-1981

VEGETATION MUIR: LAi.Si

Stratum 1: Trees 5-13 m, CC = 26, clumping slight *Eucalyptus transcontinentalis* (25), *E. gracilis* (1).

Stratum 2: Shrubs 2.1-2.8 m, CC = 20.5, clumping slight *Melaleuca pauperiflora* (20), *Exocarpos sparteus* (0.5).

Stratum 3: Shrubs 1.5-2.0 m, CC = 1.5, clumping none *Daviesia benthamii* ssp. *benthamii* (1), *Santalum acuminatum* (0.5).

Stratum 4a: Shrubs 0.0-0.5 m, CC = 1.3, clumping none *Scaevola spinescens* (1), *Olearia muelleri* (0.2), *Acacia camptoclada* (+), *Eremophila caerulea* (+).

Stratum 4b: Misc. plants, CC = 1.2, clumping slight. Annuals: *Millotia tenuifolia* (0.2), *Actinobole uliginosum* (0.1), *Caladenia sigmoidea* (0.1), *Helichrysum tepperi* (0.1), *Helipterum pygmaeum* (0.1), **Pentaschistis airoides* (0.1), *Plantago debilis* (0.1), *Triglochin calcitrapa* (0.1), *Helipterum laeve* (+), *Podolepis capillaris* (+), *Pterostylis nana* (+); 5 other spp.
Perennial Grasses: *Triodia scariosa* (+).
Sedge-like: *Lomandra effusa* (+).

No. of TAXA: 28 LAST BURNT: 60-70 years
MODIFICATION: None known or evident.

LANDFORM
BEDROCK: ?Granite GEOLOGICAL SURFACE: (Wi) Qps
UNIT: Broad Valley ELEMENT: Valley bottom

SOIL
GROUP: Deep Calcareous Earths NORTHCOTE: Gn3.93
MAIN ORIGIN: Colluvial DRAINAGE: Good
PROFILE ATTRIBUTE: Calcareous SURFACE: Hardsetting
ROCK: Nil STONE: Nil PAVEMENT: Nil
LITTER: Logs few; branches few; leaves broad, deposits 3 cm thick, 4-8 m apart under trees; leaves terete, deposits 1 cm thick, 12-15 m apart under large shrubs.

SOIL PROFILE
A 0-12 cm "Brown" loamy fine sand; loose.
B 12-62 cm Brown clay loam; firm; slightly calcareous; pH 9.0; too stony to auger deeper due to a high proportion of carbonate nodules.

COMMENTS
DISTRIBUTION: Common in south-western sector west of greenstone belt, 10-100 ha
PROFILE THICKNESS: >2 m
GENERAL: Also occurred in north-eastern section of Study Area on Calcareous Plains ((Za) Qo) on Aeolian Sands. The vegetation was not sampled in detail but consisted mainly of scattered shrubs of *Eremophila paisleyi* 1.8-2.2 m high, over *Triodia scariosa*.

MALLEE

Eucalyptus cylindrocarpa Mallee – For description see WZ26 and Comments (b).

Eucalyptus griffithsii Mallee – For description see WZ33 and Comments (d).

WZ39 *Eucalyptus eremophila* Mallee

LOCATION: 38 km NNW. of Norseman (31° 53'00"S lat., 121° 37'30"E long.)
FAUNA SAMPLED: No DATE: 20-8-1982

VEGETATION MUIR: KSi.Sr.VLr.Hr.Jr

Stratum 1: Trees 6-8 m, CC = +, clumping none *Eucalyptus transcontinentalis* (+).
Stratum 2: Mallees 3.5-5 m, CC = 25, clumping slight *Eucalyptus eremophila* (20), *E. gracilis* (5).
Stratum 3: Shrubs 2.1-2.3 m, CC = 2, clumping slight *Melaleuca uncinata* (2).
Stratum 4: Shrubs 1.6-2.0 m, CC = 0.2, clumping none *Eremophila saligna* (0.2).
Stratum 5: Shrubs 1.1-1.5 m, CC = 0.2, clumping none *Daviesia benthamii* ssp. *benthamii* (0.1), *Acacia pachypoda* (+), *Alyxia buxifolia* (+), *Grevillea huegelii* (+).
Stratum 6a: Shrubs 0.0-0.5 m, CC = 1.2, clumping slight *Podolepis capillaris* (1), *Olearia axillaris* var. *eremicola* (+), *O. muelleri* (+), *Scaevola spinescens* (+).
Stratum 6b: Misc. plants, CC = 18.5, clumping slight. Annuals: *Actinoble uliginosum* (1), *Goodenia berardiana* (1), * *Pentaschistis airoides* (1), *Calotis hispidula* (0.5), *Waitzia acuminata* (0.5), *Toxanthes perpusillus* (0.2), *Millotia tenuifolia* (0.2), *Brunonia australis* (0.1), *Calandrinia granulifera* (0.1), *C. polyandra* (0.1), *Chthonocephalus pseudevax* (0.1), *Erodium crinitum* (0.1), *Helipterum pygmaeum* (0.1), *Ptilotus gaudichaudii* var. *gaudichaudii* (0.1), *Stenopetalum filifolium* (0.1), *Crassula exserta* (+), *Helipterum hyalospermum* (+), *Podolepis canescens* (+), *Thysanotus patersonii* ssp. *patersonii* (+), *T. speckii* (+); 6 other spp.
Perennial Grasses: *Triodia scariosa* (8), *Stipa trichophylla* (0.2), *Aristida contorta* (0.1).
Sedges: *Lepidosperma drummondii* (4).
Sedge-like: *Dianella revoluta* (0.1), *Lomandra effusa* (+).

No. of TAXA: 45 LAST BURNT: 40-50 years
MODIFICATION: None known or evident

LANDFORM
BEDROCK: Unknown GEOLOGICAL SURFACE: (Wi) Qps
UNIT: Broad Valley ELEMENT: Sand sheet on bottom

SOIL
GROUP: Aeolian Sands NORTHCOTE: Db1.12
MAIN ORIGIN: Colluvial DRAINAGE: Good
PROFILE ATTRIBUTE: None SURFACE: Crusting
ROCK: Nil STONE: Nil PAVEMENT: Nil
LITTER: Branches few; leaves broad, deposits 1 cm thick, 3-5 m apart.

SOIL PROFILE
A 0-33 cm "Brown" loamy sand; loose.
B 33-87 cm Red sandy clay loam; firm; 2-3% subrounded ironstone 2-4 mm; not calcareous; pH 8.0.

COMMENTS
DISTRIBUTION: South-western sector, scattered, 2-8 ha in size.
PROFILE THICKNESS: >1 m

Appendix II

Flora List

Species recorded during the survey are listed alphabetically by family, genera and species. Nomenclature largely follows Green (1981). Species believed to be unnamed are referenced by a K.R. Newbey collecting number and voucher specimens have been lodged in the Western Australian Herbarium, Perth. Species are listed by landform units and assessed for frequency and cover/abundance. Symbols used in the table are explained below. Asterisk indicates an introduced species.

Landform Unit

B = Breakaway
G = Granite Exposure
HG = Hill, granite
HR = Hill, basic granulite
HS = Hill, quartzite
L = Salt Lake Features
P = Calcareous Plain
UN = Undulating Plain, greenstone
UR = Undulating Plain, basic granulite
V = Broad Valley

Frequency and Abundance

Frequency	Cover/Abundance
A = 1 or 2 populations	1 = 1 or 2 plants
B = Few "	2 = Few plants
C = Scattered "	3 = Few plants to 1% canopy cover
D = Frequent "	4 = 1-5% canopy cover
E = Common "	5 = 6-30% " "
	6 = 31-70% " "

CO = Conservation Status on Reserved Areas
B = Binaronca Rock Nature Reserve
N = Ngalbain Nature Reserve

Assessment
. = Not recorded
p = Poorly represented
A = Adequately represented

Species	Landform Unit										CO	
	B	G	HG	HR	HS	L	P	UN	UR	V	B	N
ADIANTACEAE												
Cheilanthes lasiophylla Pichi-Serm.	..	A3	B2	B2	..	..	..	A1	A1	..	p	.
Cheilanthes tenuifolia (N.L. Burman) Swartz	A1	E3	B2	B2	..	..	..	..	..	..	p	p
Cheilanthes sp. (KRN 7046)	..	C4	A2	..	..	..	..	A3	..	..	.	.
AIZOACEAE												
Disphyma clavellatum (Haw.) Chinnock	..	..	..	..	..	E3	..	..	..	..	.	.
Gunniopsis quadrifida (F. Muell.) Pax	..	A3	..	..	..	B3	..	..	..	..	.	.
**Mesembryanthemum crystallinum* L.	A3	B3	..	..	..	..	A3	A2	A3	..	.	p
**Mesembryanthemum* nodiflorum L.	..	A2	..	..	..	..	..	..	..	..	.	.
Sarcozona praecox (F. Meull) S.T. Blake	..	C2	..	..	..	..	A2	A2	..	A2	.	p
Tetragonia eremaea Ostenf.	A2	C3	B2	..	..	C3	C3	..	C3	..	p	.
Trianthema glossostigma F. Muell.	..	A1	..	..	..	..	..	..	..	..	.	.

Species	Landform Unit B	G	HG	HR	HS	L	P	UN	UR	V	CO B	N
AMARANTHACEAE												
Ptilotus axillaris (F. Muell.) F. Muell.	..	A1	..	..	..	..	..	..	A1	..	.	.
Ptilotus carlsonii F. Muell.	..	..	..	..	..	..	A2	..	..	..	.	.
Ptilotus exaltatus Nees var. *exaltatus*	..	..	..	..	..	..	C2	C2	B2	..	.	p
Ptilotus gaudichaudii (Stued.) J.M. Black	..	A1	..	..	..	..	..	..	B3	..	.	.
Ptilotus helichrysoides (F. Muell.) F. Muell.	A4	..	..	..	..	..	..	..	..	..	.	.
Ptilotus holosericeus (Moq.) F. Muell.	..	A1	..	..	..	..	D1	C1	B1	..	.	p
Ptilotus obovatus (Gaud.) F. Muell. var. *obovatus*	A3	D3	D4	E4	..	..	C2	C2	B2	C3	p	p
Ptilotus parvifolius (F. Muell.) F. Muell.	..	..	..	..	..	A2	..	..	..	..	.	.
Ptilotus polystachyus Gaud. (F. Muell.)	..	..		..		..	B2	..	..	..	.	.
Ptilotus spathulatus (R. Br.) Poir. var. *spathulatus*	..	B2	..	..	..	..	..	..	..	..	.	.
APIACEAE												
Daucus glochidiatus (Labill.) Fisch.	..	B2	A2	C2	..	..	..	..	B2	E2	p	.
Hydrocotyle diantha DC.	..	A3	..	..	..	..	..	..	..	..	.	.
Hydrocotyle medicaginoides Turcz.	..	..	A2	..	..	..	..	..	..	..	.	.
Hydrocotyle rugulosa Turcz.	..	A3	..	..	..	..	..	..	..	..	p	.
Hydrocotyle aff. *pilifera* Turcz. (KRN 6957)	..	C2	..	..	..	..	..	..	..	..	.	.
Myriophyllum sp. (KRN 8562)	..	A2	..	..	..	..	..	..	..	..	.	.
Trachymene cyanopetala (F. Muell.) Benth. var. *cyanopetala*	..	A2	..	A2	..	..	..	..	..	..	p	.
Trachymene cyanopetala (F. Muell.) Benth. var. *ciliatula* Domin	..	..	..	..	..	..	..	..	..	A2	.	.
Trachymene ornata (Endl.) Druce	..	A2	..	..	..	..	..	..	..	..	.	.
Trachymene pilosa Sm.	..	A1	..	..	..	..	..	..	..	..	.	.
Tracymene sp. (KRN 6977)	..	C2	..	..	A2	..	..	..	..	..	.	.
APOCYNACEAE												
Alyxia buxifolia R. Br.	A2	C2	..	B2	B1	A2	E3	D3	..	E3	p	p
ASCLEPIADACEAE												
Leichardtia australis R. Br.	..	A1	A1	B1	..	..	..	B1	B1	..	p	.
ASTERACEAE												
**Achillea millefolium L.*	..	A2	..	..	..	..	..	..	..	..	.	.
Actinobole uliginosum (A. Gray) Hj. Eichler	..	E4	E5	C3	..	A3	E3	C3	C3	E3	p	.
Angianthus micropodioides (Benth.) Benth.	..	..	..	..	..	..	..	B2	..	..	.	.
Angianthus tomentosus Wendl.	..	..	..	..	..	..	B2	B2	..	..	.	.
Asteroides athrixioides (Sonder & F. Muell.) Kroner	..	..	..	A2	..	..	D3	C2	B2	..	.	p
Blennospora drummondii A. Gray	..	A3	..	B3	..	..	..	..	..	A2	p	.
Brachycome ciliaris (Labill.) Less.	..	..	..	..	..	..	..	A2	..	B2	p	.
Brachycome iberidifolia Benth.	A1	C1	B1	..	B1	B2	B2	B2	B2	..	p	.
Brachycome lineariloba (DC.) Druce	..	..	..	..	..	B2	..	..	..	..	.	.
Brachycome perpusilla (Steetz) J.M. Black	..	..	..	..	..	..	A2	..	..	..	.	.
Brachycome pusilla Steetz	A3	C4	C3	..	..	B3	..	..	..	..	.	.

Species	Landform Unit B	G	HG	HR	HS	L	P	UN	UR	V	CO B	N
ASTERACEAE cont.												
Brachycome sp. (KRN 8469)	..	..	..	..	..	..	..	A3	..	..	.	p
Brachycome sp. (KRN 8552)	..	A3	..	..	..	..	..	..	..	..	.	.
Calocephalus angianthoides (Steetz) Benth.	..	..	..	..	..	A4	..	..	..	..	.	.
Calocephalus francisii (F. Muell.) Benth.	..	..	..	..	..	A1	..	..	..	..	.	.
Calotis hispidula (F. Muell.) F. Muell.	A3	A3	A2	..	..	A1	E3	D3	B3	E3	.	.
Calotis multicaulis (Turcz.) Druce	..	..	..	..	..	..	..	A1	..	..	.	p
Cephalipterum drummondii A. Gray	..	..	..	A2	..	..	..	A3	..	..	p	p
Ceratogyne obionoides Turcz.	..	A2	..	..	..	..	..	..	A1	..	.	.
Chrysocoryne pusilla (Benth.) Endl.	..	C4	..	..	..	B2	..	..	..	..	.	p
Chrysocoryne uniflora Turcz.	..	A3	..	..	..	..	..	..	..	..	.	.
Chthonocephalus pseudevax Steetz	..	E4	E4	C3	..	A1	D3	..	B2	D3	p	p
Cotula australis (Sieb. ex Spreng.) J.D. Hooker	..	..	..	A3	..	..	..	..	..	..	.	.
Cotula coronopifolia L.	..	A2	..	..	..	..	..	..	..	..	.	.
Cratystylis conocephala (F. Muell.) S. Moore	..	A1	..	..	..	A1	E4	D3	..	..	p	.
Cratystylis microphylla (F. Muell. & Tate) S. Moore	..	..	..	..	..	A2	..	..	..	..	.	.
Cratystylis subspinescens (F. Muell. & Tate) S. Moore	..	..	..	..	..	D5	..	..	A4	..	.	p
Erodiophyllum elderi F. Muell.	..	..	..	..	..	..	A1	..	..	..	.	.
Gnephosis burkittii Benth.	A4	B4	D5	..	..	A3	..	..	..	..	p	.
Gnephosis intosa S. Moore	..	A4	..	..	..	..	..	..	..	..	.	.
Gnephosis skirrophora (Sonder & F. Muell. ex Sonder) Benth.	..	..	..	..	..	A2	..	..	A1	..	.	.
Gnephosis aff. *pygmaea* (KRN 8635)	A2	C3	..	..	..	..	..	..	C3	A2	p	.
Helichrysum ambiguum Turcz.	..	..	..	D3	..	..	..	..	..	..	p	.
Helichrysum cassiope S. Moore	..	..	..	..	..	..	..	A3	..	..	.	.
Helichrysum tepperi F. Muell.	A3	A2	..	..	..	A1	D2	D2	..	E3	.	p
Helipterum battii F. Muell.	..	A3	D3	..	..	..	..	..	..	..	.	.
Helipterum demissum (A. Gray) Druce	..	D3	..	B3	..	..	..	..	..	..	p	.
Helipterum fitzgibbonii F. Muell.	..	..	..	..	..	..	B2	C2	..	..	.	.
Helipterum floribundum DC.	..	..	..	..	..	..	..	..	A2	..	.	.
Helipterum hyalospermum F. Muell. ex Benth.	..	A3	D3	B3	..	..	..	..	..	B2	p	.
Helipterum laeve (A. Gray) Benth.	..	E4	..	B3	D3	..	C2	..	..	B2	p	p
Helipterum manglesii (Lindl.) Benth.	..	A3	..	..	..	..	..	..	..	..	.	.
Helipterum oppositifolium S. Moore.	..	..	..	..	..	..	..	A3	..	..	.	.
Helipterum pygmaeum (DC.) Benth.	A3	C3	D3	..	..	..	D3	D3	B2	D3	p	p
Helipterum roseum (Hooker) Benth.	..	A3	..	A3	..	A2	..	..	..	..	p	.
Helipterum splendidum Hemsley	..	..	A2	..	..	..	..	..	..	..	.	.
Helipterum strictum (Lindl.) Benth.	..	B2	..	C2	..	B2	A2	C3	..	..	p	p
Helipterum tenellum Turcz.	..	A2	..	..	..	A1	A2	..	A2	..	.	.
Helipterum tietkensii F. Muell.	..	..	..	..	..	..	..	..	A2	..	.	.
Helipterum sp. (KRN 7727)	..	A2	..	..	..	..	..	..	..	..	.	.
Hyalochlamys globifera A. Gray	..	B4	..	..	..	..	B2	..	A3	..	.	.
Isoetopsis graminifolia Turcz.	A3	D3	D3	C2	..	A1	D3	C2	D2	D3	p	p

Species	Landform Unit B	G	HG	HR	HS	L	P	UN	UR	V	CO B	N
ASTERACEAE cont.												
Millotia myosotidifolia (Benth.) Steetz	..	A3	..	..	..	..	..	..	..	..	.	.
Millotia tenuifolia Cass.	..	D3	..	..	..	..	..	..	..	A2	p	.
Minuria cunninghamii (DC.) Benth.	..	..	..	..	..	A2	..	..	..	..	.	.
Minuria gardneri N.S. Lander & R. Barry	..	..	..	..	..	A2	..	..	..	..	.	.
Olearia axillaris (DC.) F. Muell. ex Benth. var. *eremicola* Diels	..	..	..	..	..	..	..	..	A1	B1	.	.
Olearia muelleri (Sonder) Benth.	..	B2	..	..	..	B2	E4	E3	B2	E4	p	p
Olearia propinqua S. Moore	..	A1	..	..	..	..	..	..	..	..	.	.
Olearia revoluta F. Muell. ex Benth.	..	B3	..	..	..	..	A2	A2	B2	A1	.	.
Olearia stuartii F. Muell. ex Benth.	..	A3	..	..	..	..	..	..	..	..	.	.
Olearia aff. *cassiniae* Benth. (KRN 7153)	..	..	..	..	..	..	..	..	A1	..	.	.
**Osteospermum clandestinum* (Less.) T. Norlindh	A2	A3	..	..	..	..	A1	..	..	..	p	.
Podolepis canescens A. Cunn. ex DC.	..	..	..	..	..	..	..	..	..	A1	.	.
Podolepis capillaris (Steetz) Diels	..	C3	E3	..	..	B1	..	..	D2	C2	.	p
Podolepis lessonii (Cass.) Benth.	..	C4	C3	..	..	..	..	A3	..	..	.	.
Pogonolepis stricta Steetz	..	A4	..	..	..	B4	..	..	..	..	.	.
Pseudognaphalium luteo-album (L.) Hillard & Burtt	..	..	A2	..	..	..	..	..	A2	..	.	.
Quinetia urvillei Cass.	..	A2	..	..	..	..	..	..	..	..	.	.
Rutidosis multiflora (Nees) B.L. Robinson	..	D4	..	..	..	..	..	..	..	..	.	.
Schoenia cassiniana (Gaud.) Steetz	..	A2	..	..	..	..	..	..	..	..	.	.
Scyphocoronis major (Turcz.) Druce	..	A1	..	..	..	..	..	..	..	..	.	.
Senecio glossanthus (Sonder) Belcher	A3	E3	E3	B3	A3	E3	E2	D2	D2	E2	p	p
Senecio lautus G. Forster ex Willd. ssp. *dissectifolius* Ali	..	B2	B3	..	..	E2	..	A2	B2	..	.	.
Senecio quadridentatus Labill.	..	A1	..	..	..	A1	A2	..	..	..	.	.
Toxanthes perpusillus Turcz.	A1	C4	D5	..	..	..	..	A4	..	B2	p	.
Vittadinia sp. (KRN 6929)	..	B2	..	..	..	A1	..	..	..	..	.	.
Vittadinia sp. (KRN 3375)	..	..	B2	..	..	..	..	..	..	..	.	.
Waitzia acuminata Steetz	..	D3	..	B3	..	A1	..	A3	..	A3	p	.
Waitzia suaveolens (Benth.) Druce	..	..	..	..	..	A1	..	..	..	..	.	.
Genus indet. (KRN 8559)	..	..	..	..	..	A1	..	..	..	..	.	.
BORAGINACEAE												
Halgania andromedifolia Behr & F. Muell.	..	..	..	..	..	..	B2	..	..	..	.	.
Halgania cyanea Lindl.	..	A2	..	..	..	..	..	..	..	..	.	.
Halgania integerrima Endl.	..	A2	..	..	..	..	..	..	A1	..	.	.
Halgania viscosa S. Moore	..	A3	..	..	..	..	..	..	..	..	.	p
Halgania rigida S. Moore	..	..	..	..	..	..	A2	..	..	..	.	.
Halgania aff. *rigida* S. Moore (KRN 7649)	..	..	..	..	..	..	B3	..	..	..	.	.
Heliotropium asperrimum R.Br.	..	..	..	..	..	..	..	..	A1	..	.	.
Heliotropium curassavicum L.	..	..	..	..	..	A1	..	..	..	..	.	.
Heliotropium sp. (KRN 6982)	..	B2	..	..	..	..	A2	..	..	..	.	.
Omphalolappula concava (F. Muell.) Brand	..	..	..	..	..	A1	..	A2	..	..	.	.
Plagiobothrys australasicus (DC.) I.M. Johnston	..	..	C4	..	..	..	..	..	..	..	.	.

Species	Landform Unit B	G	HG	HR	HS	L	P	UN	UR	V	CO B	N
BRASSICACEAE												
**Alyssum linifolium* Stephan ex Willd.	..	..	..	..	..	..	A2	..	..	..	.	.
**Brassica tournefortii* Gouan	..	A3	..	..	..	..	..	..	E4	..	p	.
**Carrichtera annua* (L.) DC.	..	..	..	..	..	..	A1	..	..	..	.	.
Harmsiodoxa brevipes (F. Muell.) O.E. Schultz	..	A2	..	..	..	..	A1	..	..	..	.	.
Lepidium oxytrichum Sprague	A3	A3	..	..	..	..	..	A3	B2	..	.	.
Lepidium platypetalum Hewson	..	..	..	..	..	..	..	A2	..	..	.	.
Lepidium rotundum (Desvaux) DC.	..	..	..	..	..	A1	..	A1	..	..	.	p
Menkea australis Lehm.	..	B3	..	..	..	B2	D3	B2	B1	D3	p	.
Menkea lutea E.A. Shaw	..	..	..	..	..	..	A3	A3	A1	..	.	p
Menkea sphaerocarpa F. Muell.	..	..	..	..	..	..	A2	A2	..	..	.	.
Phlegatospermum eremaea (J.M. Black) E. Shaw	..	..	..	..	..	A1	A2	..	..	..	.	.
**Raphanus raphanistrum* L.	..	..	..	..	..	..	..	..	..	A1	.	.
**Sisymbrium irio* L.	..	..	..	..	..	..	..	..	C3	..	.	.
Stenopetalum filifolium Benth.	..	B2	..	B2	..	A1	..	..	..	B2	.	.
Stenopetalum lineare R. Br. ex DC.	..	B2	B2	..	..	B2	C2	..	C1	..	p	.
Stenopetalum robustum Endl.	..	..	..	..	..	A2	..	..	..	..	.	.
Stenopetalum sphaerocarpum F. Muell.	..	..	..	..	..	A1	..	..	..	..	.	.
CAMPANULACEAE												
Wahlenbergia communis Carolin	..	B1	..	..	..	..	..	..	..	..	.	.
Wahlenbergia gracilenta Carolin	..	B2	..	..	..	..	..	..	..	..	.	.
Wahlenbergia sp. (KRN 7194)	..	B2	..	..	..	..	A1	..	A1	..	.	.
CARYOPHYLLACEAE												
**Herniaria hirsuta* L.	..	..	..	..	..	..	..	..	A3	..	.	.
**Spergularia rubra* (L.) J. & C. Presl	..	A3	..	..	..	..	..	..	..	..	.	.
Stellaria filiformis (Benth.) Mattf.	..	B2	..	..	..	..	D2	C2	..	..	p	.
Genus indet. (KRN 7235A)	..	..	..	..	..	..	..	..	A1	..	.	.
CASUARINACEAE												
Allocasuarina acutivalvis (F. Muell.) L.A.S. Johnson	..	..	..	..	..	A1	..	..	A1	..	.	.
Allocasuarina campestris (Diels) L.A.S. Johnson ssp. *campestris*	..	B5	..	..	..	..	..	..	A5	..	.	.
Allocasuarina campestris (Diels) L.A.S. Johnson ssp. *grossa* L.A.S. Johnson	..	..	..	..	D4	..	..	..	..	..	.	.
Allocasuarina helmsii (Ewart & Gordon) L.A.S. Johnson	..	B3	..	..	C4	..	B3	B4	A3	..	.	.
Allocasuarina huegeliana (Miq.) L.A.S. Johnson	..	A2	..	..	..	..	..	..	..	..	.	.
Casuarina cristata Miq. ssp. *pauper* (F. Muell. ex Miq.) L.A.S. Johnson	..	..	..	..	..	..	B4	A3	A1	..	.	.
Casuarina obesa Miq.	..	..	..	..	..	B2	..	..	..	..	.	.
CENTROLEPIDACEAE												
Centrolepis aristata (R. Br.) Roemer & Schultes	..	A1	..	..	..	..	..	..	..	..	.	.
Centrolepis cephaloformis F.M. Reader ssp. *cephaloformis*	..	B2	..	..	..	..	..	..	..	..	.	.

Species	Landform Unit B	G	HG	HR	HS	L	P	UN	UR	V	CO B	N
CENTROLEPIDACEAE cont.												
Centrolepis glabra (F. Muell. ex Sonder) Hieron	..	B3	..	..	..	..	..	..	..	..	.	.
Centrolepis humillima F. Muell. ex Benth.	..	B2	..	..	..	..	..	..	..	..	.	.
Centrolepis polygyna (R. Br.) Heiron	..	..	..	..	..	A3	..	..	..	..	.	.
Centrolepis sp. (KRN 7122)	..	A4	..	..	..	..	..	..	..	..	.	.
CHENOPODIACEAE												
Atriplex acutibractea R.H. Anderson	..	..	..	..	..	..	..	B4	..	..	.	.
Atriplex inflata F. Muell.	..	..	..	..	..	A1	..	..	..	..	.	.
Atriplex nummularia Lindl.	..	A1	..	..	..	A2	E3	C2	A3	..	p	p
Atriplex quadrivalvata Diels.	A1	..	..	..	..	A1	..	..	..	..	.	.
Atriplex semibaccata R. Br.	..	A4	..	..	..	..	..	..	..	..	.	.
Atriplex spongiosa F. Muell.	..	..	..	..	..	B3	..	..	..	..	.	.
Atriplex vesicaria Heward & Benth.	A3	A4	A2	..	..	E4	D4	C3	..	D4	p	p
Atriplex vesicaria Heward & Benth. (a form -KRN 7173)	..	..	..	..	..	B3	D4	..	D4	..	.	.
Atriplex sp. (KRN 6110)	..	..	..	..	..	C3	..	..	..	..	.	.
Atriplex sp. (KRN 7218)	..	..	..	..	..	C3	..	..	..	..	.	.
Chenopodium cristatum (F. Muell.) F. Muell.	..	B2	B3	..	..	..	..	..	..	..	.	.
Chenopodium curvispicatum P.G. Wilson	A3	..	..	..	..	A1	C2	A2	A1	..	p	p
Chenopodium desertorum (J.M. Black) J.M. Black ssp. *rectum* P.G. Wilson	..	..	..	..	..	..	A1	B2	..	..	.	.
Dissocarpus paradoxa (R. Br.) F. Muell. ex Ulbrich	..	..	..	..	..	..	..	A2	..	..	.	p
Enchylaena tomentosa R. Br.	A1	D2	A2	B2	..	A1	D2	A2	A2	..	p	.
Eriochiton sclerolaenoides (F. Muell.) F. Muell. ex A.J. Scott	..	A1	..	..	..	A1	E3	C3	C3	..	p	p
Halosarcia doleiformis P.G. Wilson	..	..	..	..	..	C4	..	..	..	..	.	.
Halosarcia halocnemoides (Nees) P.G. Wilson ssp. *halocnemoides*	..	..	..	..	..	E5	..	..	..	..	.	.
Halosarcia indica (Willd.) P.G. Wilson ssp. *bidens* (Nees) P.G. Wilson	..	..	..	..	..	B4	..	..	..	..	.	.
Halosarcia indica (Willd.) P.G. Wilson ssp. *leiostachya* (Benth.) P.G. Wilson	..	..	..	..	..	A5	..	..	..	..	.	.
Halosarcia lylei (Ewart & J. White) P.G. Wilson	..	..	..	..	..	B5	..	..	..	..	.	.
Halosarcia peltata P.G. Wilson	..	..	..	..	..	C5	..	..	..	..	.	.
Halosarcia pergranulata (J.M. Black) P.G. Wilson	..	..	..	..	..	B3	..	..	..	..	.	.
Halosarcia pruinosa (Paulsen) P.G. Wilson	..	..	..	..	..	B3	..	..	..	..	.	.
Halosarcia syncarpa P.G. Wilson	..	..	..	..	..	B2	..	..	..	..	.	.
Halosarcia undulata P.G. Wilson	..	..	..	..	..	A1	..	..	..	..	.	.
Halosarcia aff. *cupuliformis* (KRN 8586)	..	..	..	..	..	A1	..	..	..	..	.	.
Maireana amoena (Diels) P.G. Wilson	..	..	..	..	..	..	..	..	A1	..	.	.
Maireana appressa (J.M. Black) P.G. Wilson	..	..	..	..	..	B3	C3	D3	..	..	.	.
Maireana brevifolia (R. Br.) P.G. Wilson	..	..	..	..	..	A2	..	..	..	..	.	.

Species	Landform Unit G	B	HG	HR	HS	L	P	UN	UR	V	CO B	N
CHENOPODIACEAE contd.												
Maireana carnosa (Moq.) P.G. Wilson	..	..	..	..	..	A1	D2	..	..	..	.	.
Maireana eriocladа (Benth.) P.G. Wilson	..	B1	..	..	..	..	D3	..	..	..	.	.
Maireana georgei (Diels) P.G. Wilson	..	..	..	..	..	..	..	B3	..	..	.	p
Maireana glomerifolia (F. Muell. & Tate) P.G. Wilson	..	..	..	..	..	C4	..	..	..	..	.	.
Maireana marginata (Benth.) P.G. Wilson	..	..	..	..	..	..	..	..	A1	..	.	.
Maireana pentatropis (Tate) P.G. Wilson	..	..	..	..	..	..	..	C2	..	..	.	p
Maireana platycarpa P.G. Wilson	..	..	..	..	..	..	A1	..	..	..	.	.
Maireana pyramidata (Benth.) P.G. Wilson	..	A1	..	..	..	B4	..	B5	..	..	.	p
Maireana radiata (P.G. Wilson) P.G. Wilson	..	..	..	..	..	A1	B3	B2	..	..	.	.
Maireana sedifolia (F. Muell.) P.G. Wilson	..	..	A2	..	..	A5	D5	B3	A4	..	.	p
Maireana tomentosa Moq.	..	..	..	..	..	..	..	A1	..	..	.	.
Maireana trichoptera (J.M. Black) P.G. Wilson	..	A1	..	..	..	..	D3	..	A1	D3	.	.
Maireana triptera (Benth.) P.G. Wilson	..	B2	..	..	..	..	B2	..	..	..	.	.
Maireana hybrid (KRN 6950)	..	A1	..	..	..	A1	B3	..	..	..	.	.
Maireana hybrid (KRN 6951)	..	A1	..	..	..	..	..	..	..	..	.	.
Maireana georgei (Diels) P.G. Wilson × *Enchylaena tomentosa* R. Br. (KRN 8592)	..	..	..	..	..	..	..	B3	..	..	.	.
Rhagodia crassifolia R. Br.	..	A1	..	..	..	B4	..	B3	..	..	.	p
Rhagodia crassifolia R. Br. (a form – KRN 6996)	..	..	..	..	..	..	B2	B2	A1	..	.	p
Rhagodia drummondii Moq.	..	C3	A2	..	..	A4	E4	D3	D3	..	p	p
Rhagodia preissii Moq. ssp. *preissii*	..	A1	..	..	..	..	..	..	..	..	p	.
Salsola kali L.	..	..	..	..	..	A1	..	A2	..	..	p	.
Sclerolaena articulata (J.M. Black) A.J. Scott	..	..	..	..	..	D3	D3	..	..	..	.	p
Sclerolaena clavata (E.H. Ising) A.J. Scott	..	..	..	..	..	A1	..	..	..	..	.	.
Sclerolaena diacantha (Nees) Benth.	A3	D3	C2	..	..	E2	E4	E3	B2	E4	p	p
Sclerolaena drummondii (Benth.) Domin	..	..	..	..	..	..	..	A1	..	..	.	.
Sclerolaena eurotioides (F. Muell.) A.J. Scott	..	..	..	..	..	E2	..	..	..	..	.	.
Sclerolaena obliquicuspis (R.H. Anderson) Ulbrich	A3	B3	..	C3	..	A1	D3	C3	A1	..	p	p
Sclerolaena parviflora (R.H. Anderson) A.J. Scott	..	..	..	..	..	..	..	B1	A1	..	.	.
Sclerolaena uniflora R. Br.	..	..	..	..	..	..	..	B2	..	..	p	p
Sclerolaena aff. *convexula* (R.H. Anderson) A.J. Scott (KRN 8549)	..	..	..	..	..	A1	..	..	..	..	.	.
Sclerolaena sp. (KRN 8574)	..	..	..	..	..	A3	..	..	..	..	.	.
Suadea australis (R. Br.) Moq.	..	..	..	..	..	..	..	B2	..	..	.	p
CONVOLVULACEAE												
Convolvulus erubescens Sims	..	..	..	..	..	..	..	..	A1.	..	.	.

Species	Landform Unit B	G	HG	HR	HS	L	P	UN	UR	V	CO B	N
CRASSULACEAE												
Crassula colorata (Nees) Ostenf. var. *colorata*	..	B2	..	..	..	..	..	..	..	..	.	.
Crassula colorata (Nees) Ostenf. var. *miriamiae* (Ostenf.) Toelken	..	A3	..	..	..	..	..	..	..	..	.	.
Crassula exserta (Reader) Ostenf.	A2	E4	D3	C3	..	E3	E3	E2	B2	E3	p	.
Crassula peduncularis (S.M.) Meign.	..	A2	..	..	..	..	..	..	..	..	.	.
Crassula sieberiana (Schultes & J.H. Schultes) Druce ssp. *sieberiana*	..	C2	..	..	..	..	..	..	..	..	.	.
Crassula sieberiana (Schultes & J.H. Schultes) Druce ssp. *tetramera* Toelken	..	B2	..	..	..	..	..	..	..	..	.	.
CUPRESSACEAE												
Callitris columellaris F. Muell.	..	..	..	..	..	C5	..	..	..	..	.	.
Callitris preissii Miq. ssp. *verrucosa* (A. Cunn. ex Vogel) J. Garden	..	..	..	..	..	A4	A4	..	..	..	.	.
CYPERACEAE												
Gahnia lanigera (R. Br.) Benth.	..	A2	..	..	..	..	..	..	..	..	.	.
Isolepis congrua Nees	..	B3	..	..	..	..	..	..	..	..	.	.
Lepidosperma brunonianum Nees	..	A2	..	..	..	..	..	..	..	..	.	.
Lepidosperma drummondii Benth.	..	A3	..	..	..	A5	A5	..	..	B4	.	.
Lepidosperma resinosum (Nees) Benth.	..	A3	..	..	..	..	..	..	..	..	.	.
Lepidosperma viscidum R. Br.	..	B3	..	..	..	..	..	..	..	..	.	.
Lepidosperma viscidum R. Br. var. *flaccidum* Kukenthal	..	A3	B3	..	..	..	..	..	..	..	.	.
Lepidosperma sp. (KRN 7045)	..	..	..	..	D3	..	..	..	..	..	.	.
Schoenus nanus (Nees) Benth.	..	A2	..	..	..	..	..	..	..	..	.	.
Schoenus odontocarpus F. Muell.	..	..	..	..	..	..	A1	..	..	..	.	.
Schoenus sculptus (Nees) Boeck.	..	A4	..	..	..	..	..	..	..	..	.	.
DENNSTAEDTIACEAE												
Pleurosorus rutifolius (R. Br.) Fee	..	A3	A2	B2	..	..	..	..	A1	..	p	.
DROSERACEAE												
Drosera andersoniana (W.V. Fitz.) Ewart & White	..	A3	..	..	..	..	..	..	..	..	.	.
Drosera glanduligera Lehm.	..	A2	..	..	..	..	..	..	..	..	.	.
Drosera macrantha Endl. ssp. *macrantha*	..	D3	..	..	D2	..	..	..	..	..	.	.
Drosera menziesii R. Br.	..	A2	..	..	..	..	..	..	..	..	.	.
Drosera ramellosa Lehm.	..	A3	..	..	..	..	..	..	..	..	.	.
ELATINACEAE												
Elatine gratioloides A. Cunn.	..	A2	..	..	..	..	..	..	..	..	.	.
EPACRIDACEAE												
Leucopogon sp. (KRN 6954)	..	A2	..	..	..	..	..	..	..	..	.	.
Styphelia intertexta George	..	..	..	..	..	..	A1	..	..	..	.	.
EUPHORBIACEAE												
Beyeria brevifolia (Muell. Arg.) Benth. var. *truncata* Shaw	..	A1	..	..	..	..	A4	..	..	..	.	.
Beyeria lechenaultii (DC.) Baill.	..	..	..	C3	..	..	C3	B2	..	..	p	.

Species	Landform Unit B	G	HG	HR	HS	L	P	UN	UR	V	CO B	N
EUPHORBIACEAE cont.												
Bertya cupressoidea (Gruning) Shaw	..	..	..	..	..	..	A5	..	..	..	.	.
Euphorbia aff. *drummondii* Boiss. (KRN 8530)	..	..	B3	..	..	..	..	..	..	..	.	.
Euphorbia drummondii Boiss.	..	D2	A1	..	..	..	..	A1	A1	..	p	.
Euphorbia tannensis Spreng. ssp. *eremophila* (A. Cunn.) Hassall	..	..	..	A1	..	..	..	A1	..	..	p	.
Poranthera microphylla Brongn.	..	..	..	..	..	..	..	..	A1	..	.	.
FRANKENIACEAE												
Frankenia cinerea DC.	..	..	..	..	..	C2	A3	..	..	..	.	.
Frankenia pauciflora DC.	..	..	..	..	..	B3	..	..	..	..	.	.
Frankenia punctata Turcz.	..	..	..	..	..	B3	..	..	..	..	.	.
Frankenia sp. (KRN 6592)	..	..	..	..	..	E3	..	B2	..	..	.	p
GERANIACEAE												
**Erodium cicutarium* (L.) L'Herit.	A2	B4	B3	B2	..	B2	C3	..	B2	..	p	.
Erodium crinitum Carolin.	..	E3	D3	D3	..	C3	E3	D2	B2	E3	p	p
Erodium cygnorum Nees	..	B2	..	..	..	..	..	..	..	..	.	.
Erodium sp. (KRN 8526)	..	..	..	..	..	A3	..	..	..	..	.	.
GOODENIACEAE												
Brunonia australis Smith	..	..	..	..	..	..	..	..	..	A2	.	.
Coopernookia strophiolata (F. Muell.) Carolin	..	..	..	..	..	A1	..	..	..	..	.	.
Dampiera trigona De Vriese var. *latealata* E. Pritzel	..	A3	..	B3	..	..	..	A2	..	..	p	.
Dampiera tenuicaulis E. Pritzel var. *tenuicaulis*	..	..	..	..	..	..	..	..	A1	..	.	.
Goodenia berardiana (Gaud.) Carolin	..	A4	..	..	..	..	..	..	..	B3	.	.
Goodenia havilandii Maiden & Betche	..	B4	D3	..	..	..	..	A3	..	..	p	.
Goodenia krauseana Carolin	..	A2	..	..	..	..	..	..	..	..	.	.
Goodenia pinnatifida Schlecht	..	A4	..	..	..	..	A2	..	..	..	.	.
Goodenia triodiophila Carolin	..	..	..	..	..	..	..	..	A1	..	.	.
Goodenia aff. *havilandii* Maiden & Betche (KRN 6770)	..	A2	..	..	..	..	..	..	..	..	.	.
Goodenia sp. (KRN 8475)	..	..	..	..	..	..	..	A1	..	..	.	p
Scaevola bursariifolia J.M. Black	..	..	..	..	..	..	A1	..	..	..	.	.
Scaevola oxyclona F. Muell.	..	A2	..	..	..	..	..	..	..	..	.	.
Scaevola spinescens R. Br.	A1	A2	B2	E3	..	A2	E4	E4	B2	E4	p	p
Velleia hispida W.V. Fitzg.	..	A2	..	..	..	..	..	..	..	..	.	.
Velleia rosea S. Moore	..	A2	..	..	..	..	..	..	..	..	.	.
HALORAGACEAE												
Gonocarpus nodulosus Nees	..	C3	..	..	..	..	..	..	..	..	p	.
Haloragis gossei F. Muell.	..	A2	..	..	..	..	..	..	..	..	p	.
HYPOXIDACEAE												
Hypoxis glabella R. Br.	..	A2	..	..	..	..	..	..	..	..	.	.
Hypoxis leptantha Benth.	..	A1	..	..	..	..	..	..	..	..	.	.
ISOETACEAE												
Isoetes australis Williams	..	A4	..	..	..	..	..	..	..	..	.	.

Species	Landform Unit B	G	HG	HR	HS	L	P	UN	UR	V	CO B	N
JUNCACEAE												
**Juncus bufonius* L.	..	A2	..	..	..	..	..	..	..	..	.	.
Juncus pallidus R. Br.	..	A4	..	..	..	..	..	..	..	..	.	.
JUNCAGINACEAE												
Triglochin calcitrapa Hooker	..	E3	B3	..	..	A1	C2	..	..	C2	p	.
Triglochin centrocarpa Hooker	..	A2	A2	..	..	C2	..	..	..	..	.	.
Triglochin minutissima F. Muell.	..	A3	..	..	..	..	..	..	..	..	.	.
LAMIACEAE												
Prostanthera aspalanthoides A. Cunn. ex Benth.	..	B3	..	B3	C3	..	..	..	..	..	.	.
Prostanthera campbellii F. Muell.	..	..	..	..	..	A4	..	..	..	..	.	.
Prostanthera campbellii F. Muell. var. *crassifolia* Benth.	..	..	..	A1	..	..	..	..	..	..	.	.
Prostanthera grylloana F. Meull.	..	A4	..	..	..	..	..	..	..	..	.	.
Prostanthera serpyllifolia (R. Br.) Briq. ssp. *serpyllifolia*	..	..	..	..	..	..	..	..	A2	..	.	.
Prostanthera wilkieana F. Muell.	..	..	..	B2	..	..	A1	..	..	..	p	.
Prostanthera sp. (KRN 8541)	A3	..	..	..	..	..	..	..	..	..	.	.
Westringia cephalantha F. Muell.	..	..	..	..	..	A2	..	..	..	A2	.	.
Westringia rigida R. Br.	..	B2	..	..	..	B2	D3	D3	B2	..	.	p
LAURACEAE												
Cassytha melantha R. Br.	..	..	..	..	..	..	..	..	..	A1	.	.
LEGUMINOSAE subfamily CAESALPINIOIDEAE												
Cassia artemisioides Gaud.	..	B3	B1	B2	..	..	A1	B2	A2	..	p	p
Cassia cardiosperma F. Muell.	..	..	..	..	..	..	A2	..	..	..	.	.
Cassia nemophila A. Cunn. ex Vogel var. *nemophila*	A1	A3	C2	B2	..	A1	E4	E3	C2	E4	p	p
Cassia pleurocarpa F. Muell. var. *angustifolia* D.E. Symons	..	..	..	..	..	..	A1	..	..	..	.	.
LEGUMINOSAE subfamily MIMOSOIDEAE												
Acacia acuminata Benth.	..	E5	..	C3	C3	A1	B4	B2	D3	..	p	p
Acacia aneura F. Muell. ex Benth.	..	A2	..	..	..	..	..	..	..	..	.	p
Acacia beauverdiana Ewart & Sharman	..	A5	..	..	..	..	..	..	..	..	.	.
Acacia camptoclada C. Andrews	..	..	..	..	..	A1	A2	..	..	B2	.	.
Acacia colletioides Benth.	..	..	..	..	..	B2	C3	C3	..	..	.	.
Acacia enervia Maiden & Blakely	..	..	..	..	..	..	B3	..	..	..	.	.
Acacia eremophila W.V. Fitzg.	..	..	..	..	..	A3	A5	..	..	..	.	.
Acacia erinacea Benth.	..	A1	..	..	..	..	C3	C2	B2	..	.	p
Acacia gilesiana F. Muell.	..	..	..	..	..	A1	..	A4	..	..	.	.
Acacia hemiteles Benth.	..	A1	..	..	..	B3	D4	D4	B2	..	p	p
Acacia inamabilis E. Pritzel	..	..	..	..	..	..	A1	..	..	..	.	.
Acacia ixiophylla Benth.	..	..	..	..	..	..	..	..	A1	..	.	.
Acacia jennerae Maiden	..	A3	..	..	..	..	A3	B3	..	B3	p	p
Acacia lasiocalyx C. Andrews	..	A4	..	..	..	..	..	..	..	..	.	.
Acacia ligulata A. Cunn. ex Benth.	..	A3	..	..	..	A1	..	..	..	..	.	.
Acacia merrallii F. Muell.	..	..	..	..	..	A1	D4	C4	..	..	.	.

Species	Landform Unit B	G	HG	HR	HS	L	P	UN	UR	V	CO B	N
LEGUMINOSAE subfamily MIMOSOIDEAE cont.												
Acacia nyssophylla F. Muell.	..	..	..	..	..	..	C3	C3	..	..	.	.
Acacia oswaldii F. Muell.	..	..	..	..	..	..	A1	..	..	..	.	.
Acacia pachypoda Maslin	..	..	..	..	..	..	..	..	..	A2	.	.
Acacia prainii Maiden var. *linearis* Maiden	..	A2	..	..	..	..	..	..	..	..	.	p
Acacia quadrimarginea F. Muell.	..	B3	E4	E5	..	..	..	B3	..	..	p	p
Acacia resinomarginea W.V. Fitzg.	..	..	..	..	B4	..	..	..	..	..	.	.
Acacia tetragonophylla F. Muell.	A3	A3	D3	D4	..	A1	..	B4	..	..	.	p
Acacia uncinella Benth.	..	A3	..	..	..	..	..	..	A2	..	.	.
Acacia aff. *eremophila* W.V. Fitzg. (KRN 7170)	..	..	..	..	..	..	A2	..	..	..	.	.
Acacia aff. *duriuscula* W.V. Fitzg. (KRN 6992)	..	A4	..	..	..	..	..	..	..	..	.	.
Acacia aff. *uncinella* Benth. (KRN 8442)	..	A4	..	..	..	..	..	..	..	..	.	p
Acacia sp. (KRN 7568)	..	A5	..	..	..	..	..	..	..	..	.	.
Acacia sp. (KRN 8497)	..	A5	..	..	..	..	..	..	..	..	.	.
Acacia sp. (KRN 8572)	..	..	..	A2	..	..	..	..	..	..	p	.
Acacia sp. (KRN 9615)	..	..	..	..	..	..	..	..	A1	..	.	.
LEGUMINOSAE subfamily PAPILIONOIDEAE												
Bossiaea leptacantha E. Pritzel	..	..	..	..	..	..	B2	..	..	..	.	.
Brachysema daviesioides (Turcz.) Benth.	..	..	..	..	..	..	..	..	A1	..	.	.
Clianthus formosus (G. Don) Ford & Vickery	..	A2	..	..	..	..	..	..	A1	..	.	.
Daviesia benthamii ssp. *benthamii* Meisn.	..	..	..	..	..	A3	..	..	..	C3	.	.
Daviesia pachyloma Turcz.	..	A3	..	..	..	..	..	..	..	..	.	.
Glycine clandestina Willd.	..	B2	A1	..	..	..	..	..	A1	..	p	.
Glycyrrhiza acanthocarpa (Lindl.) J.M. Black	..	A2	..	..	..	..	..	..	..	..	.	.
Jacksonia sp. (KRN 5879)	..	..	..	..	..	B3	..	..	..	..	.	.
Kennedia prorepens (F. Muell.) F. Muell.	..	..	..	..	..	..	..	A2	..	..	.	.
Mirbelia microphylla (Turcz.) Benth.	..	C3	A2	..	B1	..	..	..	..	..	.	.
Pultenaea sp. (KRN 8444)	..	..	..	..	..	..	A1	..	..	..	.	.
Swainsona canescens (Benth.) F. Muell. var. *canescens*	..	..	..	..	..	..	..	A1	..	..	.	.
Swainsona microphylla A. Gray var. *microphylla*	..	..	..	..	..	..	..	A1	A1	..	.	.
Templetonia sulcata (Meisn.) Benth.	..	..	..	..	..	..	B3	..	..	..	.	.
LILIACEAE												
Arthropodium capillipes Endl.	..	D2	A2	..	..	..	..	..	..	..	.	.
Borya nitida Labill.	..	A3	..	..	..	..	..	..	..	..	.	.
Bulbine semibarbata (R. Br.) Haw.	C3	..	..	..	..	..	A2	..	..	..	p	.
Dianella revoluta R. Br.	..	C1	..	A1	C1	A1	..	..	A1	B1	p	.
Lomandra effusa (Lindl.) Ewart	..	..	..	..	..	B3	A3	..	..	C3	.	.
Lomandra leucocephala (R. Br.) Ewart	..	..	..	..	..	A2	..	..	..	..	.	.
Stypandra imbricata R. Br.	..	A1	..	..	..	..	..	..	..	..	.	.
Thysanotus patersonii R. Br. spp.												

Species	Landform Unit B	G	HG	HR	HS	L	P	UN	UR	V	CO B	N
LILIACEAE cont.												
manglesianus (Kunth.) N.H. Brittan	..	B2	..	..	..	..	..	..	..	..	.	.
Thysanotus patersonii R. Br. spp. *patersonii*	..	C1	..	..	A2	B1	A2	..	B1	B1	.	.
Thysanotus speckii N.H. Brittan	..	..	..	..	..	..	..	..	..	A1	.	.
Thysanotus aff. *pyramidalis* N.H. Brittan (KRN 8531)	..	..	A1	..	..	..	..	..	..	..	.	.
Wurmbea tenella (Endl.) Benth.	..	E2	D2	..	A1	C1	..	A1	A2	..	.	p
LOBELIACEAE												
Isotoma petraea F. Muell.	..	A3	A2	..	..	..	..	..	..	..	.	.
Isotoma scapigera (R. Br.) G. Don	..	..	..	..	..	A3	..	..	..	..	.	.
LOGANIACEAE												
Mitrasacme paradoxa R. Br.	..	..	B2	..	..	..	..	..	..	..	.	.
LORANTHACEAE												
Amyema benthamii (Blakely) Danser	..	A1	A1	..	..	..	..	..	..	..	.	.
Amyema miquelii (Lehm. ex Miq.) Tieghem	..	..	..	..	..	..	C3	C3	..	..	p	p
Amyema preissii (Miq.) Tieghem	..	A1	B1	..	..	..	..	..	..	..	.	.
MALVACEAE												
Abutilon sp. (KRN 7544)	..	A1	..	..	..	..	..	..	..	..	.	.
Alyogyne hakeifolia (Giord.) Alef.	..	..	..	A1	..	..	..	..	..	..	p	.
Lawrencia repens (S. Moore) Melville	..	..	..	..	..	..	B2	..	..	..	.	.
Radyera farragei (F. Muell.) Fryxell & Hashmi	..	..	..	..	..	..	..	A2	..	..	.	p
Sida calyxhymenia J. Gay ex DC.	A1	A2	B2	B2	..	..	..	B2	..	..	p	p
Sida sp. (KRN 6968)	..	C2	..	..	..	..	B2	..	..	..	.	.
MARSILEACEAE												
Marsilea sp. (KRN 6989)	..	A2	..	..	..	..	..	..	..	..	.	.
MYOPORACEAE												
Eremophila alternifolia R. Br.	A4	..	D4	E4	..	..	A3	C3	..	..	p	p
Eremophila caerulea (S. Moore) Diels	..	..	..	..	..	..	C3	C3	..	C3	.	.
Eremophila clarkei Oldfield & F. Muell. *sens. lat.*	..	A4	C3	B3	..	..	..	D3	..	..	.	p
Eremophila decipiens Ostenf.	..	C2	..	..	..	C2	E3	E3	C2	..	p	p
Eremophila dempsteri F. Muell.	A1	A2	..	..	..	..	B4	..	C3	..	.	.
Eremophila gibbosa Chinnock	..	A2	..	..	..	..	..	..	..	..	.	.
Eremophila glabra (R. Br.) Ostenf.	A1	A1	..	..	..	A1	..	D3	..	..	.	p
Eremophila interstans (S. Moore) Diels	..	..	..	..	..	..	B3	D4	A3	..	p	p
Eremophila ionantha Diels	..	A2	..	..	..	A1	C4	D3	A1	..	.	.
Eremophila oldfieldii F. Muell. var. *angustifolia* S. Moore	..	..	..	..	..	..	A3	..	..	..	.	.
Eremophila oppositifolia R. Br. var. *oppositifolia*	..	..	..	D3	..	..	A3	D4	..	..	.	p
Eremophila oppositifolia R. Br. var. *angustifolia* S. Moore	..	..	..	..	..	..	..	B3	..	..	p	.
Eremophila pachyphylla Diels	..	..	..	..	..	..	C4	C3	..	..	.	.
Eremophila paisleyi F. Muell. *sens. lat.*	..	..	..	..	..	A4	C4	C3	B3	..	.	.

Species	Landform Unit B	G	HG	HR	HS	L	P	UN	UR	V	CO B	N
MYOPORACEAE cont.												
Eremophila saligna (S. Moore) C.A. Gardner	..	..	..	..	..	..	A3	A2	B1	A2	.	.
Eremophila scoparia (R. Br.) F. Muell.	..	A4	..	..	..	B2	C4	D4	..	..	.	p
Eremophila serrulata (A. Cunn. ex A. DC.) Druce	..	C3	..	B3	..	..	..	A3	..	..	p	p
Eremophila veronica (S. Moore) C.A. Gardner	..	..	..	..	..	..	B3	..	..	..	.	.
Eremophila sp. (KRN 6930)	..	..	..	..	..	..	A1	..	..	..	.	.
Eremophila sp. (KRN 8103)	..	..	..	..	..	..	..	..	A5	..	.	.
Myoporum desertii A. Cunn. ex Benth.	..	A3	..	..	..	A1	B3	..	..	..	.	.
Myoporum platycarpum R. Br.	..	..	..	..	..	C3	B3	..	B2	..	.	.
MYRTACEAE												
Astartea sp. (KRN 8462)	..	..	..	B3	..	..	..	..	..	..	.	.
Baeckea carnosa S. Moore	..	A3	..	..	..	..	..	..	..	..	.	.
Baeckea crispiflora F. Muell.	..	A3	..	..	..	..	..	..	..	..	.	.
Baeckea sp. (KRN 7010)	..	..	..	..	E6	..	..	..	..	..	.	.
Calothamnus gilesii F. Muell.	..	A1	..	..	A2	..	..	..	..	..	.	.
Calytrix tetragona Labill.	A3	A3	..	..	..	..	..	..	..	..	.	.
Darwinia diosmoides (DC.) Benth.	..	..	..	..	..	C4	..	..	..	..	.	.
Eucalyptus brachyphylla C.A. Gardner	..	A1	..	..	..	..	..	..	..	..	.	.
Eucalyptus calycogona Turcz.	..	..	..	..	..	..	C4	..	..	..	.	.
Eucalyptus campaspe S. Moore	..	..	..	..	..	..	A5	..	..	..	.	.
Eucalyptus celastroides Turcz.	..	..	..	..	..	..	..	B2	..	..	.	.
Eucalyptus cylindrocarpa Blakely	..	..	..	..	..	..	B5	..	..	..	.	.
Eucalyptus dundasii Maiden	..	..	..	..	..	..	B5	..	..	..	.	.
Eucalyptus effusa Brooker	..	..	..	..	..	..	..	..	A3	..	.	.
Eucalyptus eremophila (Diels) Maiden	..	..	..	..	..	..	..	..	..	B5	.	.
Eucalyptus flocktoniae (Maiden) Maiden	..	..	..	..	..	..	D4	..	..	..	.	.
Eucalyptus foecunda Schauer	..	A2	..	..	..	B5	..	..	..	..	.	.
Eucalyptus gracilis F. Muell.	..	..	..	..	..	B4	D4	D4	..	D4	.	p
Eucalyptus griffithsii	..	A3	..	..	..	..	A5	A3	C4	B4	p	p
Eucalyptus grossa F. Muell. ex Benth.	..	A5	..	..	..	..	..	..	..	..	.	.
Eucalyptus kruseana F. Muell.	..	A2	..	..	..	..	..	..	..	..	.	.
Eucalyptus lesouefii	..	..	..	..	..	B4	C5	E5	..	..	.	p
Eucalyptus longicornis (F. Muell.) F. Muell. ex Benth.	..	..	..	..	..	..	D5	A3	..	..	.	.
Eucalyptus loxophleba Benth.	..	A5	..	..	..	..	..	..	..	..	.	.
Eucalyptus oleosa F. Muell. ex Miq. var. *oleosa*	..	..	..	..	..	..	D5	A5	A5	..	.	.
Eucalyptus oleosa F. Muell. ex Miq. var. *borealis* C.A. Gardner	..	..	..	A2	..	..	..	..	..	..	p	.
Eucalyptus peeneri (Blakely) L.D. Pryor & L.A.S. Johnson ex C.D. Boosma	..	..	..	..	..	..	..	A2	..	..	p	.
Eucalyptus petraea D.J. Carr & S.G.M. Carr	..	..	C3	..	..	..	..	..	..	..	.	.
Eucalyptus platycorys & Blakely	..	..	..	..	..	B5	..	..	..	..	.	.
Eucalyptus pyriformis Turcz.	..	..	..	..	..	..	..	..	A1	..	.	.

Species	Landform Unit B	G	HG	HR	HS	L	P	UN	UR	V	CO B	N
MYRTACEAE cont.												
Eucalyptus salmonophloia F. Muell.	..	..	..	..	..	..	C5	D5	..	B5	p	p
Eucalyptus salubris F. Muell.	..	..	..	..	..	..	E5	B2	B5	..	.	.
Eucalyptus stricklandii	A5	..	..	..	..	..	..	B4	..	..	.	.
Eucalyptus torquata Luehm.	..	..	..	..	..	..	..	E5	..	..	.	p
Eucalyptus transcontinentalis	..	..	..	..	..	..	B5	A2	..	C5	.	.
Eucalyptus uncinata Turcz.	..	..	..	..	..	..	..	..	A4	..	.	.
Eucalyptus websteriana	..	A3	..	B3	B3	..	..	A4	..	..	.	.
Eucalyptus aff. *conglobata* (R. Br. ex Benth.) (KRN 9710)	..	..	..	..	..	..	A3	..	..	..	.	.
Eucalyptus sp. (KRN 7169)	..	..	..	..	..	..	A3	..	..	..	.	.
Eucalyptus sp. (KRN 6959)	..	..	..	..	..	..	B4	..	..	..	.	.
Eucalyptus sp. (KRN 8493)	..	..	..	..	..	A3	..	..	..	..	.	.
Eucalyptus sp. (KRN 8577)	..	..	..	..	..	..	A3	..	..	..	.	.
Leptospermum erubescens Schauer	..	A4	..	..	..	..	..	..	..	..	.	.
Melaleuca acuminata F. Muell.	..	A1	..	..	..	..	..	..	..	..	.	.
Melaleuca coccinea George	..	A4	A3	..	..	..	..	..	..	..	.	.
Melaleuca eleuterostachya F. Muell.	..	..	..	..	..	A1	B3	C4	..	B3	.	.
Melaleuca elliptica Labill.	..	A3	A3	..	..	..	..	..	..	..	p	.
Melaleuca fulgens R. Br.	..	A4	B3	..	B3	..	..	..	A3	..	.	.
Melaleuca lateriflora Benth.	..	B4	..	..	..	..	..	..	..	..	.	.
Melaleuca pauperiflora F. Muell.	..	..	..	..	..	..	D4	..	A2	D3	.	.
Melaleuca quadrifaria F. Muell.	..	..	..	..	..	..	A4	..	..	..	.	.
Melaleuca uncinata R. Br.	..	E5	..	..	C3	C5	A5	..	..	B4	.	p
Melaleuca aff. *cuticularis* Labill. (KRN 8502)	..	..	..	..	..	A3	..	..	..	..	.	.
Melaleuca aff. *cymbifolia* Benth. (KRN 6274)	..	..	..	..	..	..	A2	..	..	..	.	.
Melaleuca aff. *pauperiflora* F. Muell. (KRN 7694)	..	..	..	..	A2	C4	E5	C4	..	..	.	.
Melaleuca sp. (KRN 7075)	..	..	..	..	..	..	B3	..	..	..	.	.
Melaleuca sp. (KRN 6958)	..	..	..	..	..	..	B3	..	..	..	.	.
Thryptomene australis Endl.	..	B4	..	B3	..	..	..	..	..	..	.	.
OPHIOGLOSSACEAE												
Ophioglossum lusitanicum L.	..	..	..	..	..	..	..	B2	..	..	p	.
ORCHIDACEAE												
Caladenia filamentosa R. Br. var. *denticulata* (Lindl.) H. Reichenb.	..	A2	..	..	A2	..	..	..	..	..	.	.
Caladenia filamentosa R. Br. var. *tentaculata* R.S. Rogers	..	A2	..	..	B3	..	..	..	..	..	.	.
Caladenia sigmoidea R.S. Rogers	..	..	..	..	..	..	..	..	..	B2	.	.
Diuris longifolia R. Br.	..	A1	..	..	..	..	..	..	..	..	.	.
Microtis unifolia (G. Forster) H. Reichenb.	..	A2	..	..	..	..	..	..	..	..	.	.
Pterostylis nana R. Br.	..	E2	B2	B2	D2	..	..	..	..	A2	p	p
Pterostylis sp. (KRN 9598)	..	..	..	..	..	..	A1	..	A1	B2	.	.
Thelymitra nuda R. Br.	..	A1	..	..	B1	..	..	..	..	B2	.	.
OXALIDACEAE												
Oxalis corniculata L.	..	A2	..	..	..	A1	..	..	A2	..	.	.

Species	Landform Unit B	G	HG	HR	HS	L	P	UN	UR	V	CO B	N
PITTOSPORACEAE												
Pittosporum phylliraeoides DC	..	B3	B3	A2	..	..	C2	C3	B2	..	p	p
PLANTAGINACEAE												
Plantago debilis R. Br.	..	B2	..	C2	..	C2	E3	E3	..	E3	p	p
Plantago drummondii Decaisne	..	..	..	..	..	..	A1	..	..	..	.	.
POACEAE												
Amphipogon turbinatus R. Br.	..	B3	..	..	..	B3	..	..	..	..	.	.
Aristida contorta F. Muell.	..	B4	..	C3	..	..	..	B4	A1	B3	p	p
Danthonia setacea R. Br.	..	..	..	..	..	..	..	..	B3	..	.	.
Danthonia pallida R. Br.	..	..	..	..	..	..	A1	..	..	..	.	.
Eragrostis australasica (Steud.) C.E. Hubbard	..	..	..	..	..	..	..	A2	..	..	.	.
Eragrostis dielsii Pilger ex Diels & Pritzel	..	D4	C3	..	..	..	..	..	..	A2	p	.
Eriachne mucronata R. Br. var. *desertorum* C.A. Gardner	..	..	..	..	..	A3	..	..	A2	..	.	.
Eriachne pulchella Domin	..	A1	..	..	..	..	..	..	..	..	.	.
**Lophochloa pumila* (Desf.) Bor	A3	..	..	..	..	B3	C2	B3	B2	..	.	.
**Pentaschistis airoides* (Nees) Stapf	..	C4	B2	..	C3	B3	B2	..	..	C2	p	.
Spartochloa scirpoidea (Steud.) C.E. Hubbard	..	A4	..	..	..	..	..	..	..	..	.	.
Stipa elegantissima Labill.	..	A2	..	C2	..	B1	E2	E2	B1	..	p	p
Stipa eremophila Reader	..	..	..	..	..	A4	C3	A4	B2	..	p	.
Stipa trichophylla Benth.	..	A2	..	A2	..	..	A2	..	..	B3	p	.
Thyridolepis multicaulis (Pilger) S.T. Blake	..	A1	..	..	..	..	..	..	..	..	.	.
Triodia scariosa N.T. Burbidge	..	D4	..	..	..	D5	B4	A5	D5	B4	.	.
Tripogon loliiformis (F. Muell.) C.E. Hubbard	..	B2	B3	..	..	A3	..	..	..	..	p	.
**Vulpia myuros* (L.) C.D. Gmelin	..	..	B3	..	..	..	..	..	..	..	.	.
Genus indet. (KRN 7232)	..	..	..	..	..	..	..	..	A2	..	.	.
POLYGALACEAE												
**Emex australis* Steinh.	..	..	..	..	..	..	..	..	B3	..	.	.
Muehlenbeckia adpressa (Labill.) Meisn.	..	A1	..	..	..	..	..	..	..	..	.	.
PORTULACACEAE												
Calandrinia calyptrata J.D. Hooker	..	A3	..	..	..	..	..	..	..	..	.	.
Calandrinia eremaea Ewart	..	A2	..	..	..	..	..	..	..	..	.	.
Calandrinia granulifera Benth.	..	D4	..	..	..	A3	..	..	..	D3	.	.
Calandrinia polyandra Benth.	A3	E4	C3	D3	..	B3	E3	E3	C3	D3	p	.
Calandrinia porifera Syeda	..	A3	..	..	..	..	..	..	..	..	.	.
Calandrinia sp. (KRN 7113)	..	..	..	..	..	..	..	..	A2	..	.	.
PRIMULACEAE												
**Anagallis arvensis* L.	A1	C3	A3	A2	..	..	B2	..	..	B2	p	.
PROTEACEAE												
Grevillea acuaria (F. Muell.) Benth.	..	A2	..	..	..	D3	C4	B3	..	B3	.	p
Grevillea heugelii S. Moore	..	..	..	..	..	..	B3	..	..	B2	.	.
Grevillea juncifolia Hooker	..	..	..	..	..	A3	..	..	..	..	.	.
Grevillea nematophylla F. Muell. (a form – KRN 8249)	..	..	..	..	B1	..	..	..	..	..	.	.

Species	Landform Unit B	G	HG	HR	HS	L	P	UN	UR	V	CO B	N
PROTEACEAE cont.												
Grevillea oligantha F. Muell.	..	..	..	..	..	..	A4	..	..	..	.	.
Grevillea oncogyne Diels	..	..	..	..	..	A1	..	..	..	..	.	.
Grevillea paniculata Meisn.	..	A1	..	..	..	..	..	..	..	..	.	.
Grevillea pectinata R. Br.	..	..	..	..	..	..	B3	..	..	..	.	.
Grevillea pterosperma F. Muell.	..	..	..	..	..	..	A3	..	..	..	.	.
Grevillea sarissa S. Moore	..	..	..	..	..	A1	..	..	..	..	.	.
Grevillea teretifolia Meisn.	..	A2	..	..	..	..	..	..	A2	..	.	.
Grevillea sp. (KRN 6905)	..	A4	..	..	B3	..	..	..	..	..	.	.
Hakea arida Diels	..	..	A2	..	..	..	..	..	..	..	.	.
Hakea francisiana F. Muell.	..	..	..	..	..	A3	..	..	..	..	.	.
Hakea kippistiana Meisn.	..	..	..	..	..	A3	..	..	..	..	.	.
Persoonia teretifolia R. Br.	..	..	..	..	..	..	..	..	..	B2	.	.
RANUNCULACEAE												
Myosurus minimus L.	..	..	..	..	..	..	A1	..	..	..	.	.
Ranunculus pentandrus J.M. Black var. *platycarpus* (F. Muell.) Hj. Eichler	..	A2	..	..	..	..	..	..	..	..	.	.
RHAMNACEAE												
Cryptandra miliaris Reiss.	..	..	..	A2	..	..	..	..	..	..	.	.
Cryptandra parvifolia Turcz.	..	C3	..	..	..	A4	B3	..	C2	..	.	.
Cryptandra pungens Steud.	..	A2	..	..	B2	..	..	..	..	..	.	.
Cryptandra sp. (KRN 8566)	..	..	..	..	..	A3	..	..	..	..	.	.
Spyridium complicatum F. Muell.	..	A3	..	..	..	..	..	..	..	..	.	.
Trymalium aff. *ledifolium* Fenzl) (KRN 5606)	..	A4	..	..	C3	..	..	C3	B3	..	.	.
Genus indet. (KRN 7073)	..	..	..	..	..	..	A2	..	..	..	.	.
RUBIACEAE												
Opercularia spermacocea Labill.	..	A3	..	..	..	..	..	..	..	..	.	.
RUTACEAE												
Boronia fabianoides (Diels) P.G. Wilson	..	..	..	..	..	..	A1	..	..	..	.	.
Geijera linearifolia (DC.) J.M. Black	..	..	..	..	..	..	C3	..	C3	..	.	.
Microcybe multiflora Turcz.	..	..	..	..	..	..	A1	..	..	..	.	.
Phebalium filifolium Turcz.	..	..	..	..	..	A1	B2	..	..	..	.	.
Phebalium lepidotum (Turcz.) P.G. Wilson var. *ledidotum*	..	..	..	..	..	..	..	A3	A1	..	.	.
Phebalium tuberculosum (F. Muell.) Benth. var. *tuberculosum*	..	A2	..	..	..	..	A2	..	..	..	.	.
SANTALACEAE												
Exocarpos aphyllus R. Br.	..	A1	..	..	..	B3	E4	E4	A3	E4	p	p
Exocarpos cupressiformis Labill.	..	..	..	..	..	A3	..	..	..	..	.	.
Exocarpos sparteus R. Br.	..	..	..	..	..	..	..	..	..	A1	.	.
Santalum acuminatum (R. Br.) A. DC.	A2	A1	B2	..	..	C2	D3	E3	B2	E3	.	p
Santalum spicatum (R. Br.) A. DC.	A1	C3	A3	B3	..	..	B2	D3	..	B2	p	p
SAPINDACEAE												
Dodonaea adenophora Miq.	..	A3	..	C4	..	..	..	..	..	..	p	.
Dodonaea angustissima Hort. ex DC.	..	..	..	..	A2	E3	A2	..	B2	..	.	.
Dodonaea attenuata A. Cunn.	..	A3	..	..	..	..	..	..	..	..	.	.

Species	Landform Unit B	G	HG	HR	HS	L	P	UN	UR	V	CO B	N
SAPINDACEAE cont.												
Dodonaea boroniifolia G. Don	..	A3	..	..	..	..	..	..	..	..	.	.
Dodonaea lobulata F. Muell.	A2	B3	C3	C4	..	..	A2	D4	..	..	.	p
Dodonaea microzyga F. Muell.	..	B2	..	..	..	..	..	..	..	..	.	.
Dodonaea stenozyga F. Muell.	..	A1	..	..	A1	..	B2	C3	B3	..	.	.
Heterodendron oleifolium Desf.	..	..	B2	..	..	A3	B3	..	C3	..	.	.
SCROPHULARIACEAE												
Glossostigma drummondii Benth.	..	A4	..	..	..	..	..	..	..	..	.	.
Limosella curdieana F. Muell.	..	..	..	..	..	..	A1	..	..	..	.	.
SOLANACEAE												
Lycium australe F. Muell.	..	A3	..	..	..	D2	..	C3	..	..	.	p
Nicotiana rotundifolia Lindl.	..	D2	..	A2	..	..	..	..	..	..	p	.
Solanum hoplopetalum Bitt. & Summerh.	..	..	..	..	..	..	B2	..	..	..	.	.
Solanum lasiophyllum Dunal ex Poir	..	D2	D2	C2	..	..	A2	D3	D2	..	p	p
**Solanum nigrum* L.	..	A1	..	..	..	..	..	..	..	..	p	.
Solanum nummularium S. Moore	..	B1	..	..	..	..	A1	C2	B2	..	p	.
Solanum petrophilum F. Muell.	..	B2	D3	..	..	..	..	..	..	..	p	.
Solanum plicatile (S. Moore) Symon	..	..	..	..	..	..	B2	..	..	..	.	.
STACKHOUSIACEAE												
Stackhousia huegelii Endl.	..	A2	..	..	..	..	..	..	..	..	.	.
Stackhousia georgei Diels	..	A2	..	..	..	..	..	..	..	..	.	.
STERCULIACEAE												
Brachychiton gregorii F. Muell.	..	B2	B2	C3	..	..	..	..	..	..	.	p
Commersonia sp. (KRN 7229)	..	A2	..	..	..	..	E2	D2	D2	..	p	.
Keraudrenia integrifolia Steud.	..	A1	.	.	.	A3	..	..	..	..	.	.
Lasiopetalum aff. *ogilvieanum* F. Muell. (KRN 7101)	..	..	..	..	..	..	..	..	A1	..	.	.
Rulingia luteiflora E. Prtizel	..	A1	..	..	..	..	..	C3	..	..	p	p
THYMELAEACEAE												
Pimelea microcephala R. Br.	..	B2	B2	B3	..	..	A1	A1	B2	..	p	.
Pimelea thesioides S. Moore	..	A2	..	D2	A2	..	..	..	..	..	p	.
URTICACEAE												
Parietaria debilis G. Forster	A1	B3	D3	B2	..	..	..	..	..	..	p	.
VIOLACEAE												
Hybanthus epacroides (C.A. Gardner) Melch.	..	..	..	..	..	..	..	..	A1	..	.	.
Hybanthus floribundus (Lindl.) F. Muell. ssp. *curvifolius* E.M. Bennett	..	..	..	..	..	..	..	..	A1	..	.	.
ZYGOPHYLLACEAE												
Zygophyllum apiculatum F. Muell.	..	A1	..	..	..	..	..	D3	..	..	.	.
Zygophyllum compressum J.M. Black	..	..	..	..	..	A1	..	..	..	..	.	.
Zygophyllum eremaeum (Diels) Ostenf.	..	A1	..	..	..	C2	..	C3	..	..	p	p
Zygophyllum glaucum F. Muell.	..	..	..	..	..	..	D3	D3	..	..	.	.
Zygophyllum ovatum Ewart & J. White	A3	B2	..	..	..	A2	D3	D3	B3	..	p	p

Species	Landform Unit										CO	
	B	G	HG	HR	HS	L	P	UN	UR	V	B	N
ZYGOPHYLLACEAE cont.												
Zygophyllum aff. *aurantiacum* (Lindl.) F. Muell.	..	A1	..	..	..	B1	B2	..	A2	..	.	.
Zygophyllum aff. *fruiticulosum* DC. (KRN 6919)	..	..	..	..	..	..	B2	..	..	..	.	.

Appendix III

Additional Vegetation Data for Fauna Sites

Some of the fauna sample sites were other than the typical vegetation sites described in Appendix I. Each of the former sites is described and their differences from the typical vegetation descriptions are listed below. Brief descriptions are presented for WZ32a and WZ37a as they were not sampled in detail. "Differences" presents major differences of plant species with CC = 1, or greater. "No dominants" indicates that CC of species was less than 1. Some of the sites have their strata numbers different from those of the typical sites. In these cases, strata are defined by life form and height range. The last description is of an atypical vegetation site (WZ40). See Appendix I for explanation of terms and codes.

WZ7a Granite Complex

LOCATION: Uraryie Rock, 22 km SW of Zanthus (31° 11'20"S lat., 123° 25'30"E long.)
FAUNA SAMPLED: Yes DATE: 15-8-1980

The site is a composite of two vegetation types. (i) Granite Complex occurred on the small, low-domed and largely bare exposure with a few, small sheets of soil, as well as the narrow, peripheral inner apron. (ii) *Acacia acuminata* Tall Shrubland was present on the outer apron and covered 3-4 ha.

(i) Granite Complex

VEGETATION MUIR: Ji.GLr

Stratum 1a: Shrubs 0.0-0.1 m, CC = +, clumping none *Vittadinia* sp. (KRN 8620) (+).

Stratum 1b: Misc. plants, CC = 52.6, clumping slight. Annuals: *Chrysocoryne pusilla* (15), *Calandrinia granulifera* (10), *Chthonocephalus pseudevax* (5), *Centrolepis* sp. (KRN 7122) (4), *Toxanthes perpusillus* (4), *Actinobole uliginosum* (2), *Calandinia* sp. (KRN 7113) (2), *C. polyandra* (2), *Crassula exserta* (2), *Isolepis congrua* (0.2), *Brachycome iberidifolia* (+), *Euphorbia drummondii* (+), *Senecio lautus* ssp. *dissectifolius* (+), *Triglochin calcitrapa* (+), *Wurmbea tenella* (+).
Aquatics: *Glossostigma drummondii* (0.1).
Perennial grasses: *Eragrostis dielsii* (3), *Tripogon loliiformis* (3).

No. of TAXA: 18 LAST BURNT: <30 years
MODIFICATION: Light grazing by stock, rabbits and camels

LANDFORM
BEDROCK: Granite GEOLOGICAL SURFACE: (Za) Px
UNIT: Granite Exposure ELEMENT: Inner apron, soil sheets

SOIL
GROUP: Granitic Soils NORTHCOTE: Uc1.13
MAIN ORIGIN: Colluvial DRAINAGE: Variable
PROFILE ATTRIBUTE: Skeletal SURFACE: Hardsetting
ROCK: Nil
STONE: 0-6% cover, subangular granite 2-10 cm long, patchy.
PAVEMENT: 0-15% cover, material 2-10 mm long, patchy.
LITTER: Nil

SOIL PROFILE
A 0-15 cm Dusky red loamy fine sand; firm; no obvious weathering zone.

(ii) *Acacia acuminata* Tall Shrubland

VEGETATION MUIR: Sr.SDi.Jr

Stratum 1: Shrubs 2.1-3.0 m, CC = 4.1, clumping moderate *Acacia acuminata* (4), *A. ligulata* (0.1).

Stratum 2: Shrubs 1.1-1.5 m, CC = 0.2, clumping none *Dodonaea lobulata* (0.2).

Stratum 3a: Shrubs 0.0-0.5 m, CC = 15.4, clumping slight *Atriplex vesicaria* (15), *Sida* sp. (KRN 6968) (0.2), *Enchylaena tomentosa* (+), *Sclerolaena obliquicuspis* (+), *Solanum lasiophyllum* (+), *S. nummularium* (+), *Vittadinia* sp. (KRN 8620) (+).

Stratum 3b: Misc. plants, CC = 5.2, clumping slight. Annuals: *Tetragonia eremaea* (2), *Calandrinia polyandra* (1), *Crassula exserta* (0.1), **Erodium cicutarium* (0.1), *Brachycome iberidifolia* (+), *Chenopodium cristatum* (+), *Chrysocoryne pusilla* (+), *Chthonocephalus pseudevax* (+), *Clianthus formosus* (+), *Euphorbia drummondii* (+), *Podolepis capillaris* (+), *Senecio lautus* ssp. *dissectifolius* (+), *Triglochin centrocarpa* (+), *Zygophyllum aurantiacum* (+).
Perennial Grasses: *Triodia scariosa* (1), *Eragrostis dielsii* (0.2).

No. of TAXA: 26 LAST BURNT: 40 years

MODIFICATION: Moderately grazed by stock, rabbits and camels. An abandoned well was used in the past to water stock.

LANDFORM

BEDROCK: Granite GEOLOGICAL SURFACE: (Za) Qpc

UNIT: Granite Exposure ELEMENT: Outer apron

SOIL

GROUP: Granitic Soils NORTHCOTE: Uc1.13

MAIN ORIGIN: *In situ* weathering DRAINAGE: Good

PROFILE ATTRIBUTE: Shallow SURFACE: Hardsetting

ROCK: Nil STONE: Nil PAVEMENT: Nil

LITTER: Leaves narrow, deposits 3 cm thick, averaging 20 m apart.

SOIL PROFILE

A 0-53 cm Dark reddish brown sandy loamy; firm; too dry to auger deeper.

COMMENTS

The vegetation composite more closely resembles Granite Complex than *Acacia acuminata* Tall Shrubland. The upper stratum of the latter vegetation type was more open than the normal range (4.1 vs. 15-35). Past grazing around the well was responsible.

DIFFERENCES:

Differs from typical site (WZ7) by: Shrubs 2.1-3.0 – *Acacia* aff. *duriuscula* (5) and *Thyptomene australis* (5) absent; shrubs 0.6-1.0 m – *Grevillea* sp. (KRN 6905) (2) absent; shrubs 0.0-0.5 m – *Atriplex vesicaria* (14) present; annuals of *Drosera macrantha* ssp. *macrantha* (2) replaced by *Chrysocoryne pusilla* (3), *Tetragonia eremaea* (2), *Calandrinia granulifera* (1), *C. polyandra* (1), *Chthonocephalus pseudevax* (1), *Toxanthes perpusillus* (1); perennial grasses – *Triodia scariosa* (1) additional.

WZ16a *Halosarcia* Low Shrubland

LOCATION: 10 km NE. of Buningonia Spring (31°21'20"S lat., 123°36'10"E long.)

FAUNA SAMPLED: Yes DATE: 14-8-1980

VEGETATION MUIR: SDi

Stratum 1a: Shrubs 0.0-0.5 m, CC = 24.2, clumping slight *Halosarcia halocnemoides* ssp. *halocnemoides* (15), *H. doleiformis* (4), *Atriplex* sp. (KRN 7218) (2), *H. peltata* (2), *Disphyma clavellatum* (1), *Maireana appressa* (0.1), *Frankenia cinerea* (+), *Sclerolaena eurotioides* (+), *Zygophyllum compressum* (+).

Stratum 1b: Misc. plants, CC = 0.5, clumping moderate. Annuals: *Tetragonia eremaea* (0.2), *Atriplex spongiosa* (+), *Brachycome iberidifolia* (+), *B. lineariloba* (+), *Crassula*

exserta (+), **Erodium cicutarium* (+), *Senecio lautus* ssp. *dissectifolius* (+), *Triglochin centrocarpa* (+).
Perennial Grasses: *Stipa trichophylla* (+).

No. of TAXA: 19 LAST BURNT: No evidence of burning
MODIFICATION: None known or evident
LANDFORM
BEDROCK: Unknown GEOLOGICAL SURFACE: (Za) Qre
UNIT: Salt Lake Features ELEMENT: Floor of small salt lake
SOIL
GROUP: Saline Soils NORTHCOTE: Uc5.22
MAIN ORIGIN: Alluvial DRAINAGE: Poor
PROFILE ATTRIBUTE: Saline SURFACE: Crusting
ROCK: Nil STONE: Nil PAVEMENT: Nil LITTER: Nil
SOIL PROFILE
A 0-30 cm Yellowish red loamy fine sand; friable; not calcareous; pH 8.25.
B 30-100 cm Reddish yellow sandy loam; friable; not calcareous; pH 8.0.
DIFFERENCES:
Differs from typical site (WZ16) by: Stratum 1a – *Halosarcia halocnemoides* ssp. *halocnemoides* (15), *H. doleiformis* (4) and *Atriplex* sp. (KRN 7218) (2) replaced *Mairaena glomerifolia* (20), *H. syncarpa* (7) and *Atriplex* sp. (KRN 6110) (2).

WZ18a *Eucalyptus salmonophloia* Woodland
LOCATION: 23 km SE. of Sinclair Soak (31° 54'50"S lat., 122° 24'50"E long.)
FAUNA SAMPLED: Yes DATE: 12-8-1980
VEGETATION MUIR: Mr.Sr.SAr.SCr.SDi

Stratum 1: Trees 15-17 m, CC = 5, clumping slight *Eucalyptus salmonophloia* (5).
Stratum 2: Trees 10-13 m, CC = 1, clumping moderate *Eucalyptus longicornis* (1).
Stratum 3: Shrubs 2.1-5 m, CC = 4.1, clumping moderate *Myoporum platycarpum* (3), *Pittosporum phylliraeoides* (1), *Dodonaea angustissima* (0.1), *Exocarpos aphyllus* (+).
Stratum 4: Shrubs 1.6-2.0m. CC = 4.1, clumping slight *Eremophila scoparia* (2). *Atriplex nummularia* (1), *Santalum acuminatum* (1), *Acacia jennerae* (+). *Pimelea microcephala* (+).
Stratum 5: Shrubs 1.1-1.5 m, CC = 0.1, clumping none *Beyeria brevifolia* (0.1).
Stratum 6: Shrubs 0.6-1.0 m, CC = 3, clumping slight *Scaevola spinescens* (3), *Cassia nemophila* var. *nemophila* (+).
Stratum 7a: Shrubs 0.0-0.5 m, CC = 11.8, clumping slight *Cratystylis conocephala* (6), *Atriplex vesicaria* (4), *Olearia muelleri* (1), *Rhagodia drummondii* (0.5), *Sclerolaena diacantha* (0.2), *Enchylaena tomentosa* (+), *Sarcozona praecox* (+).
Stratum 7b: Misc. plants, CC = 1, clumping strong. Annuals: *Actinobole uliginosum* (+), **Anagallis arvensis* (+), *Calandrinia polyandra* (+), *Calotis hispidula* (+), *Crassula exserta* (+), *Eriochiton sclerolaenoides* (+), *Harmsoidea brevipes* (+), *Heliotropium* sp. (KRN 6982) (+), *Helipterum pygmaeum* (+), **Pentaschistis airoides* (+), *Senecio glossanthus* (+).

No. of TAXA: 34 LAST BURNT: 150 years
MODIFICATION: Cut over for mining timber.
LANDFORM
BEDROCK: Unknown GEOLOGICAL SURFACE: (Wi) Qps
UNIT: Calcareous Plain ELEMENT: Level plain

SOIL
GROUP: Deep Calcareous Earths NORTHCOTE: Gn2.16
MAIN ORIGIN: *In situ* weathering DRAINAGE: Good
MAIN ATTRIBUTE: Calcareous B SURFACE: Crusting
ROCK: Nil STONE: Nil PAVEMENT: Nil
LITTER: Trunks few; branches few; leaves broad, deposits 3 cm thick, averaging 30 m apart.

SOIL PROFILE
Same as WZ18

DIFFERENCES:
Differs from typical site (WZ18) by: Stratum 2 *Myoporum platycarpum* ((3), 4-5 m high), *Santalum acuminatum* (1) additional; stratum 3 – *Eremophila scoparia* (2) additional; stratum 5 – *Cratystylis conocephala* (6) additional, *Scaevola spinescens* reduced from (15) to (3), and *Rhagodia drummondii* from (3) to (0.5). CC of annuals was reduced from 3% to 0.5%, and the number of annual species from 19 to 9 – all with CC = +.

WZ24a *Eucalyptus oleosa* Low Woodland
LOCATION: 3 km NNE. of Buningonia Spring (31° 24'40"S lat., 123° 34'20"E long.)
FAUNA SAMPLED: Yes DATE: 14-8-1980

VEGETATION MUIR: LAr.SDi

Stratum 1: Trees 5-10 m, CC = 7, clumping none *Eucalyptus oleosa* (4), *Casuarina cristata* ssp. *pauper* (3), *Amyema miquelii* parasitic on *E. oleosa* (+).

Stratum 2: Shrubs 2.1-3.5 m, CC = 1.2, clumping none *Heterodenrum oleifolium* (1), *Exocarpos aphyllus* (0.2), *Myoporum deserti* (+).

Stratum 3: Shrubs 1.6-2.0 m, CC = 0.2, clumping slight *Acacia hemiteles* (0.2), *Eremophila scoparia* (+).

Stratum 4: Shrubs 0.6-1.0 m, CC = 0.1, clumping none *Cassia artemisioides* (+), *C. nemophila* var. *nemophila* (+), *Eremophila decipiens* (+).

Stratum 5a: Shrubs 0.0-0.5 m, CC = 11.7, clumping slight *Maireana sedifolia* (10), *Olearia muelleri* (1), *Atriplex vesicaria* (a form) (0.5), *Commersonia* sp. (KRN 7229) (+), *Ptilotus obovatus* var. *obovatus* (+), *Maireana georgei* (+), *M. trichoptera* (+), *Rhagodia drummondii* (+), *Sclerolaena diacantha* (+).

Stratum 5b: Misc. plants, CC = 0.2, clumping none. Annuals: *Crassula exserta* (+), *Eriochiton sclerolaenoides* (+), *Zygophyllum ovatum* (+).
Perennial Grasses: *Stipa elegantissima* (+), *S. trichophylla* (+).

No. of TAXA: 25 LAST BURNT: *ca* 100 years
MODIFICATION: None known or evident

LANDFORM
BEDROCK: Unknown GEOLOGICAL SURFACE: (Za) Qpe
UNIT: Calcareous Plain ELEMENT: Level Surface

SOIL
GROUP: Deep Calcareous Earths NORTHCOTE: Um5.22
MAIN ORIGIN: *In situ* weathering DRAINAGE: Good
PROFILE ATTRIBUTE: Calcareous SURFACE: Crusting
ROCK: Nil STONE: Nil
PAVEMENT: 0-10% cover of material 3-18 mm across, patchy.
LITTER: Trunks few; branches few; leaves broad, deposits 2 cm thick under eucalypts, averaging 10 m apart.

SOIL PROFILE
A 0-24 cm Reddish brown fine sandy loam; friable; highly calcareous; pH 8.25.

B 24-59 cm Red sandy clay; friable; inclusions 30-50% carbonate nodules 5-18 mm across; highly calcareous; pH 8.75.
C 59-100 cm Reddish yellow sandy clay loam; friable; inclusions 5-10% soft carbonate nodules; slightly calcareous; pH 8.5.

DIFFERENCES:
Differs from typical site (WZ24) by: Stratum 1 – *Eucalyptus oleosa* reduced from (16) to (4), and *Casuarina cristata* ssp. *pauper* (3) additional; stratum 2 – *Acacia hemiteles* (2) replaced by *Heterodendrum oleifolium* ((1), 3-4 m high); stratum 4 – no dominants; stratum 5a – *Maireana sedifolia* (10) additional.

WZ25a *Eucalyptus salubris* Low Woodland

LOCATION: 6 km SSE. of Buningonia Spring (31°28'10"S lat., 123°36'00"E long.)
FAUNA SAMPLED: Yes DATE: 14-8-1980

VEGETATION MUIR: LAr.SCr.SDr

Stratum 1: Trees 8-11 m, CC = 6.2, clumping slight *Eucalyptus salubris* (6), *E. oleosa* (0.2).
Stratum 2: Shrubs 2.1-4.0 m, CC = 0.4, clumping none *Heterodendrum oleifolium* (0.2), *Acacia nyssophylla* (0.1), *Santalum acuminatum* (0.1), *Exocarpos aphyllus* (+).
Stratum 3: Shrubs 1.6-2.0 m, CC = 0.1, clumping none *Geijera linearifolia* (0.1), *Eremophila ionantha* (+).
Stratum 4: Shrubs 1.1-1.5 m, CC = 0.1, clumping none *Cassia nemophila* var. *nemophila* (+), *Eremophila decipiens* (+), *E. scoparia* (+).
Stratum 5: Shrubs 0.6-1.0 m, CC = 3.2, clumping none *Cratystylis conocephala* (1), *Maireana sedifolia* (1), *Scaevola spinescens* (1), *Rhagodia drummondii* (0.2).
Stratum 6a: Shrubs 0.0-0.5 m, CC = 6.2, clumping slight *Atriplex vesicaria* (a form) (6), *Enchylaena tomentosa* (+), *Ptilotus holosericeus* (+), *P. obovatus* var. *obovatus* (+), *Sclerolaena diacantha* (+), *Solanum nummularium* (+), *S. plicatile* (+).
Stratum 6b: Misc. plants, CC = 0.6, clumping moderate. Annuals: *Actinobole uliginosum* (+), *Calandrinia polyandra* (+), *Calotis hispidula* (+), *Crassula exserta* (+), **Erodium cicutarium* (+), *Helipterum pygmaeum* (+), *Isoetopsis graminifolia* (+), *Menkea australis* (+), *Tetragonia eremaea* (+).
Perennial Grasses: *Stipa trichophylla* (0.1).

No. of TAXA: 33 LAST BURNT: *ca* 100 years
MODIFICATION: None known or evident.

LANDFORM
BEDROCK: Unknown GEOLOGICAL SURFACE: (Za) Qpe
UNIT: Calcareous Plain ELEMENT: Level surface

SOIL
GROUP: Deep Calcareous Earths NORTHCOTE: Um5.12
MAIN ORIGIN: *In situ* weathering DRAINAGE: Good
MAIN ATTRIBUTE: Calcareous SURFACE: Crusting
ROCK: Nil STONE: Nil
PAVEMENT: 0-20% cover of material 6-15 mm across, patchy.
LITTER: Trunks few; branches many; leaves broad, deposits 2 cm thick, averaging 15 m apart.

SOIL PROFILE
A 0-31 cm Dark reddish brown sandy clay loam; very friable; not calcareous; pH 8.0.
B 31-100 cm Red sandy clay loam; firm; inclusions 50-60% carbonate nodules 4-15 mm across at top of horizon, decreasing to 10-15% at bottom of auger hole; highly calcareous; pH 8.0.

DIFFERENCES:
Differs from typical site (WZ25) by: Mallees – absent; shrubs 2.1-2.4 m – no dominants; shrubs 1.6-2.0

m – no dominants; shrubs 1.1-1.5 m – no dominants; shrubs 0.6-1.0 m – *Cratystylis conocephala* (1), *Maireana sedifolia* (1) and *Scaevola spinescens* (1) additional; *Cratystylis conocephala* (25) and *Atriplex vesicaria* (3) replaced by *A. vesicaria* (a form) (6).

WZ32a Lake ecotone

LOCATION: Southern end of Harris Lake (31° 19'30"S lat., 123° 36'30"E long.)
FAUNA SAMPLED: Yes DATE: 15-8-1980

GENERAL DESCRIPTION

The area sampled was an intricate mosaic of salt lake features supporting a number of low shrublands and a hummock grassland. Boundaries between vegetation types were rarely clearly defined. On the lower valley slope, *Maireana sedifolia* ((15), 0.5-0.8 m high) was the main cover on crusting, Deep Calcareous Earths. Other shrubs were rare. On aeolian sheets of fine sand on well-drained flats, hummock grassland consisted primarily of *Triodia scariosa* ((8-30), 0.3 m high), with a few low shrubs and annuals. CC of *T. scariosa* tended to increase with the thickness of aeolian sheets. Some areas were not covered with sand sheets. *Cratystylis subspinescens* ((15-25), 0.6-0.8 m high) low shrubland was present on aeolian clay loams which experienced some waterlogging most years. Areas lower in the landscape consisted of sub-saline soils of loams and clay loams. Waterlogging occurred most years. *Atriplex vesicaria* (a form) ((5-8), 0.3-0.4 m high) was present on slightly better-drained soils, and *Sclerostegia disarticulata* ((8-10), 0.4-0.6 m high) on wetter areas. The latter vegetation graded into *Halosarcia* Low Shrubland on floors of salt lakes. Surrounding Harris Lake was a peripheral dune, 2-3 m high of Aeolian Loam, supporting mainly *Halosarcia indica* ssp. *bidens* ((5-6), 0.5-0.6 m high) and *S. disarticulata* ((3-4), 0.4-0.6 m high).

WZ34 *Eucalyptus uncinata* Mallee

LOCATION: 4 km SW. of Buningonia Spring (31° 26'30"S lat., 123° 31'40"E long.)
FAUNA SAMPLED: Yes DATE: 14-8-1980

VEGETATION MUIR: KSr.Sr.SDi.Jr

Stratum 1: Mallees 4-6 m, CC = 5, clumping moderate *Eucalyptus uncinata* (5).

Stratum 2: Shrubs 2.1-7 m, CC = 3.2, clumping none *Myoporum platycarpum* (3), *Acacia acuminata* (0.1), *Dodonaea angustissima* (+), *Heterodendrum oleifolium* (+).

Stratum 3: Shrubs 1.6-2.0 m, CC = 0.1, clumping none *Geijera linearifolia* (+), *Pittosporum phylliraeoides* (+).

Stratum 4: Shrubs 1.1-1.5 m, CC = 0.1, clumping moderate *Cassia nemophila* var. *nemophila* (+), *Pimelea microcephla* (+).

Stratum 5: Shrubs 0.6-1.0 m, CC = 1.1, clumping none *Rhagodia drummondii* (1), *Cratystylis conocephala* (+), *Eremophila decipiens* (+).

Stratum 6a: Shrubs 0.0-0.5 m, CC = 14.2, clumping none *Atriplex vesicaria* (a form) (10), *Ptilotus obovatus* var. *obovatus* (4), *Sclerolaena diacantha* (0.2).

Stratum 6b: Misc. plants, CC = 2.5, clumping slight. Annuals: *Tetragonia eremaea* (2), *Calandrinia polyandra* (0.1), *Crassula exserta* (0.1), *Actinobole uliginosum* (+), *Brachycome iberidifolia* (+), *Erodium cicutarium* (+), *Eriochiton sclerolaenoides* (+), *Menkea australis* (+), *Senecio glossanthus* (+), *Stenopetalum lineare* (+), *Thysanotus patersonii* ssp. *patersonii* (+), *Zygophyllum aurantiacum* (+).
Climbers: *Leichardtia* australis (+).
Perennial Grasses: *Stipa trichophylla* (+).

No. of TAXA: 29 LAST BURNT: *ca* 80 years

MODIFICATION: Grazed many years previously with no obvious evidence of grazing remaining.

LANDFORM

BEDROCK: Basic granulite GEOLOGICAL SURFACE: (Za) Px

UNIT: Undulating Plain, basic granulite ELEMENT: Low rise
SOIL
GROUP: Deep Calcareous Earths NORTHCOTE: Gc1.22
MAIN ORIGIN: *In situ* weathering DRAINAGE: Good
PROFILE ATTRIBUTE: Calcareous SURFACE: Crusting
ROCK: Nil STONE: Nil PAVEMENT: Nil
LITTER: Branches few; leaves broad, deposits 2 cm thick, averaging 30 m apart.
SOIL PROFILE
A21 0-9 cm Dusky red loamy sand; friable to loose; not calcareous; pH 8.5.
A22 9-57 cm Red sandy loam; friable; highly calcareous; pH 8.25.
B 57-100 cm Red sandy clay loam; friable; highly calcareous; pH 8.25.
DIFFERENCE:
Occurred on the broad top of a low rise over a greenstone and basic granulite complex. The typical vegetation (WZ34) occurred on the lower slope to the rise and the adjacent colluvial flat, over granite. WZ34a occurred on Deep Calcareous Earths (pH 8.25) and was friable to at least 1 m. Last burn occurred at least 80 years ago. WZ34a vegetation differed from WZ34 by: Stratum 2 – *Myoporum platycarpum* ((3), 6-7 m) additional; stratum 5 – *Rhagodia drummondii* (1) additional; stratum 6a – *Atriplex vesicaria* (a form) (10) and *Ptilotus obovatus* var. *obovatus* (4) additional; annuals – *Tetragonia eremaea* (2) additional; perennial grasses – *Triodia scariosa* (15) absent.

WZ37a *Triodia scariosa* Hummock Grassland
LOCATION: Junction of Uraryie Rock and Harris Lake tracks (31° 26′20″S lat., 123° 32′10″E long.)
FAUNA SAMPLED: Yes DATE: 15-8-1980
DESCRIPTION
The site, not recorded in detail, surrounded a small granite exposure with an ephemeral rock pool. The area had suffered from over-grazing by rabbits. One section had siliceous soils supporting *Triodia scariosa* (5-20), and low annuals dominated by *Tetragonia eremaea* (3) and *Gnephosis burkittii* (2). The other section was on soils with a higher calcareous content than the first section, and supported *Sclerolaena diacantha* ((10-15), 0.1 m high) and *Ptilotus obovatus* var. *obovatus* ((3-4), 0.3-0.4 m high). Dead and fallen remains of *Myoporum platycarpum* and *Pittosporum phylliraeoides* had CC = 3-4. Amongst the dead wood was *Rhagodia drummondii* ((1), 0.6-0.8 m high).

ADDITIONAL VEGETATION DESCRIPTION

WZ40 *Eucalyptus salubris* Low Woodland (immature)

LOCATION: 14 km ESE. of Sinclair Soak (31° 51'00"S lat., 122° 20'20"E long.)
FAUNA SAMPLED: Yes DATE: 9-8-1980

VEGETATION MUIR: LBi.SCi.SDi

Stratum 1: Trees 3.5-4.5 m, CC = 12, clumping moderate *Eucalyptus salubris* (12).
Stratum 2: Shrubs 3.5-4 m, CC = 1, clumping slight *Melaleuca* aff. *pauperiflora* (1).
Stratum 3: Shrubs 1.6-2.0 m, CC = +, clumping none *Santalum acuminatum* (+).
Stratum 4: Shrubs 0.6-1.0 m, CC = 12.2, clumping moderate *Eremophila scoparia* (12), *E. ionantha* (0.2), *Beyeria brevifolia* (+), *Exocarpos aphyllus* (+).
Stratum 5a: Shrubs 0.0-0.5 m, CC = 12.2, clumping moderate *Eremophila veronica* (12), *Acacia merrallii* (+), *Dodonaea stenozyga* (+), *Maireana trichoptera* (+), *Olearia muelleri* (+), *Scaevola spinescens* (+).
Stratum 5b: Misc. plants, CC = 0.5, clumping moderate. Annuals: *Calandrinia polyandra* (0.1), *Asteridea athrixioides* (+), *Calotis hispidula* (+), *Zygophyllum ovatum;* 4 other spp.

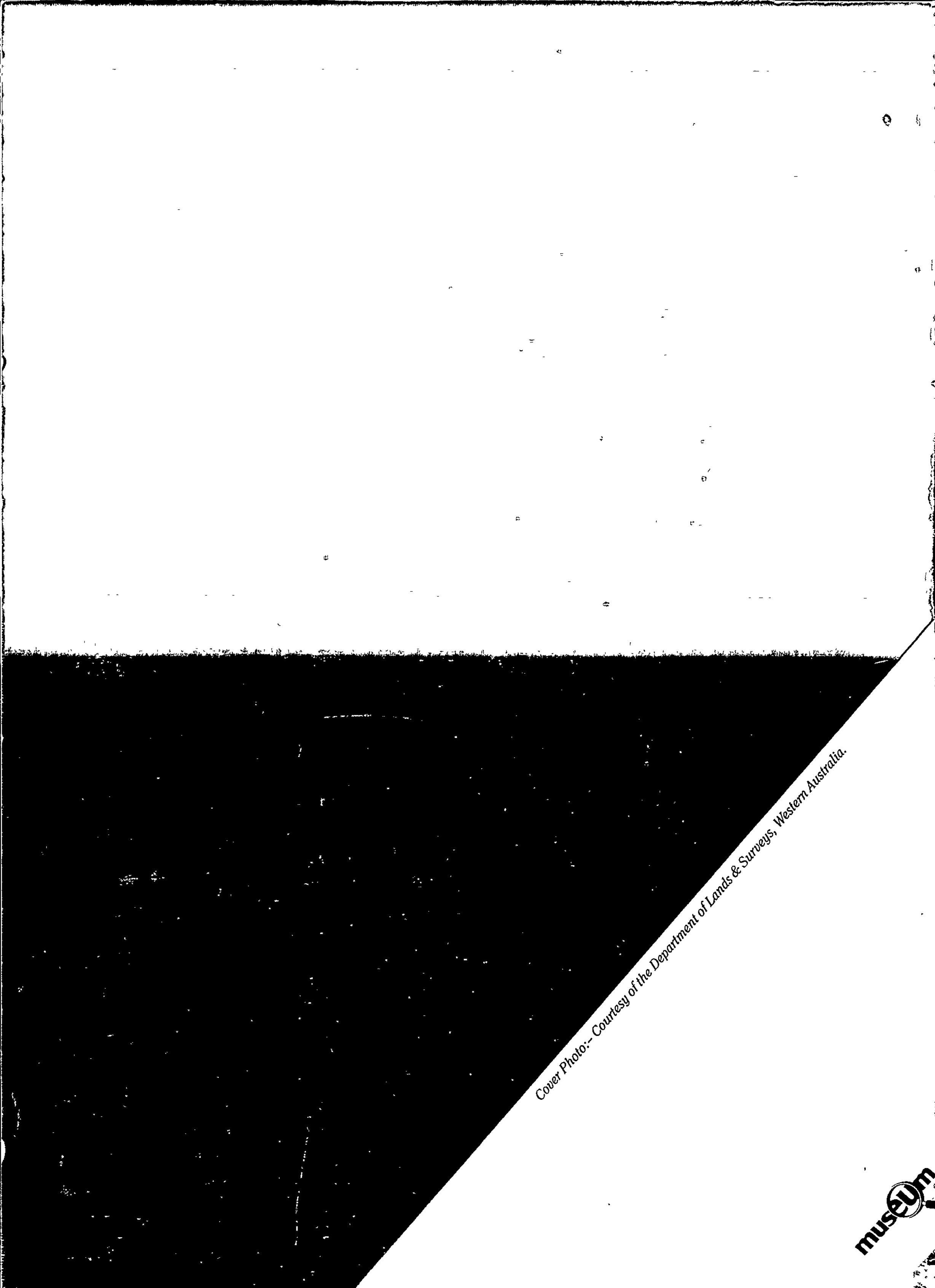
No. of TAXA: 21 LAST BURNT: 30-35 years
MODIFICATION: The dense stand of immature *Eucalyptus salubris* suggests that this small area had been burnt *ca* 30 years ago.

LANDFORM
BEDROCK: Unknown GEOLOGICAL SURFACE: (Wi) Qps
UNIT: Calcareous Plain ELEMENT: Soil type specific

SOIL
GROUP: Deep Calcareous Earths NORTHCOTE: Gn2.16
MAIN ORIGIN: *In situ* weathering DRAINAGE: Good
PROFILE ATTRIBUTE: Calcareous SURFACE: Crusting
ROCK: Nil STONE: Nil PAVEMENT: Nil
LITTER: Branches few; leaves broad, deposits 2 cm thick, 3-6 m apart.

SOIL PROFILE
A 0-15 cm Dark red loam; friable.
B 15-100 cm Red sandy clay; firm; highly calcareous; pH 8.75.

COMMENTS
DISTRIBUTION: Only area seen in Study Area, 2-4 ha
PROFILE THICKNESS: >2 m



Cover Photo:- Courtesy of the Department of Lands & Surveys, Western Australia.