A BIOLOGICAL SURVEY OF MOUNTAINS IN SOUTHERN WESTERN AUSTRALIA

A report prepared by Sarah Barrett, Department of Conservation & Land Management, Western Australia for the Australian Nature Conservation Agency

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Report by Sarah Barrett

Department of Conservation and Land Management
South Coast Regional Office, Albany
In conjunction with
Australian Nature Conservation Agency
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ABSTRACT

The south coast region of Western Australia contains a series of mountain peaks up to 1000m in height. They occupy a vast area which is known to be floristically one of the most diverse in Australia. The peaks are effectively biological islands, in a landscape of otherwise low relief, which formed an archipelago in the Eocene seas. A biological survey of 13 mountains extending more than 600 km from Mt Lindesay in the west to Mt Ragged in the east was conducted from 1994 -1996. The aims of the project were to compile and collect data to assess the nature conservation values of these mountains, to develop a methodology to assess this data and to describe and quantify threats to these areas.

The survey methodology included a quadrat-based flora survey, a vertebrate fauna survey based on both systematic trapping and a range of opportunistic techniques and a systematic litter invertebrate pitfall survey.

The results of the survey significantly increase our knowledge of the biodiversity of the mountain peaks.

The flora survey identified a flora characterised by a high number of narrow range endemics. Of the 750 species surveyed 101 were restricted to a particular mountain or mountain range, another 12 occurred in two or more of the mountains surveyed. Endemics were most common in the Proteaceae, Epacridaceae, Myrtaceae and Papilionaceae, in particular in the genera Darwinia *and* Nemcia. *The flora included 16 Declared Rare and 69 priority taxa. Eleven plant communities were derived from floristic analysis. The eastern Stirling Range montane thicket community was identified as a significant sub-community within the Stirling Range with a high number of localised endemic species.*

*The fauna survey provided an initial inventory of the mountain fauna in the absence of previous systematic fauna surveys. Sixteen mammal species, including five threatened or rare species were recorded using a range of survey techniques including hair sampling devices and scat analysis. Quokka (*Setonix brachyurus*) was recorded from five mountains.*

Twenty-six reptile and nine frog species were recorded including one rarely collected snake. Reptile diversity was generally low in the cooler mountain environments.

A litter invertebrate survey of selected mountains recorded 141 spiders, 51 ants and 11 snail species. Spiders and snails in particular were notable for a significant number of Gondwanan relic taxa persisting in the moister mountain environments. A new population of the critically endangered mygalomorph (trapdoor spider) Moggridgea *sp. was located during the survey. Newly recognised mygalomorph species of the genus* Neohomogona *recorded from Toolbrunup and Mt Manypeaks indicate the potential for narrow range invertebrate endemics to occur in mountain areas.*

*The survey confirmed that the major threats to these mountain ecosystems are the impact of dieback (*Phytophthora cinnamomi*), frequent fire, feral animals and recreation. The study assessed these impacts both qualitatively and quantitatively where feasible, in particular in relation to dieback and fire. On the basis of this assessment the foremost threat identified, with the exception of those mountains determined to have low dieback hazard, was unequivocally the fungus* Phytophthora cinnamomi. *The impact of the disease has major implications for mountain*

ecosystems including direct effects on plant community composition and indirect ecological effects.
On the basis of the changes in floristics and structure observed in the eastern Stirling Range montane thicket as a result of Phytophthora cinnamomi, the community was proposed as a "Critically Endangered" Threatened Ecological Community.

Rates of regeneration post-fire were extremely slow on these higher peaks. A high level of disease impact was observed in more frequently burnt sites. These factors, as well as the fire-sensitivity of relic mygalomorph spider species, suggest the need to ensure an adequate fire-free interval in this community.

The major implication for recreational activity is the potential to introduce and spread disease and therefore management of recreational access is paramount for disease control. Area and track closures are management options which help contain disease spread.

Despite the logistical problems in undertaking a survey of this nature in a mountain environment the project methodology was effective in achieving the aims of the study. A similar approach may be of value elsewhere in Australia, particularly in remote areas where access is restricted.

PROJECT OBJECTIVES

1. To compile and collect relevant biological, environmental and resource data and information to enable explicit assessments to be made of the nature conservation values of mountain peak protected areas in southern Western Australia.

2. To develop a methodology to assess the data collected to provide a scientific basis for identifying the biological diversity of each mountain peak.

3. To undertake survey and other work to describe and quantify threats to these mountain peaks for input into the conservation decision making processes.

1. INTRODUCTION

Mountain Ecosystems

Much of the biological diversity of mountain areas is dependent upon the isolation, protection and ecological challenge of mountain environments (Costin, 1983). Internationally, mountains are a last refuge for many rare plants and animals eliminated from more transformed lowlands. Therefore they are vital to biological diversity conservation.

Costin (1983) defines a mountain as a steep, elevated, ecologically recognisable area of land, absolute elevation in itself is not necessarily a criterion. Mountains all exhibit a vertical dimension which results in an altitudinal gradient and stratification of climate, soils and vegetation, and have different aspects and exposures (IUCN, 1992).

While the biodiversity at higher elevations is generally low (IUCN, 1992), mountain environments typically contain many rare and endemic species (Moore & Black, 1993). Steep environmental gradients and the close proximity of different altitudinal zones may allow the migration of biota in response to climatic change. Due to small scale patterns of variability in physical conditions such as temperature, radiation, moisture, wind exposure and snow cover, many different communities may occur in a small area (IUCN, 1992).

Culturally, many mountains have a metaphysical significance for indigenous populations which involves sacredness, fear, ceremony and mystique (IUCN, 1992). Mountains also have a concentration of high scenic value attractions for tourists and recreational use due to geological and physiographical features as well as natural history attributes.

Threats to mountain ecosystems

Mountain environments are generally fragile, both physically and biologically, due to their steepness, extreme weather conditions and the instability of their soils (Moore & Black, 1993). In addition land use changes in the hinterland of mountains as well as within mountain areas themselves may isolate them as ecological islands in the sky (Costin, 1983). Mountain biota, under climatic stress at the best of times, are particularly vulnerable to climatic change from increasing greenhouse gases.

The use of mountain areas by residents and visitors frequently results in a change of direction and intensity of natural processes. Problems encountered in mountain regions of the world include altered fire regimes, trampling and other physical damage to vegetation and soils, pollution and waste disposal, the introduction of alien organisms and the dispersal of plant and animal pathogens (IUCN, 1992). As mountains are essentially island habitats they are often highly susceptible to harm from introduced organisms. The risk may be enhanced because of the high proportion of disturbed ground (from natural and man-made causes) and the slower growth of plant communities. Plant or animal pathogens may be more easily dispersed in a mountain area because of their tendency to spread rapidly downhill and infection may therefore have wider implications (IUCN, 1992). Successful invasion by plants and animals is generally dependent upon a mammalian vector (O'Connor, 1993).

Studies from very different mountain ecosystems show that up to a certain level recreational pressures have little or no negative impact on the environment; beyond that point problems quickly intensify (Mercer, 1992). Recreation may impact on the environment directly *eg*. trampling effects, or indirectly *eg*. spread of disease. Trampling results in abrasion of vegetation, abrasion of surface soil litter and organic layers and compaction of soils. (Hendee *et al*., 1990). Removal of ground cover in turn leaves soils more vulnerable to erosive forces. The more profound impacts are associated with campsites and trails, additional problems of overnight stays include the disposal of human waste and the impact of campfires not least of which is the increased risk of wild-fire. Both day trips and overnight stays result inevitably in some degree of litter.

In the mountains of the southwest of Western Australia there is the additional risk of spread of plant disease. The management of access is critical in minimising the spread of the fungal disease *Phytophthora*, the requirements for access must be balanced by the need to protect areas from the introduction of disease (Gillen & Napier, 1994).

Mountains of southern Western Australia

Hopkins *et al.* (1983) identify six upland groups of mountain ranges and distinct mountains in Western Australia based upon physical and biological characteristics in a landscape of otherwise low relief. Included in these are the Stirling-Barren Ranges, the Porongurup Range, Mt Ragged and the granite monadnocks of the south-west. The study area largely falls within the species rich area of the Transitional Rainfall Zone of Hopper (1979) the area between the Arid Zone (<300 mm annual rainfall) and the High Rainfall Zone (>800 mm annual rainfall). The stress of past climatic oscillations appears to have been a major factor in this extensive speciation. Nodes of species richness within the Transitional Rainfall Zone occur in upland areas to the north of Perth in the Mt Leseur area and to the south in the Stirling Range and the Barren Ranges which share a common geological history (Hopkins *et al.*, 1983).

Although the mountains of southern Western Australia have a low elevation on an international basis, they have a very significant conservation value and high recreational value (Watson, 1991a,b). The flora contains a high degree of species diversity with numerous rare and geographically restricted species. These include both old and relatively recently derived species (Hopkins *et al.*, 1983). Some species which are found in more mesic areas of the extreme southwest have outlying populations associated with the mountains.

The fauna of the Stirling Range includes several relic species of invertebrates that occur nowhere else in the state. These species have a closer relationship to groups in mountainous areas of eastern Australia, Tasmania, New Zealand and other Gondwanan continents than they do to representatives living in the surrounding lowlands (Main, 1993).

The mountains of southern Western Australia have their own particular suite of problems foremost of which are believed to be the impact of plant disease, fire, feral animals and recreation (Watson, 1991b).

Culture and History

Aboriginal Culture

Legends involving the mountains, in particular the Stirling Range, Porongurup Range and Peak Charles, indicate that they were significant areas in Aboriginal culture. There are several archaeological sites in and around the Stirling Range National Park, largely artefact scatters. One artefact scatter has been recorded near the Porongurup Range.

There are very few records of the Aboriginal People who lived in the Stirling - Porongurup region in the early days of European settlement. Publications discussing the Aboriginal culture of the area have been written largely by non-Aboriginal authors. It is known that for thousands of years the plains in the Stirling Range region

were the hunting grounds of small family groups of Aboriginal People including the Kaneang and Koreng tribes of the Nyungar people of the south-west (Green, 1984). They developed a system of beliefs to explain the environment around them (Palmer, 1976). Both the Porongurup and the Stirling Ranges were significant, powerful spiritual places in the culture of the people. The Aboriginals did not camp at the Porongurups due to the presence of the "Mamarvre" or "Little People" who live in quiet places. Several legends exist concerning the Stirling Range in general - describing how the mountains were formed, as well as myths about specific mountains including Bluff Knoll, Ellen Peak, Toolbrunup and Mt Magog. Many stories have established the tradition that the Stirling Ranges are hostile, dangerous and associated with death. It has been related that the Aborigines never camped on Bluff Knoll and did not like hunting around it (Palmer, 1976). However they used to live nearby because there was plenty of honey and bush food around each side of the Stirling Range and plenty of water also. An area near Ellen Peak was visited to collected red ochre for painting. The Stirling Range is also known as an important place for the regeneration of spiritual power.
The breakdown of traditional life began with the coming of sandalwood cutters and kangaroo hunters in the 1830s/40s. The latter impacted on the food and clothing resource of the Aborigines, this together with land clearing and disease epidemics resulted in a dwindling of the population.

Peak Charles forms the south western extremity of the "Ngatju" roaming ground. It is considered to be spiritually significant and therefore "must be protected from man and machines" (Billy Kerr, Esperance Express, 7/12/84). Aboriginal legends concerning Peak Charles describe mythical "Little Men" or Wiltjardis who are covered in hair and only come out at night. A big fire was necessary to ward the inhabitants of the mountain off at night. There is one registered archaeological site in the Peak Charles area (Steve Corsini, pers comm).
Similarly It is felt by local Aboriginals that Mt Ragged is a significant spiritual area, attributed with a certain "power". Aboriginals do not go there, particularly avoiding overnight stays as they fear death or illness may result. Only the proper tribal law man can go there (from a conversation of John Winton, Dept. of Conservation & Land Management, Esperance, with a full-blood Noongar - Graham Williams).
The Fitzgerald area was extensively used by Aboriginals however the majority of registered Aboriginal Sites, mainly archaeological, are located on level ground or on small rises near the coast or water courses and swamps (Bird,1985). No specific legends regarding the Barren Ranges are known.
Little is known specifically about Mt Lindesay or Mt Manypeaks. It is known that the Aborigines had two names for Mt Lindesay: Beipeigup meaning a particular small fish, and Peeoetup, the place of a particular bird (Mc Conachie, unpub.). No registered Aboriginal Sites are currently recorded in these mountain areas (Steve Corsini, pers comm).

European Culture

The first recorded sighting of the Stirling Ranges was by Capt. Mathew Flinders in 1802 from aboard the H.M.S. Investigator. The Porongurup Range was first visited by a Capt. Wakefield in 1828. In 1832 Ensign Robert Dale lead what was probably the first expedition to the Stirling Range and made the first recorded ascent of the Range - up Mt Toolbrunup. In 1835 Surveyor General Roe named the Range after the Governor General of the Swan River Colony replacing the Aboriginal name - 'Koikyennuruff'. Among the early explorers of the mountains was the most important early botanical collector in the region - James Drummond who completed 6 major collections between 1841 and 1851. His third included Albany, the Manypeaks area

and the Porongurup Range, and his fourth the Stirling Range and West Mount Barren. Ferdinand von Mueller, Victorian Government Botanist, visited Albany, the Porongurup and Stirling Range in 1867 (Sandiford, 1988).
Early uses of the Stirling Range area included kangaroo and dingo hunting, sandalwood harvesting and beekeeping. Land settlement in the area around the Range began in the late 1800s. Eventually only the National Park remained uncleared. The first pastoral lease to include the Porongurup Range was taken out in 1859. The Porongurup Range was logged until it became a National Park in 1925 and its lower slopes were used for grazing. In 1913 the Stirling Range National Park was gazetted. By 1920 the Stirling Range Tourist Association had developed access roads in the area. By 1931 the Porongurup Range was a "leading holiday resort" and was gazetted a National Park in 1925.
The Stirling Range and the Porongurup Range were used as a military training area since the Second World War as these were the only areas in Western Australia where training in mountainous terrain was possible.
The Barren Ranges were named by Capt. Flinders in 1802. Plant collector William Baxter was among the first Europeans in the Fitzgerald River area in 1823 and 1828 followed by Drummond in 1847. Early uses of the Fitzgerald River area included sealing, whaling, pastoralism, mining and agriculture but similar to the Stirling Range the rugged coastal mountains were relatively undisturbed. The area became a National Park in 1976 and in 1978 the Park was gazetted a World Biosphere Reserve by UNESCO. Thumb Peak and Mid Mt Barren are within the "core" or "wilderness" area of the Biosphere Reserve.
The first European explorer in the Denmark area was Surgeon Lieutenant Thomas Braidwood Wilson who climbed Mt Lindesay December 9th 1829 with the well known Aboriginal guide Mokare. The mountain was named after Colonel Patrick Lindesay, Commanding Officer of the 39th Regiment at Albany.
The first European to explore the Peak Charles area was Lieutenant John Septimus Roe, the State's first Surveyor General. In 1948-49 he named the Fitzgerald peaks including Peak Charles and Peak Eleanora after Governor Charles Fitzgerald and his sister. Roe ascended Mt Ragged in 1948. Plant specimens in the Mt Ragged area were collected by Roe and the early seaborne expeditions, and later by the explorer and surveyor John Forrest in 1870.
Today the major uses of the mountains are for tourism, recreation and nature study. Major attributes of the mountains include their natural beauty, geology, flora and fauna, remoteness and "wilderness" qualities. Bluff Knoll is significant as the highest mountain in the south-west of Western Australia and provides good rock climbing conditions in a State of generally low relief.
Current activities include bushwalking, mountain climbing, rock climbing, abseiling, photography and observing wildflowers particularly in spring - the wild-flower season. The eastern end of the Stirling Range from Ellen Peak to Bluff Knoll is used for a 1-3 day ridge walk with over-night stops on the ridge.

Origins of the names of the peaks:

Bluff Knoll: originally applied to Isongerup Peak by Roe in 1831, Aboriginal name Pualaar-miial or Bullah Meual - "great many-faced hill"

Ellen Peak: named after the wife of Governor Sir James Stirling (Roe 1931), originally applied to Pyungoorup.

Mondurup Peak: recorded as Mongerup by Drummond, meaning 'body scar'

Mount Ragged: descriptive (Eyre, 1841). Aboriginal name Purrganu.
Nancy Peak: reputedly after a cow that had a calf under the peak.

Porongurup: recorded as Borong-gurup, Perrengorep, and Porongorrup .

Toolbrunup Peak: from the Aboriginal Tualypaaranap meaning "drizzle carrier".

Mt Lindesay: after Colonel Patrick Lindesay

Mt Manypeaks: descriptive

Thumb Pk: descriptive

Peak Charles & Peak Eleanora: named after Governor Charles Fitzgerald and his sister Eleanora

Previous surveys / studies

Flora

The mountains surveyed occur within the South-West Botanical Province (Beard 1980) and include parts of the Menzies, Warren, Eyre, and Roe Botanical Districts. The vegetation of the region has been described structurally and mapped at 1:250,000 by Beard (1972, 1973,1976, 1979).
A check-list of vascular plants of the Stirling Range National Park was compiled by Hussey (1977) and the Park surveyed by Keighery (1993). The Porongurup Range National Park was surveyed by Smith (1961), Abbott (1982) and Keighery (unpub.); the Barren Ranges by Chapman & Newbey (1995) in a Fitzgerald River National Park survey, and Peak Eleanora and Peak Charles by Newbey & Hnatiuk (1988) in a Goldfields survey .

While these surveys have provided an overview of the flora there has been little systematic or community based survey targeting the mountain peaks with the exception of a phytosociological study of the Stirling Range by Pignatti *et al.* (1993).

Fauna

There have been few systematic fauna surveys of the mountains to date with the exceptions of Peak Charles and Peak Eleanora which were included in the Goldfields Survey (How *et al.*, 1988), the Barren Ranges in the Fitzgerald River Biological Survey (Chapman & Newbey, 1995) and the Stirling Range (Muir & Harold, 1985). These surveys however focussed on the lower slopes and valleys.
There are opportunistic collection records for all sites (WA Museum records) though much of the data again pertains to lower slopes of these mountains.
There has been no comprehensive survey of the invertebrate fauna of the Stirling Range however certain groups have received attention in particular mygalamorph spiders (Main, 1993). These include several Gondwanan relics endemic to the Range.

Plant Disease

The major plant pathogens occurring in native ecosystems of the southwest of Western Australia have been described by Shearer (1994). These include *Phytophthora* species, rust fungi, *Armillaria luteobubalina* root rot and aerial canker -

Botryosphaeria ribis and *Cryptodiaporthe* sp. There has been a lack of systematic disease surveys in communities of the southwest of Western Australia.
Studies on the effect of *Phytophthora cinnamomi* on vegetation have been reviewed by Weste & Markes (1987). The susceptibility of the flora of the Stirling Range to *Phytophthora cinnamomi* and the impact of the disease on plant communities (lower slopes and valleys) has been described by Wills (1993). Wills & Keighery (1994) highlight the serious impact of plant disease on ecosystems in the southwest. Families particularly susceptible to *P. cinnamomi* include the Proteaceae, Epacridaceae and Papilionaceae.
There have been few studies investigating the impact of plant disease on vertebrate communities (eg Nichols & Bamford, 1985; Nichols & Watkins, 1984) or invertebrates (Postle *et al.*, 1986; Nichols & Burrows, 1985). Wilson *et al.* (1990) investigated the effects of dieback on small mammals in the Eastern Otway Ranges, Victoria.

Fire

Mountains tend to have higher concentrations of fire-sensitive ecosystems than adjacent lowlands (IUCN, 1992). Due to the influence of topography mountains are prone to rapid spreading and high intensity fires such as occur in Western Australia (IUCN, 1992).
Fire ecology and plant succession studies in mountain regions in Eastern Australia eg. Kirkpatrick (1983); Costin (1983); Costin *et al.*(1969); Barrow *et al.* (1968); Wimbush & Costin (1979) emphasise the slow rates of recovery of plant communities in these ecosystems. Wilson *et al.* (1990) investigated the effects of fire on small mammals in the Eastern Otway Ranges.

There has been little research to date into the fire ecology of mountain communities in the southwest of Australia. Research by Main & Gaull (1993) and Friend & Williams (1993) indicate that there is a clear dichotomy in the fire sensitivity of species inhabiting the wet gullies and thickets of the uplands in the Stirling Range and those occupying the seasonally dry lowland mallee-heath. Keighery (unpub) has described the fire response of plant species endemic to the Stirling Range. The identification of species vulnerable to fire based on the fire response types of Gill (1981) is a prerequisite to management of fire-prone ecosystems. Obligate seed regenerating species, in particular bradysporous species with seed storage amongst the foliage and no secondary dormancy, once released to the ground, are most vulnerable to local extinction, especially as a result of recurrent perturbation by fire (Hopkins & Griffin, 1984).

2. PHYSICAL ENVIRONMENT

Climate

The study area experiences a Mediterranean climate characterised by mild wet winters and hot dry summers. The weather is controlled by the west to east movement of sub-polar depressions. Associated with this are cold fronts throughout the year, and troughs during summer. Mean annual rainfall decreases north and west across the region from 1001 mm at Denmark 34°57' S 117°57'E to 338mm at Salmon Gums 32°59'S 121°37'E. Over 50% of the annual rainfall falls in the winter months. Annual variation in rainfall can be substantial. Yearly maximum and minimum temperatures are strongly influenced by distance from the coast with inland areas experiencing greater extremes than coastal areas. Frosts are relatively common inland. Strong sea-breezes mitigate high summer temperatures on the coast. Wind is an important climatic factor on the coast, influencing species composition and vegetation structure. Windless days are uncommon and prevailing winds are generally from the west and south-west in winter while over summer they are pre-dominantly south-easterly, increasing in strength in the afternoon. The regular occurrence of hot, dry and windy weather during the summer and early autumn may provide conditions ideal for the start and spread of bush-fires. Lightning is an important source of fires in the region.

Mean winter minimum (coldest month) and mean summer maximum (hottest month), mean annual rainfall, raindays and the length of the growing season for the nearest meteorological stations are shown in Table 2.1
Mean annual rainfall for 1994 was considerably lower throughout the study area. For example Mt Barker had 675 mm in 1994 compared with an average of 743 mm, there were 154 raindays, 14 less than the average (Bureau of Meteorology). Rainfall statistics for stations adjacent to the Stirling Range and Barren Range were below average again in 1995.

Orographic effects

Orographic effects are most apparent within the Stirling Range. Rainfall decreases north-eastward from an average of 743mm per annum at Mt Barker southeast of the range to 386 mm at Amelup northeast of the range. Little is known of the distribution patterns of rainfall within the Range however orographic factors have a strong influence. Areas on the southern side of the range receive more rainfall than areas in the rain-shadow to the north *eg*. Moingup Springs in Chester Pass has a mean annual rainfall of 647 mm p/a and Bluff Knoll Rangers Residence (north of the range) 500 mm p/a (National Park records).
The southwest to northeast rainfall trend is complicated by the effect of altitude. The highest rainfall is estimated to be about 1,000 mm near Bluff Knoll in the eastern end of the park. The higher peaks experience extended periods of continuous drizzle and cloud cover when winds are on-shore from the ocean to the south, even during summer months. This additional precipitation has an important influence on the distribution of moisture dependent plants and animals throughout the range.
Rainfall varies significantly on all of the peaks and this is reflected in the changing flora types (Courtney, 1993). Occasionally snow may fall on higher peaks. During winter and spring, snowfalls are reported more frequently in the Stirlings than for any other locality in Western Australia (Hopkins *et al.*, 1983). Heavy rainfall following intense winter storms or summer cyclones can cause rapid run-off on steep slopes.
Surface wind analysis records show a variation in dominant wind patterns between the eastern and western end of the Range. In summer the dominant wind for the western end of the Range comes from the southeast to the southwest while at the eastern end the wind is more dominantly from the east to southeast. In winter the

winds in the western end are mainly from the northwest while the eastern end experiences wind more dominantly from the west. Winds are stronger in winter and speeds in excess of 100 km per hour are not uncommon on the higher peaks of the Stirling Range.
Wind patterns in the Porongurup Range are similar to those of the western end of the Stirling Range.

Table 2.1. Weather Statistics (Bureau of Meteorology, Perth)

	Stirling Ra	Porongurup Range	Manypeaks	Mt Lindesay	Thumb Pk Barren Range	Pk Charles Pk Eleanora	Mt Ragged
Station (Temp)	Mt Barker alt: 250m 34°38'S 117° 39'E	Mt Barker alt:250m 34° 38'S 117° 39'E	Albany Airport alt: 71m 34° 57'S 117° 48'E	Denmark alt:18m 34° 57'S 117° 22'E	Ravensthorpe alt:232m 33° 35'S 120° 3'E	Salmon Gums alt:249m 32° 59'S 121° 37'E	Balladonia alt:149m 32° 28'S 123° 52'E
Station (rainfall)	Mt Barker	Porongorups alt: 300m 34° 40'S 117° 51oE	Manypeaks alt:100m 34° 50'S 118° 10'E	Denmark	Bremmer Bay alt: 20m 34° 24'S 119° 23'E	Salmon Gums	Balladonia
Mean winter July/Aug min °C	6.1	6.1	7.4	7.1	6.6	5.0	4.7
Mean summer (Jan) max °C	27.1	27.1	25.1	25.5	29.1	30.9	32.2
Mean annual rainfall (mm)	743	844	711.5	1001	630.8	338	251
Growing season (months)	8	-	8.3	10.1	7.7	4.4	-
raindays	168	159	130	186	117	90	-

Climatic change

With the break-up of Gondwanaland it is thought that temperatures gradually dropped. Up to 15 million years ago plant fossils indicate that many cool temperate rainforest species occurred in southern Australia. By 5 million years ago wetlands had given way to grasslands. As conditions became drier the range of many species contracted to higher rainfall zones such as the Stirling Range. The southwest evolved a Mediterranean climate and the flora evolved into some of its current forms (Courtenay, 1993).
Within the last million years the world's climate has fluctuated between warm inter-glacial and cold glacial periods (Courtenay, 1993). In the period 5000-10,000 years before the present time the climate of southern Australia is considered to have been substantially wetter than at present. Floral distributions in Western Australia have led to the belief that after about 5,000 years ago conditions became drier (Hopkins *et al.*, 1983).
In recent years scientists have surmised that human activity may be altering weather patterns through the Greenhouse effect and it is predicted that global rainfall will increase and sea-levels rise. Another prominent issue is the depletion of

stratospheric ozone which shields surface life from the harmful effects of U-V radiation. There are no accurate regional predictions of the implications of the Greenhouse effect or the reaction of native vegetation and fauna to increased U-V levels.

Geology

The surface geology of the study area has been described and mapped at a scale of 1:250,000 on the Mount Barker-Albany Sheet (Muhling & Brakel, 1985), Bremer Bay Sheet (Thom & Chin, 1984), Lake Johnston Sheet (Gower & Bunting, 1976) and Malcolm-Cape Arid Sheet (Lowry & Doepel, 1974).

Pre-Cambrian Geology

A major portion of south-western Australia is occupied by the Archean Shield or Yilgarn Block which abuts the Stirling Range and the northern edge of the study area. The rocks of the Yilgarn formed 2,600 to 3,100 million years ago and are amongst the oldest in the Earth. The crustal stability of the Yilgarn block has limited major orogenesis (Johnstone *et al*, 1973).

South and east of the Yilgarn Block the basement consists of younger metamorphic rocks and granites of Proterozoic age dated between 1300 and 1700 m.y. ago. This area forms the Albany-Fraser Province, a Proterozoic mobile zone that truncates the southern portion of the Yilgarn Block, characterised by strongly deformed, high grade gneisses intruded by magmatic granitoids (Moir & Newbey, 1995).

The Albany-Fraser province can be divided into two Proterozoic Mobile belts. Deformation in the Albany Mobile Belt commenced after the Fraser Mobile Belt had already undergone a period of intense reworking.

Granite intrusions into the metamorphosed gneisses of the Albany - Fraser Province form the Porongurup Range, Mt Manypeaks, and Mt Lindesay. These porphyritic granite batholiths were emplaced about 1100 m.y. ago (Turek & Stevenson, 1966). Gower & Bunting (1976) consider the intrusion which formed Peak Charles to have occurred some 1670 m.y. ago.

Erosion of the surrounding softer metamorphic rocks resulted in the harder granites being exposed. The granite was than subject to erosive forces which formed large rounded peaks, interspersed with incised valleys eg. in the Porongurup Range.

Stirling Range Formation and Mount Barren Group

The Stirling Range and the Barren Ranges share a common geological history, being components of the Stirling-Barren Series.

For many years, the sediments of the Stirling Range have been regarded as being around 1,100 million years old (Turek & Stephenson, 1966). They were believed to have been metamorphosed in the period shortly after deposition in association with broad scale movements of the earth's crust. These movements were seen as the cause of the uplift and folding of rocks to form the Stirling Range.

There is now a strong argument suggesting that the Stirling Range may have been subjected to a more recent uplift which would explain its more youthful un-weathered appearance and topographic relief. This uplift probably occurred in association with the separation of Antarctica from Australia in the Eocene (Cope, 1975).

Recent findings of apparent fossils in the sediments of Stirling Range have cast doubt over the previous interpretation of their age. The fossils suggest an age for the sediments of 540-590 million years, about half the previously determined age. This finding is leading to a total re-appraisal of the geological history of the Stirling Range (Stirling Range and Porongurup Range National Park Draft Management Plan, unpub.).

The Stirling Range Formation consists of a hard resistant sequence of sandstone, and metasedimentary quartzite, phyllite and slate. The surrounding granites and gneiss of the Albany-Fraser Province have eroded more readily leaving the Stirling Range as a prominent landform extending some 65km in an east-west direction, reaching 1073m at Bluff Knoll. Ripple marks may be found in many places throughout the range, for example on the summit of Toolbrunup Peak, and are evidence of the sedimentary origins of the rocks (Muhler & Brakel, 1985).

The Barren Ranges of the Fitzgerald River National Park are an extensive area of steeply dipping quartzite and phyllitic schist, forming rugged hills and stony rises of up to 500m above sea-level along the coast, hill slopes are up to 45° and some coastal slopes are perpendicular.
An extensive wave-cut bench about 80m above the present sea level is characteristic of much of the coast-line.

The Proterozoic Mt Ragged beds over-lie Middle-Proterozoic granites, gneisses and migmatites of the Albany-Fraser Province (Lowry & Doepel, 1974).
The Mount Ragged Beds are composed of a sequence of quartzite's, micaceous schists, quartz-pebble conglomerates and acid volcanic rocks in the vicinity of Mount Ragged, exposed as a series of north-easterly trending belts.
Mount Ragged is formed of vertically stratified gneiss with a central band of massive quartzite whose resistance to erosion is responsible for the persistence of the ranges (Beard, 1973). At the base of Mount Ragged is a wave cut platform which corresponds to similar benches around the Barrens of the Fitzgerald River National Park and Peak Charles.

Eocene Sea

About 60 million years ago the final separation of Australia from Antarctica began. Between 43 and 40 million years ago the sea rose about 150 metres above its present level and covered most of the land south of the Stirling Fault, resulting in the "Eocene Sea". The peaks of the Barrens, Stirlings, Porongurups, Peak Charles and Mt Ragged remained above sea level as islands.

Soils

The soils of the mountains have not been studied or mapped in detail. Most of the soils are acid with a low nutrient status. They have been weathered *in situ* from granitoid or quartzite bedrock. The depth of soil profile is generally very shallow with skeletal soils less than 25 cm thick common on the upper slopes and peaks. Deeper soils have accumulated in areas of more gentle topography.

3. METHODS

The Study Area:

Thirteen mountain sites were selected with a geographical spread ranging from Mt Lindesay in the west (34°50'20"S 117°18'30"E), to Mt Ragged in Cape Arid National Park in the east (33°26'47"S 123°28'19"E), (Fig 3.1). Six peaks occur within the Stirling Range, the most significant mountain range in the region (Fig 3.2).

All of the mountains occur within National Parks with the exception of Mt Lindesay which is "Proposed National Park' (Dept. of Conservation & Land Management, 1994a) and the northern aspect of Mt Manypeaks which is within a Water & Rivers Commission of Western Australia Catchment area, also proposed National Park.

The survey was restricted largely to the upper third of each mountain in terms of total altitude above mean sea level.

Vegetation and Floristics

A minimum of two permanent 10 x10 metre quadrats were demarcated on each mountain using aluminium droppers. The quadrat number was attached to the north-west corner. Quadrats were selected to represent the range of communities present in vegetation that was as floristically and structurally homogenous as possible. Ten m x 10 m plots were chosen to be consistent with recent major surveys eg.Gibson *et al.* (1994). Larger plots would have been difficult to negotiate on steep slopes.

Most sites were visited on at least three occasions to encounter species flowering outside the main spring season and the majority were visited more frequently.

The quadrat latitudes and longitudes were located using a GPS and altitude was extrapolated from 1:50,000 maps. A photograph of each site was taken on a line from the north-west peg towards the south-east peg.

The following data was recorded for each 10 x 10 m site:

- aspect: compass bearing
- slope: scale of 1-3: 1 = gentle, 2 = moderate, 3 = steep
- geology
- soil type: including soil depth, colour, texture according to Mc Donald *et al.*, (1990)
- % cover of exposed rock, bare ground, litter; litter depth
- vegetation structure: height, stratification and percentage canopy cover was recorded according to Muir's Structural Classification (1977).
- floristics: plant species present, their average heights, abundance (Braun Blanquet, 1965), flowering information.
- plant disease: the presence or absence of dieback in the quadrat based on visual interpretation factors and the sampling of dead or dying root material for laboratory testing for *Phytophthora*.

Estimates of mean annual rainfall and mean annual temperature for each quadrat were derived from the BIOCLIM model of Busby (1986).

'Lithic' plant communities were surveyed by means of plot-less sites recording both species growing on lithic surfaces (granite and quartzite exposures) and species endemic to the vegetation fringing lithic areas.

Voucher specimens were deposited in and identifications confirmed by the Western Australian Herbarium, Perth. Nomenclature is largely as per Green (1985).

Additional data added to the flora database :

- species conservation status

- endemism
- flowering date
- fire-response category
- dieback and aerial canker susceptibility

Fire Data

Categories of fire response (Table 3.1) were based on those of Gill (1981) and Wardell-Johnson (unpub). Fire-response data was obtained from field observations of more recently burnt sites. Additional data was derived from Bell (1993), Robinson & Coates (1995), Keighery (unpub), Wardell-Johnson (unpub.), McCaw (unpub.), Newbey (unpub) and George (1984). Fire records were obtained from records of the Department of Conservation & Land Management, Albany. Fire frequency was determined by counting the number of fires which had occurred in the 25 years from 1970-1995.

Regeneration of recently burnt sites was assessed using photography, estimating percentage canopy cover and by measuring plant height at 1 metre intervals on a diagonal from the north-west to the south-west corner.

Table 3.1. Fire Response Category

Fire Response	Category
Mature plants die following 100% leaf-scorch (Category 8 if no further data available):	8
*propagules present after fire in the form of canopy stored seed	1
*propagules present after fire in the form of soil stored seed	2
*no propagules remain on site after fire	3
Mature plants survive 100% canopy scorch (Category 9 if no further data available):	9
*resprout from root suckers or rhizomes	4
*resprout from basal stem buds eg. lignotubers	5
*resprout from epicormic shouts	6
*resprout from unharmed usually terminal buds	7
*Resprout underground corm or bulb	11
Ferns & Allies	
*reproduces by rhizomes or spores	10
Unknown	0

Plant Disease

Plant disease, in particular *Phytophthora cinnamomi*, was assessed with the assistance of Malcom Grant, Dieback Interpreter, CALM Albany. Plant material was sent for laboratory analysis to the Department of Conservation & Land Management Vegetation Health Service, Como.

Disease impact and the dieback susceptibility of species was assessed on the basis of sampling and field observations. Additional data was obtained from Wills (1993), Wardle-Johnson (unpub.) and Bellgard (unpub.).

A 'Dieback Hazard Rating' of low, high or very high was assigned to each quadrat and to each mountain area. Dieback hazard is defined as the 'combination of site and climatic factors that influence the potential damage done by the disease'. These include site floristics, soil properties, drainage characteristics, topography and climate.

Fig. 3.1. Mountain survey sites southern Western Australia

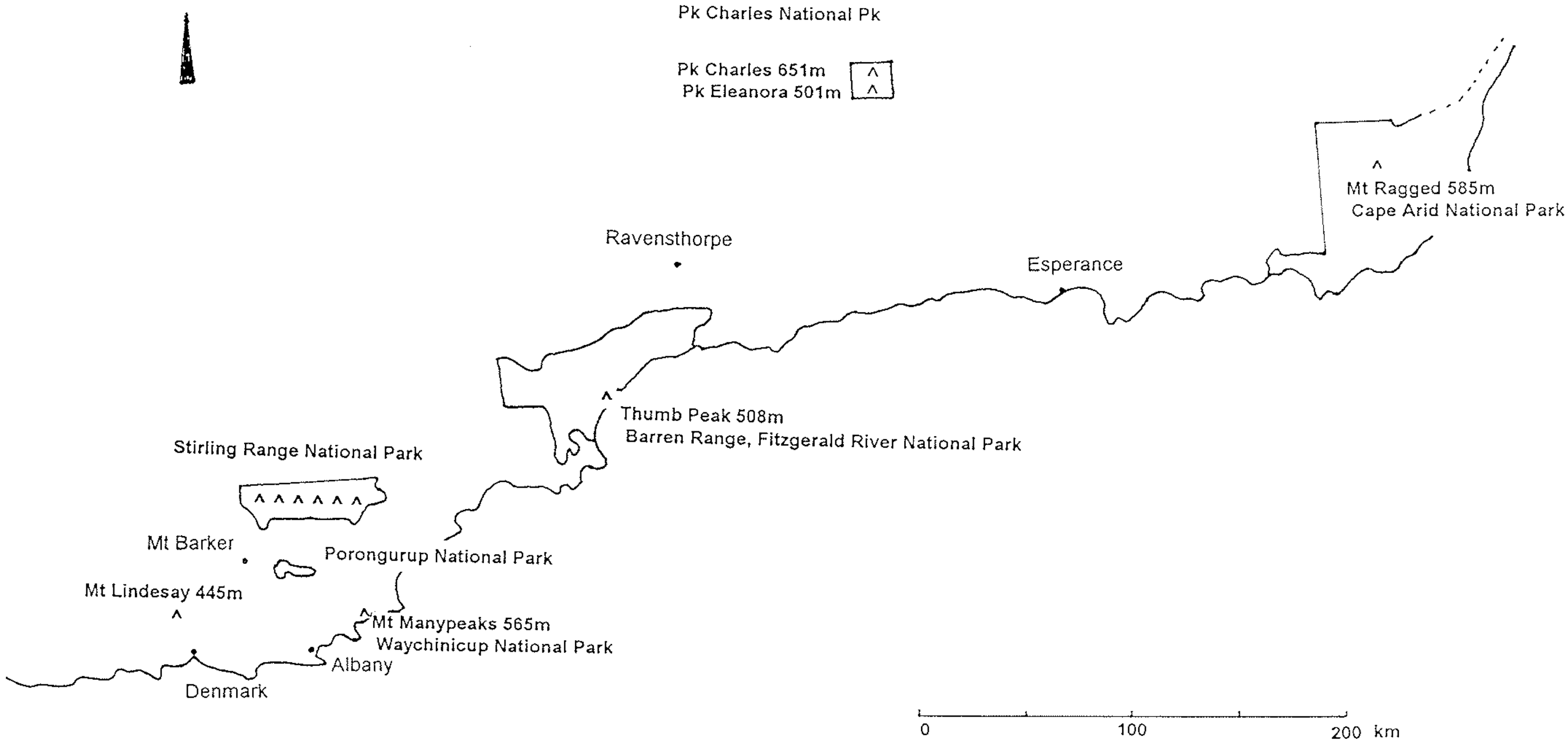
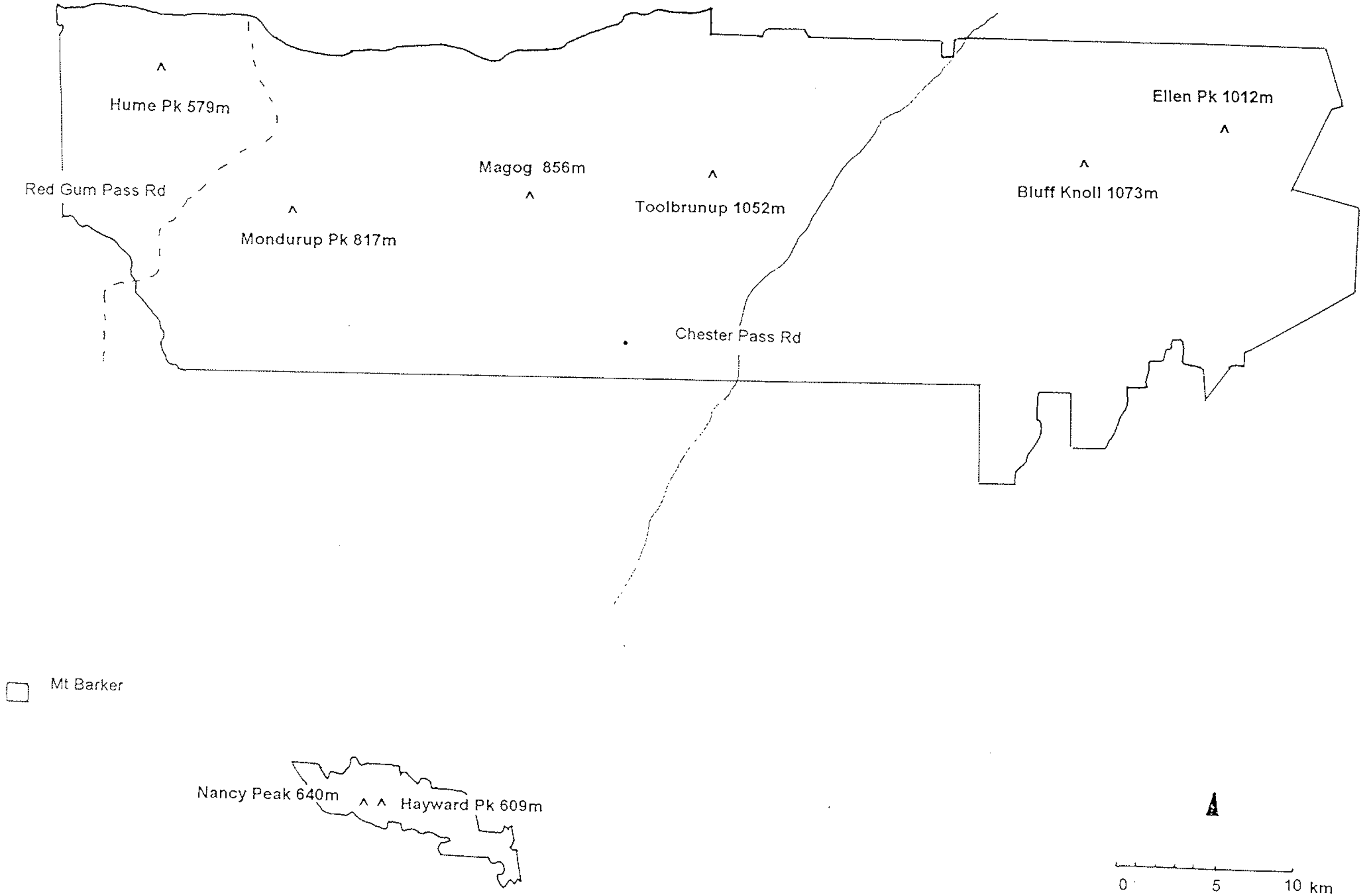


Fig. 3.2. Mountain sites in the Stirling Range & Porongurup Range National Parks



The impact of the disease at a site was assessed using a scale of 0 - 2 with 0 = no evidence of infection; 1 = 'recently infested', disease currently active, no old deaths evident and 2 = 'old-infested', high impact. The high impact sites were in areas with a long history of infection, confirmed by the old stumps of species such as *Xanthorrhoea platyphylla.*
Dieback susceptibility was measured using a scale of 1-12 based on that of Wills (1993) (Table 3.2).

As the majority of the mountain sites are areas with a high to very high hazard rating a 'hygiene evaluation' was undertaken. This refers to a process which assesses a proposed activity at a particular site, dieback hazard, risk of introducing or intensifying the disease, the consequences of infection, hygiene measures to minimise the consequences and an evaluation of the adequacy of hygiene (Dept. Of Conservation & Land Management, 1993).

Table 3.2 Dieback Susceptibility Rating (Wills, 1993)

	Disease Susceptibility [1]			
Evidence [2]	Resistant	Low	Variable	High
Inferred	3	4	7	10
Limited	2	5	8	11
Good	1	6	9	12

[1]Disease Susceptibility:
Resistant = no deaths observed, no secondary symptoms apparent
Low susceptibility = generally < 20% killed at any location, and/or other secondary symptoms observed
Variable susceptibility = 20-80% killed varying with location
High susceptibility = generally > 80% killed

[2]**Evidence**:
Inferred = based on trends observed in members of the same genera,
Limited = based on one observation / sampling
Good = based on several observations

Byrophytes
Mosses and liverworts were collected opportunistically from each mountain and identified by Brian Best, Herbarium of Western Australia.

Fauna Survey

Systematic Sampling:
Between twenty and forty Elliott traps (9cm x 9 cm x 32cm) were set in trap-lines at each site. Between four to six pit traps were used at most sites using 10 litre buckets, numbers were limited by the rocky substrate. 10 metre flywire fences 30 cm high and embedded into the substrate were used in conjunction with buckets except in areas of dense thicket vegetation.
Trap-lines were set with universal bait and run for a minimum of two successive nights. Trap nights were limited by water supplies which had to be transported up the mountain along with trapping and camping equipment.

Hair Tubes:
Due to the problems with standard trapping techniques, mammalian hair-sampling tubes as described by Suckling (1978) and Scotts & Craig (1988) were trialed.

Hair sampling tubes have been used for the detection of small mammals in trees (Suckling ,1978) and for the detection of rare mammals such as *Potorous longipes* (Scotts & Craig, 1988).
For the purpose of this survey a conical shaped hair tube was designed targeting small to medium sized mammals (Appendix 1). The tube, which has a protected baited chamber, may be left in the field for extended periods, increasing effectively the number of trap-nights possible. In addition to the conical tubes a 'run-through' hair sampling device was used on selected sites targeting species such as quokka which utilise 'run-ways' through the vegetation. This technique is being currently used by the East Gippsland Potoroo Team, NSW and the Two-Peoples Bay Potoroo Recovery Team, WA. The 'run-through' has been found to work more effectively in conjunction with baited hair tubes in their vicinity which serve to attract the target animals to the area (Wes Manson, pers comm.). Both types of "hair tube' were left in situ for between 10 and 20 days.
Hair was analysed by B. Triggs of "Dead Finish", Vic.

Invertebrate Pitfall Survey

A more detailed pitfall survey of litter invertebrates was conducted initially at five of the study sites - Bluff Knoll, Toolbrunup and Mondurup (Stirling Range); Mt Manypeaks, east of Albany and the Nancy-Hayward Peak area of the Porongurups. Sampling was conducted in March and August/September 1995. Due to wet spring conditions September sampling was not permitted at Mt Manypeaks because of disease risk and the survey was extended to Mt Lindesay, Mt Magog with an additional site on Bluff Knoll. These sites were re-sampled March 1996. Systematic sampling of all these sites was repeated in June 1996.
Additional opportunistic sampling was conducted at Mt Ragged, Thumb Peak, Ellen Peak and Mt Manypeaks between April and May 1996.
Each pitfall trap consisted of a 6 oz plastic cup (8.5 cm x 10.5 cm). Traps were layed out at 4m intervals in a 4 x 4 matrix creating a 12m x 12 m grid, using a total of 16 cups per grid.
A minimum of 2 grids were established per mountain, the majority were associated with flora quadrats.
When in use each pitfall was half-filled with Galt's solution which consisted of 5% sodium chloride, 1% potassium nitrate, 1% chloral hydrate, a trace of glycerine, and 93% water.
Traps were open for 10 days in each sampling session, after which the contents were bulked, fine-sieved and transferred from Galt's solution to 70% ethanol. Invertebrates were sorted and counted by G. Regan with the aid of a stereo microscope. Animals were identified to Order level with the aid of keys in CSIRO (1970) and Harvey & Yen (1989). The number of individuals belonging to each order was calculated. Ants were separated from Hymenoptera and identified using Andersen (1991).
Spiders, opiliones (harvest spiders), scorpions and centipedes were forwarded to Mark Harvey, and snails and slugs (Gastropoda) to Shirley Slack-Smith, of the Western Australian Museum for identification.
Mygalomorph spiders were identified by Barbara York-Main, University of Western Australia.

Opportunistic Sampling

Opportunistic survey was conducted for both vertebrates and invertebrates to add to the data derived from systematic procedures especially where standard methods were limited by the terrain.

Fox scats were analysed for prey hair by B. Trigg and non-predator scats were examined for grooming hairs. Readily identifiable scats (rabbit, fox, possum) and signs (bandicoot, echidna) were recorded.
Collections of diurnal reptile and amphibians species were made by hand (Reptile Consultant, Greg Harold assisted with surveys on Mt Lindesay and Toolbrunup Peak).Foraging for nocturnal species was limited due to the hazardous terrain involved. Frog calls were taped where possible.

Bird records were restricted to species of high conservation significance.

Recreational Impacts

The extent of recreational use was estimated from general observations of activity levels and from path counters and visitor log books where available.
Access to the mountain peak was recorded using the categories of walkway, track and route based on Department of Conservation & Land Management (1990):
* Walkway - relatively short, well formed path.
* Track - more difficult path designed to "boot" standard
* Route - may range from defined to pathless being lightly marked to unmarked

The impact of recreation was further assessed by the extent of side path formation ie deviation from the main track, this was rated using "0" = none, "minimal" = 1 or 2 side-paths and "multiple side-paths" = 3 or more side paths.
The extent of track erosion was rated on a scale of A-D:
* A = nil erosion
* B = nil, erosion potential with greater use or time
* C = Erosion up to a depth of 5cm
* D = Erosion between 6 & 15cm
* E = Erosion to a depth of 16 cm or more

Soil erodibility was determined by means of the Emmerson Test (Elliott & Leys, 1991) to determine soil dispersibility and rated as - low, moderate, high or extreme.

Path drainage was assessed by the presence / absence of water pooling during moist conditions.
The quantity of rubbish present was assessed on a scale of 0-3 (0 = none, 1=1-5 pieces of litter, 2=5-20 pieces of litter, 3= > 20 pieces of litter per mountain site).
The presence / absence of overnight camping indicated by evidence of camp-fires and bare ground exposures was noted.

Flora and invertebrate analysis

Sites were classified according to similarities in plant species composition using the Czeanowski coefficient and "unweighted pair-group mean average" fusion method (UPGMA, Sneath & Snokal, 1973). Species were classified into groups according to their occurrence at the same sites by using the same analysis.

Invertebrate pitfall grid sites were classified using the same techniques based upon presence / absence data for ant and spider species.

4. VEGETATION & FLORISTICS

A total of 750 plant taxa (species, subspecies and varieties) from 72 families were found in the forty-seven sites (thirty-eight 10 x 10m quadrats and nine 'lithic' sites) or in adjacent areas. A list of species showing location by mountain is given in Appendix 2. Of these, 713 were natives and 37 were introduced species. Fifty of the native taxa were undescribed including several newly recognised species. The most common families were Proteaceae, Myrtaceae, Papilionaceae and Epacridaceae. The location (latitude / longitude) and altitude of each site is given in Appendix 3.

Byrophytes collected opportunistically are listed in Appendix 4. The greatest species richness occurred on the granite exposures in the Porongurup Range site with 14 moss species recorded.

Of the 750 taxa, 113 appear to be endemic to the study area (Appendix 5). Of these 59 were largely confined to the Stirling Range, 8 to the Porongurup Range, eight to Mt Lindesay, one to Mt Manypeaks, 17 to the Barren Ranges, three to Peak Charles and five to Mt Ragged. Another 12 species are endemic to two or more of the mountain areas.
Forty-eight species from the Stirling Range and nine species from Mt Ragged are either outlying populations or occur at the limit of their range.

Rare and Priority Taxa

Sixteen species of Declared Rare Flora and 69 priority taxa were recorded during the survey including several new populations of DRF and some 30 new populations of priority taxa. Appendix 6 lists Rare and Priority taxa surveyed (Department of Conservation & Land Management, 1995a) and threat categories according to Department of Conservation & Land Management (1994b,1995b). Of the DRF one species - *Dryandra montana* - is currently listed as "critically endangered".
One taxa, *Persoonia micranthera* (P1) was not located during the survey and is likely to be extinct.

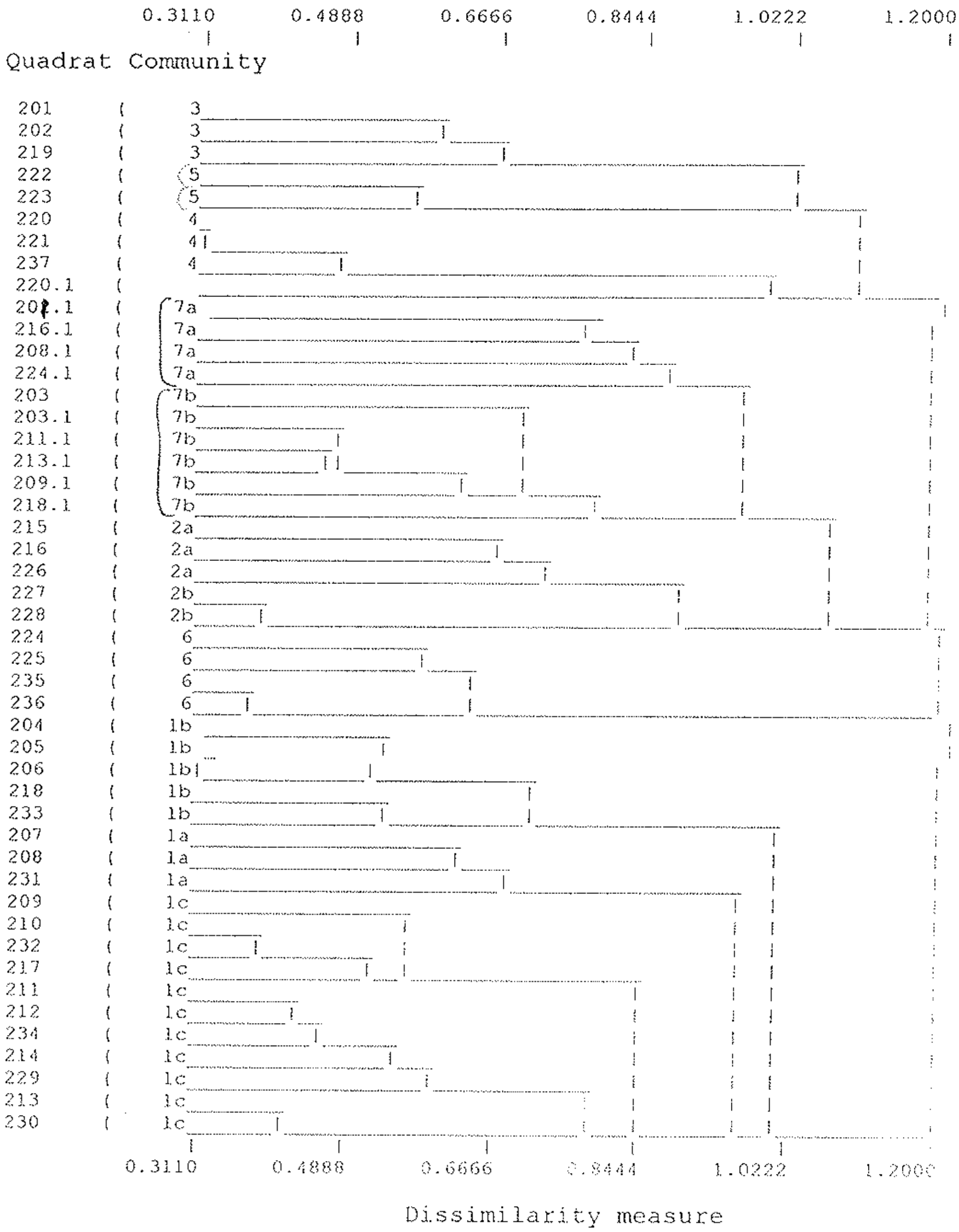
Plant communities

The data set for the multivariate analysis consisted of 546 taxa from 47 sites. Species richness in the 100m^2 quadrats ranged from 17 to 56 species per quadrat. From the analysis site groups are discussed at two scales: a seven group level and an eleven group level.The latter reflects more closely the communities observed in the field. This classification is not considered definitive and it is accepted that as more data becomes available new communities are likely to emerge. Fig 4.1 shows the dendogram derived from the floristic analysis.

Seven Group Classification

The seven group classification broadly reflects the major mountains ranges or individual mountains with the exceptions of the Mt Lindesay sites which are grouped with the Stirling Range sites, the Porongurup Range sites which are grouped with the Toolbrunup woodland sites and the 'lithic' sites (granite / quartzite exposures) which form a distinct group.
Table 4.1 shows average values for species richness, altitude, mean annual rainfall and mean annual temperature (derived from BIOCLIM), soil texture and the impact of *Phytophthora cinnamomi* for the each of the seven community groups.
A two-way table (Appendix 7) shows the species composition of the seven groups.

Fig. 4.1. Dendrogram showing the seven 'super-groups' and 11 community groups defined from presence / absence data.



Eleven Group Classification

The eleven group classification subdivides the Stirling Range and Mt Lindesay sites into three communities: Mt Lindesay, The western Stirling Range sites (with the exception of quadrat 217 Mondurup Peak), and the central - eastern Stirling Range sites. The eastern Stirling Range forms a distinct sub-group in its own right and will be discussed separately.

The lithic communities split into quartzite and granite lithic groups. The Porongurup Range and Toolbrunup sites also separate. Thumb Peak lithic site (220.1) is excluded from these sub-groups as the data collected was considered to be insufficient.

Table 4.2 shows average values for species richness, altitude, mean annual rainfall, mean annual temperature, soil texture and the impact of *P. cinnamomi* for the 11 subgroups.

Table 4.1. Average values for species richness, rainfall and temperature (from BIOCLIM), soil texture, slope and dieback impact (7 group classification).

Community Group	Mean species richness	Altitude (m. asl)	Annual rainfall (mm)	Annual temp. (°C)	Soil[1]	Slope[2]	Dieback impact[3]	No. of quadrats
Stirling Ra-Mt Lindesay (1)	35.6	732.9	876.5	13.4	3.7	2	0.8	19
Porongurup-Toolbrunup (2)	26	654	861.8	13.6	4.2	2.2	0	5
Manypeaks (3)	19.7	523.3	936	13.7	3	1.3	0	3
Thumb Pk (4)	48.3	448.3	387.3	14.8	3	2.3	0	3
Mt Ragged (5)	35.5	512.5	328.5	15.3	1	2	0	2
Pk Charles-Pk Eleanora (6)	23	507.5	256.8	15.8	1	2	0	4
Lithic (7)		785	865.9	13.3	2.6		0.4	10

[1]*soil texture: 1= loamy sand, 2=clayey sand, 3=sandy loam, 4=loam, 5= sandy clay loam*
[2]*slope: 1= gentle 2= moderate 3= steep*
[3] *dieback impact: 1= recently infected/relatively intact 2= long infected*

Table 4.2. *Average values for species richness, rainfall and temperature (from BIOCLIM), soil texture, slope and dieback impact (11 group classification).*

Community Group	Mean species richness	Altitude (m. asl)	Annual rainfall (mm)	Annual temp. (°C)	Soil[1]	Slope[2]	Dieback impact[3]	No. of quadrats
Mt Lindesay (1a)	45.7	421	1099	14	2	1.7	1	3
Western Stirling Ra (1b)	44	600	737.4	13.9	3	1.8	0	5
Central-eastern Striling Ra (1c)	29.1	878	850.8	12.9	4.5	2.2	1.2	11
Toolbrunup (2b)	23	790	833	13.3	5	3	0	2
Porongurup Ra (2a)	28	563	881	13.8	3.7	1.7	0	3
Manypeaks (3)	19.7	523.3	936	13.7	3	1.3	0	3
Thumb Pk (4)	48.3	448.3	387.3	14.8	3	2.3	0	3
Mt Ragged (5)	35.5	512.5	328.5	15.3	1	2	0	2
Pk Charles-Pk Eleanora (6)	23	507.5	256.8	15.8	1	2	0	4
Lithic - granite (7a)		525	769.5	14.2	1		0.2	4
Lithic - quartzite (7b)		956	930.2	12.6	3.7		0.6	6

[1]*soil texture: 1= loamy sand, 2=clayey sand, 3=sandy loam, 4=loam, 5= sandy clay loam*
[2]*slope: 1= gentle 2= moderate 3= steep*
[3] *dieback impact 1= recently infected/relatively intact 2= long infected*

Appendix 8 shows typical and common species for each of these 11 communities which are described below.

Community 1a - **Mt Lindesay: Low Woodland and *E.marginata* shrub mallee - heath**

E. marginata shrub-mallee and heath predominates on the upper slopes and summit area with mixed *E. marginata - E.calophylla - E.megacarpa* low woodland in gullies. Typical (occurring in more than 60% of quadrats) shrub species include *Banksia grandis, Hakea varia* and *Beaufortia decussata*. Typical sedges are *Mesomelaena gracilipes* and *Tetraria capillaris*.

Only small pockets escaped the 1991 fire with much of the area having been burnt four times in the last 25 years. Dieback (*P. cinnamomi*) is widespread and has had a severe impact on large sections of the upper slopes. However pockets still persist which are dieback free or are only in the early stages of infection.

The community includes *Andersonia* aff. *setifolia* which is endemic to the mountain. Priority taxa include *Sphenotoma parviflorum, Gastrolobium brownii* and *Sollya drummondii*.

Andersonia sp. Mt Lindesay, another endemic, occurs on the lower slopes of the mountain.

Community 1b - **Western Stirlings: Mallee-heath, heath and thicket**

The western Stirling Range sites (Mondurup and Hume Peak) are characterised by greater species richness, lower elevation and rainfall, and lighter soils (sandy loams) than the middle - eastern Stirling Range sites. Mondurup site 217 (*Eucalyptus megacarpa* mallee) , elevation 790m, is grouped with the latter.

There is a large proteaceous component to this community which is currently dieback free.

Typical species include *Dryandra foliata (P4), D. armata* var. *nova, Petrophile divaricata, Aotus genistoides* and *Xanthorrhoea platyphylla*. Mallee species include *Eucalyptus preissiana, E.doratoxylon* and *E. staeri*.

Species endemic to the Stirling Range include *Stylidium verticillatum (P3) Andersonia echinocephala (P3), Hakea ambigua, Isopogon latifolius, Leucopogon lasiostachyus (P3), L. lasiophyllus (P2), Andersonia grandiflora (P3)* and *Lambertia ericifolia*.

Darwinia macrostegia (Declared Rare) is restricted to the western Stirling Range.

Community 1c - **Central-Eastern Stirlings: *E.marginata- E.calophylla* mallee, *E.calophylla* woodland, thicket and heath**

This community occurs at higher altitudes and is characterised by greater rainfall and soils with higher clay content (loam and sandy clay loam). It includes sites from Mt Magog, Bluff Knoll, Ellen Pk, and Mondurup (217). All of the sites occur above 650m a.s.l.

The vegetation consists of montane thickets and heath on the upper slopes, mallee-heaths on mid-slopes and marri woodland which reaches higher elevations in protected mountain gullies. From approximately 750m a.s.l. *Eucalyptus megacarpa* mallee forms a transition between *E.callophylla* woodland and *E.marginata - E.calophylla* mallee-heath below and montane thickets above. At approximately 850-900m a.s.l. *E.megacarpa* (a species normally associated with the high-rainfall karri forest) is replaced by thicket and scrub, hence a tree-line is found only on the higher peaks.

Despite a general decrease in species number in the higher mountain belt there is an increasing number of local montane endemic species.

Most of the eastern Stirling sites were burnt in 1991 with only small pockets escaping. Regeneration on exposed sites is very slow compared with more protected areas.

The eastern Stirling sites have been severely infected by dieback with minimal areas escaping infection. On Mt Magog (central-Stirling Range) pockets of uninfected vegetation persist. Typical species include *Calothamnus crassus, Kunzea montana, Banksia oreophila, Agonis parviceps* and *B.solandri*

Eastern Stirling Range Montane Community

In the eastern Stirling Range (Ellen Peak - Bluff Knoll- Coyaranup Peak) a distinct sub-group of the above community is found characterised by *Kunzea montana, Andersonia axilliflora, A. echinocephala, Banksia oreophila, Sphenotoma* aff. *dracophylloides* and *Darwinia* spp. This corresponds with the *Kunzea montana - Andersonia echinocephala* community of Pignatti *et al.* (1993).

Changes in the floristic composition of this community due to *P. cinnamomi* are significant and will be discussed in Section 6.

Species endemic to the eastern Stirling Range are *Andersonia axilliflora, Dryandra montana, Persoonia micranthera, Darwinia collina, Xyris* sp. Stirling Range, *Darwinia squarrosa, Nemcia* sp. Ellen Peak, *Hypocalymma myrtifolium* and *Stylidium keigheryi.*

On Bluff Knoll alone there are six Declared Rare species *Darwinia collina, Darwinia squarrosa, Dryandra montana, Andersonia axilliflora, Sphenotoma drummondii* and *Xyris* sp. Stirling Range.

Dryandra montana is classified as "critically endangered" (Dept. of Conservation & Land Management, 1995b). Nineteen mature indviduals remain on the Bluff Knoll Plateau, seedling regeneration is poor. During the survey 53 additional mature individuals were located in an unburnt pocket between Bluff Knoll and Moongoongoonderup Hill.

A limited number of seedlings (approximately ten) were located on Bluff Knoll.

Xyris sp. Stirling Range is found only in the peaty creek-line in the saddle between Bluff Knoll and Coyaranup Peak.

A seventh Declared Rare species, *Banksia brownii,* a fire sensitive species which is highly susceptible to dieback, used to be common on the Bluff Knoll plateau (Pignatti *et al.*, 1993). Although it is now locally extinct *B. brownii* leaf litter is still present within quadrat 213 Bluff Knoll. One population of seedlings was located during the survey in the saddle between Bluff Knoll and Coyanarup Peak and 4 mature specimens were located along with *D.montana* between Bluff Knoll and Moongoongoonderup Hill.

<u>Community 2</u>a- **Porongurup Range: Woodland, *E. diversicolor* (karri) forest, and thicket**

The floristic analysis grouped these sites together on the basis of a common herbaceous understorey characterised by the *Tetrarrhena laevis, Poa porphyroclados,Tetraria capillaris, Pteridium esculentum, Oxalis corniculata* and *Veronica plebeia.*

Characteristic species of the Porongurup sites are the endemics *Hibbertia* sp. Porongurup (Declared Rare), *Brachysema subcordatum (P4), Acacia heteroclita* ssp. *valida (P2), A. drummondii ssp. elegans* Porongurup variant (P2) and *Thryptomene saxicola.*

E.megacarpa woodland occurs at lower altitudes in the Porongurup Range (approximately 550 m a.s.l).at the base of granite domes where run-off augments rainfall.Thicket vegetation fringes the granite domes.

Below the woodland is karri forest which is at the inland limit of its geographic range. It is believed that the karri forest is an outlier population thought to have separated from the main karri forest of the Warren Botanical Subdistrict 100km further west as aridity increased about 5000 years ago (Coates & Sokolowski, 1989).

Community 2b **Toolbrunup: Marri woodland - thicket**
Characteristic species of the Toolbrunup *E. calophylla* woodland sites include the Stirling Range endemics *Acacia veronica* (P3) and *Thomasia* sp. Toolbrunup; *Trymalium floribundum* and a herbaceous / grassy understorey characterised by the *Tetrarrhena laevis*, *Poa porphyroclados*, *Tetraria capillaris* and *Corybas recurvas*. *Lasiopetalum dielsii* (P2) has been recorded only from Toolbrunup, *Nemcia vestita*, a dominant member of the community, occurs only on Toolbrunup and Mt Hassell nearby. Other Stirling range endemics include *Sphenotoma drummondii*, *S.* aff. *dracophylliodes* and *Hypocalymma phillipsii*.
There is no evidence of dieback at either of these sites however the upper slopes of Toolbrunup are difficult to interpret due to the paucity of indicator species. Both woodland sites were severely burnt in January 1996 in a wildfire.
A new population of *Banksia brownii* (DRF) was located on Toolbrunup during the study and two individuals escaped the 1996 fire.

Community 3 - **Mt Manypeaks: *E.megacarpa* mallee-thicket and heath**
E.megacarpa mallee-thicket occupies the base of large granite outcrops, which cap the Manypeaks ridge, and the moist gullies, particularly on the southern aspects. On skeletal soils on granite heath occurs, between the prominent granite outcrops there is dense thicket dominated by *Hakea elliptica*. Other typical species are *Leucopogon australis*, *Agonis marginata* and *Ricinocarpus glaucus*. *Billardiera granulata* (P4), considered endemic to the Porongurup Range, was found in *E. megacarpa* mallee-thicket.
Pommaderris grandis (P4), surveyed opportunistically, is endemic to the mountain. *Muiriantha hassellii* (P2) occurs on the lower slopes and is otherwise endemic to the Stirling Range.
While dieback has been sampled on the ridge-line (M. Grant, pers.com.) the upper slopes are virtually dieback - free at present.

Community 4 - **Thumb Peak: heath and mallee-heath**
Thumb Peak forms part of the Barren Ranges located within the Fitzgerald River National Park, which with 1748 taxa is one the richest areas for plants in Western Australia. The quartzite ranges, including the Whoogerup and Eyre Ranges, are particularly rich in flora.
This community is characterised by high species richness with a strong Proteaceous element.
Thumb Peak is currently dieback free however the dieback hazard is very high for the community. Typical species are *Eucalyptus acies* (P3), *Dryandra quercifolia* and the endemics *Hakea hookeriana* (P2), *Grevillea fistulosa* (P2), *G. coccinea* ssp. *lanata* (P3). *Adenanthos labilliardieri* (P4) and *Jacksonia compressa* (P4). Three Declared Rare species occur on the mountain - *Grevillea infundibularis*, *Adenanthos ellipticus* and *Coopernookia georgei*. *Andersonia echinocephala* also occurs on Thumb Peak, otherwise the species is confined to the Stirling Range. *Platytheca juniperina* whose main occurrence is in the Stirling Range is found on Thumb Peak - Barren Range as well as Mt Lindesay.
17 species occurring on Thumb Peak are endemic to the quartzite ranges of the Fitzgerald and of these 4 species are endemic to the mountain and nearby mid-Mt Barren and Woolbernup Hill: *Darwinia* sp. Thumb Peak (P2), *Xanthosia* sp. Thumb Peak, *Grevillea infundibularis* and *Grevillea coccinea* ssp. *lanata*. *Eucalyptus acies*, a major component of the mallee-heath on Thumb Peak, Mid-Mt Barren and adjacent Woolbernup Hill is notably absent from the remainder of the Barren Ranges. Thus

the central Barren Ranges (Thumb Peak- Mid-Mt Barren - Woolbernup Hill) form a distinct endemic community in their own right.

Community 5 - **Mt Ragged: scrub and mallee-heath**
Typical species are *Eucalyptus doratoxylon, Adenanthos oreophilus, Dampiera parvifolia, Monotoca oligarrhenoides* and the endemics *Dryandra longifolia* ssp. *archeos, Phebalium rude* ssp. *lineare* and *Scaevola brookeana. Darwinia* sp. Mt Ragged is also endemic to the mountain. Priority taxa include *Leucopogon apiculatus* and *Chorizema nervosum. Kennedia beckiana* (Declared Rare) occurs mainy on the mid - lower slopes.
Anthocercis viscosa, common on granite on the south coast from Walpole to Cape Arid, is found at the wave -cut bench mark on Mt Ragged, one of nine species at the inland or eastern limit of their range.
The mountain was last burnt in 1991 in a fire which burnt an area in excess of 120,000 hectares both within and beyond Cape Arid National Park. Virtually no areas of the mountain escaped the fire. The site is currently dieback free however the it is a very high hazard community.

Community 6 - **Peak Charles - Peak Eleanora: thicket and scrub**
The Peak Charles National Park is significant as it lies on the boundary between the South-West and Eremaean Botanical Provinces. Peak Eleanora is long unburnt (ca 100 years), most of Peak Charles was burnt in 1991 but a few pockets of thicket escaped on the upper slopes.
Typical species from the mountain community are *Calothamnus quadrifidus, Labichea lanceolata* ssp. *brevifolia, Melaleuca fulgens* and *Leucopogon cuneifolius. Allocasuarina campestris* and *Acacia lasiocalyx* are common on Peak Eleanora. Pockets of *Callitris preissii* ssp. *verrucosa* woodland present on Peak Charles pre-fire are evident from skeletons and seedling regeneration.
Drummondita hassellli, Declared Rare, is endemic to Peak Charles. *Darwinia* sp. Peak Charles (P2), also endemic, has not been recorded post-fire.

Community 7a - **Lithic exposures - granite: scrub and open herbs**
The granite sites were more diverse, with a greater herbaceous component, than the quartzite lithic community. The largest number of weed species were recorded on granite.
Typical species include *Stypandra glauca, Pelargonium australe, *Hypochoeris glabra* and *Cheilanthes austrotenuifolia.*
The bare granite rock slabs which dominate the middle slopes of Mt Lindesay supports a unique community with a number of species endemic to the mountain and nearby Little Lindesay (*Borya longiscapa, Grevillea fuscolutea, Lasiopetalum* aff. *cordifolium, Cryptandra congesta* and an undescribed species of *Laxmannia* located during the survey).
In the Porongurups the Declared Rare *Villarsia calthifolia* is endemic to the granite. *Stylidium corymbosum* var. *proliferum* considered endemic to the Porongurups was also found on granite on Mt Manypeaks as was *Banksia verticillata* (Declared Rare) ,*Sphenotoma drummondii* (main occurrence in the Stirling Range) and a new population of *Stylidium articulatum (P2)*. The fern *Asplenium aethiopicum* (P4) was located on both Mt Lindesay and Nancy Peak (Porongurup Ra), it is also known from Mt Manypeaks.

Community 7b - **Lithic exposures - quartzite: scrub and open herbs**
This community has less herbaceous species and more scrub vegetation than the granite sites.

Typical species included the endemics *Actinotus rhomboideus (P2), Sphenotoma drummondii (P3), Veilliea foliosa, Stylidium* sp. nov. Stirling Range, and *Leucopogon gnaphaloides. Platysace* sp. Stirling Range, known from Bluff Knoll and Toolbrunup and located during the survey on Ellen Peak, is also endemic.
The community is susceptible to dieback in spite of its skeletal soils. Considerable water run-off may contribute to this.

Altitude and species richness
Within community groups species richness generally showed an inverse correlation with altitude. An analysis of 20 quadrats from the Stirling Range - Mt Lindesay super-community (Community 1) showed a negative correlation between species richness and alltitude (r = -0.784, P < 0.01). Fig. 4.2 graphs species richness versus altitude for these sites.
Analysis of thirty-seven 10 x 10m quadrats surveyed showed a similar negative correlation for all mountain sites (r = -0.35, p <0.05). Fig 4.3 shows species richness versus altitude for Mt Ragged and Thumb Peak quadrats. For example at Thumb Peak a difference in altitude of the order of 150 metres corresponded with a decrease in species number from 55 to 39 per quadrat.

Fig 4.2 Species richness V altitude Mt Lindesay - Stirling Range quadrats

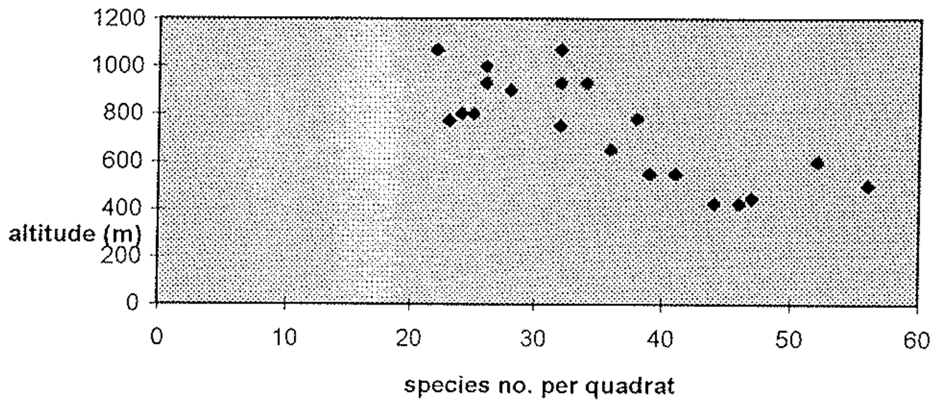
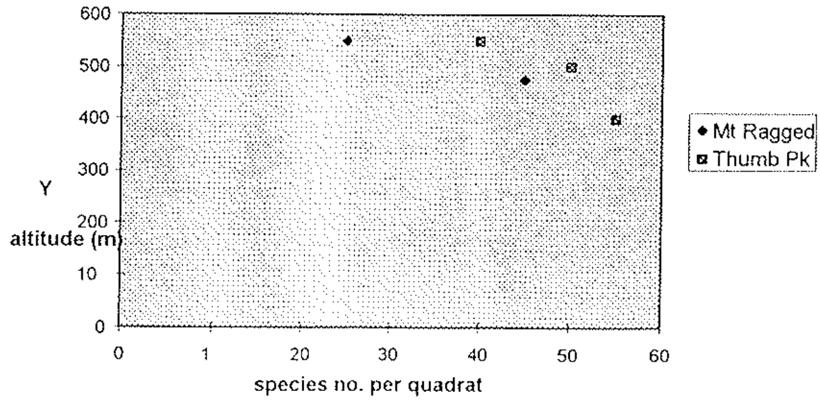


Fig.4.3 Species richness V altitude Thumb Pk & Mt Ragged sites



Weeds

Thirty-six introduced species were recorded during the survey, representing 4.8% of the flora compared with 10.5% for the State as a whole. Weed infestation is not extensive and largely confined to lithic sites. Weeds were most abundant in the families Poaceae (12 taxa) and Asteraceae (11 taxa).

The granite outcrops had a higher weed frequency than the quartzite, in particular the granite areas of the Porongurup Range Site from which the largest number of weeds were recorded (weed frequency 0.29%). The vegetation quadrats were generally weed-free with the exceptions of Porongurup Range quadrats 226 & 215, Mt Lindesay 231, Peak Eleanora 235 and Peak Charles 224 all of which occur on granite. The vegetation quadrats on quartzite mountains were all weed-free with the exception of the Toolbrunup Peak quadrats which showed an increase in weed cover after the 1996 fire.

The tracks were largely weed-free throughout with the exception of the Porongurup Range Site and the Toolbrunup Peak track.

Table 4.3 shows mean weed frequencies for quadrats from the Porongurup Range, Mt Lindesay, Pk Charles - Pk Eleanora and the lithic communities.

Table 4.3. Mean weed frequencies of weed-affected sites

	Porongurup Range	**Pk Charles - Pk Eleanora**	**Mt Lindesay**	**lithic: granite**	**lithic: quartzite**
Mean weed frequency (%)	0.04	0.13	0.02	0.15	0.09

5. FAUNA

Vertebrate Fauna

A total of 16 mammal species were recorded during the survey including three introduced species (Table 5.1). Of these, five species are currently listed as 'likely to become extinct, or is rare' in Schedule 1 of the Wildlife Conservation Act (Dept. of Conservation & Land Management, 1950).
A sixth rare mammal species *Potorous tridactylus gilbertii* (Gilbert's Potoroo) (Critically Endangered, Dept. of Conservation & Land Management, 1994b, 1995b) is considered likely to occur on Mt Manypeaks as determined by hair analysis (Tony Start, pers comm); however, due to the small hair sample the results were inconclusive.

The 26 reptile and nine frog species recorded are listed in Table 5.2. *Brachyaspis atroceps* (Lake Cronin Snake), recorded during the survey, is an uncommon species previously known from a small number of collections from the vicinity of Lake Cronin, east of Hyden.

Mammals

TACHYGLOSSIDAE

Echidna *Tachyglossus aculeatus* was identified from scats collected from Peak Eleanora and from diggings on Thumb Peak, Mt Ragged and Hume Peak. Echidna are considered to be less abundant in the wetter areas of the south-west than the agricultural land to the north. Few records exist for the Stirling Range (Friend & Muir, 1993).

DASYURIDAE

Mardo *Antechinus flavipes* was recorded from six mountain sites - Porongurup Range (karri forest), Manypeaks, Bluff Knoll and Mondurup (*Eucalyptus megacarpa* mallee-thicket), Magog (woodland) and Ellen Peak and Toolbrunup (summit area in lithic vegetation). The Stirling Range mardo is an outlier of the main population of the high rainfall karri belt in the extreme southwest of Western Australia. The Ellen Peak population is at the north-eastern limit of its range.

Dibbler *Parantechinus apicalis,* status: Endangered (Dept. of Conservation & Land Management, 1994b, 1995b).
Only limited populations of Dibbler are known in the south-west Western Australia. In this survey Dibbler was recorded from the lower slopes of Thumb Peak in sandy loam soils on quartzite, in very open mallee over heath (typical species *E. tetragona, E. decurva, Dryandra quercifolia, Adenanthos oreophila).* The area was last burnt in 1985. The Thumb Peak population comprises one of two currently known in the Fitzgerald River National Park.

PERAMELIDAE

Quenda *Isoodon obesulus fuscivente*r
Status: Vulnerable (Dept. of Conservation & Land Management, 1994b, 1995b).
The Quenda or southern brown bandicoot was identified by the analysis of fox scats and / or hair tube tapes collected from Mt Manypeaks, Mt Lindesay, the Porongurup Range site, the summit areas of Magog and Ellen Peak, and Hume Peak.

Table 5.1. Mammals Recorded in Mountain Survey

	Ellen Pk	Bluff Knoll	Toolbrunup	Magog	Mondurup	Hume	Porongurup	Mt Lindesay	Manypeaks	Thumb Pk	P Elean.	P Charles	Mt Ragged
TACHYGLOSSIDAE													
Tachyglossus aculeatus						#*				#*	#^{Sc} #*		#*
DASYURIDAE													
Antechinus flavipes	#^{S}#^{Sc}	#^{B}	#^{S}	#^{S}#^{Sc}	#^{Sc}		#^{S}		#^{Sc}				
Parantechinus apicalis										#^{S}			
Dasyurid sp. indet						#^{Sc}							#^{Sc}
PERAMELIDAE													
Isoodon obesulus	#^{HT}#^{Sc}			#^{HT}#^{Sc}		#^{Sc} #*	#^{Sc} #*	#^{Sc} #*	#^{HT}#^{Sc}	#^{S}			
PSEUDOCHEIRIDAE													
Pseudocheirus occidentalis								#^{Sc}	#^{Sc}				
TARSIPEDIDAE													
Tarsipes rostratus		#^{S}			#^{S}#^{Sc}	#^{S}	#^{S}			#^{S}			
PHALANGERIDAE													
Trichosurus vulpecula	#^{S}#^{HT}#	#^{Sc}	#*	#^{HT}#^{Sc}		#^{HT}#^{Sc}	#^{S}, #^{Sc}	#^{HT}#^{Sc}	#^{Sc}	#^{S}#^{Sc}	#^{Sc}		
MOLOSSIDAE													
Nyctinomus australis											#^{HC}		
MACROPODIDAE													
Macropus fulginosus	#^{Sc}	#^{Sc}	#^{Sc}	#^{Sc}		#^{Sc}	#^{Sc}	#^{Sc}			#^{Sc}		
Macropus eugenii	#^{Sc}												
Potorous tridactylus gilbertii?									#?				
Setonix brachyurus	#^{HT}	#^{Sc}	#^{Sc}			#^{Sc}			#^{HT}				
MURIDAE													
Rattus fuscipes	#^{S}, #^{HT}	#^{HT}#^{Sc}	#^{HT}#^{Sc}	#^{S}, #^{HT}	#^{S}, #^{HT}	#^{S}	#^{HT}#^{Sc}	#^{S}	#^{S}, #^{HT}	#^{S}, #^{HT}	#^{S}		
Mus musculus												#^{HT}	#^{S}, #^{HT}
CANIDAE													
Vulpes vulpes	#^{Sc}	#^{Sc}	#^{Sc}	#^{Sc}	#^{Sc}	#^{Sc}	#^{Sc}	#^{Sc}	#^{Sc}	#^{Sc}	#^{Sc}		
Canis familiaris		#^{Sc}									#^{Sc}		
LEPORIDAE													
Oryctolagus cuniculus	#^{Sc}	#^{Sc}					#^{Sc}		#^{Sc}			#^{Sc}	

#^{S} = trapped / seen active. #^{HT} = hair tube / run-thru. #^{Sc} = scat analysis. #* = diggings. #^{B} = ID of bones.

Characteristic bandicoot diggings were observed at all these sites. Quenda was also trapped on the lower slopes of Thumb Peak during the study period although its optimal habitat may be higher in mountain gullies (N. Baczocha pers. comm.). The southern brown bandicoot is relatively common along the wetter parts of the south coast. WA museum records indicate a contraction of range in these areas (Chapman, 1995). It is considered to be sparsely distributed in the Stirling Range favouring areas of dense habitat (Friend & Muir, 1993).
Habitat in this survey included woodland with a sedge understorey, thicket, mallee-thicket and tall dense sedges.

PSEUDOCHEIRIDAE
Western Ringtail Possum *Pseudocheirus occidentalis*
Status: Vulnerable (Dept. of Conservation & Land Management, 1994b, 1995b).
Western Ringtail Possum was identified from scats collected from Mt Manypeaks and Mt Lindesay, in *Eucalyptus megacarpa* (mallee) - *Hakea elliptica* thicket at the former location and *E. megacarpa* low woodland - *Agonis parviceps* thicket on Mt Lindesay (unburnt pocket).
The Mt Manypeaks population is at the eastern limit of its range.

TARSIPEDIDAE
Honey Possum *Tarsipes rostratus* was recorded infrequently during the survey. It was more common in heath sites in the western Stirling Range and Thumb Peak. In March 1996 honey possums were trapped on the Bluff Knoll plateau in an area of very slow post-fire regeneration.

PHALANGERIDAE
Brush-Tailed Possum *Trichosurus vulpecula* were recorded from Mt Lindesay, Manypeaks, Magog, Hume Peak, Ellen Peak and Bluff Knoll (Stirling Range); Thumb Peak (Barren Range), the Porongurup Range site and Peak Eleanora. *T. vulpecula* is considered to have declined in the Stirling Range area and in this survey it was recorded from a range of habitats including woodland, mallee-thicket, heath, rocky outcrops and caves.

MACROPODIDAE
Tammar Wallaby *Macropus eugenii* was recorded from the upper slopes of Ellen Peak in *Allocasuarina decussata* low woodland (post-fire regeneration). Tammar wallaby was plentiful in the 1800s and early this century but was considered to have disappeared from the Stirling Range (Friend & Muir, 1993).

Western Grey Kangaroo *Macropus fulginosus* was most abundant on mountains of lower elevation - Hume Peak, Mt Lindesay, Peak Eleanora and on granite outcrops in the Porongurup Range. It was also recorded from more recently burnt higher mountains - Ellen Peak and Bluff Knoll, and the mid-slopes of Magog.

Gilbert's Potoroo *Potorous tridactylus gilbertii*
Status: Critically Endangered (Dept. of Conservation & Land Management, 1994b, 1995b).
A limited hair sample obtained from a 'run-thru' on Mt Manypeaks (*Eucalyptus megacarpa* mallee-thicket) suggests that Gilbert's Potoroo may occur on the mountain however further survey work will be required to confirm this. The Potoroo, considered to be extinct, was relocated on nearby Mt Gairdner, Two-Peoples Bay Nature Reserve, in December 1994. Only 12 individuals are known with certainty in

the wild and 11 others are currently in captivity. Any extension of its current range would be highly significant.

Setonix brachyurus
Status: Vulnerable (Dept. of Conservation & Land Management, 1994b, 1995b).
Quokka was identified by I) analysis of hair tube samples from Mt Manypeaks and Ellen Peak, at the eastern end of the Stirling Range, and ii) analysis of scats (grooming hairs) collected from Toolbrunup, Bluff Knoll (both southern slopes and the Cascades area), Ellen Peak and Hume Peak in the western end of the Stirling Range. Quokka remains have also been collected from Bluff Knoll in 1990 and 1991 (WA Museum records). Analysis of scats collected after the 1996 wild-fire on Toolbrunup indicated quokka were active at this site post-fire.
Habitat was thicket; dense *E. megacarpa* mallee - thicket and *E.megacarpa / Allocasuarina decussata* low forest with a sedge understorey, in areas with moist micro-climates such as gullies or below rocky outcrops.

MURIDAE
Rattus fuscipes Southern Bush Rat was the most commonly trapped animal during the survey. There appeared to be a preference for vegetation with a dense understorey of tall sedges or shrubs with a thicket or mallee overstorey.
Bush rat was also the most commonly sampled species using hair tubes.
In the Fitzgerald River National Park numbers of bush rat were found to be significantly higher on the quartzite ranges than other land surfaces (Chapman, 1995). In Western Australia bush rat has a predominantly coastal distribution, the Peak Eleanora / Peak Charles population represents the inland limit of its range and may be an outlier population.

House Mouse *Mus musculus* was uncommon during the survey. This is in marked contrast to the often encountered situation in WA where house mouse is the most widespread and abundant of small mammals (Chapman, 1995). *M. musculus* was trapped only on Mt Ragged and identified from hair samples on Pk Charles, both of these sites were burnt in 1991. In plague years house mouse may be more abundant at other sites, such fluctuations have been observed in the Fitzgerald River area (Angela Sanders, pers. comm.).

Introduced species
CANIDAE
Canis familiaris (probably wild dog) was recorded from Peak Eleanora and Bluff Knoll (scat analysis). The scat from Bluff Knoll included rabbit hair.

Red Fox *Vulpes vulpes* was identified from scats at all sites with the exception of Mt Ragged. The most common mammalian prey identified by analysis of fox scats was *Rattus fuscipes*, other species included *Antechinus flavipes, Isoodon obesulus, Tarsipes rostratus, Trichosorus vulpecula* and *Oryctolagus cuniculus*.
Mountain tracks appeared to facilitate access to mountain summits however even at sites without any defined path and with moderate to dense canopy cover fox scats were observed.

LEPORIDAE
Rabbit *Oryctolagus cuniculus* was identified from scats and diggings on Ellen Peak, the Bluff Knoll plateau, the granite areas of the Porongurup Range and Peak Charles summit.

Rabbits on Bluff Knoll are evident over an extensive area of the summit where post-fire regrowth is already extremely slow.

Reptiles
Reptile diversity was low at all sites with the exceptions of Peak Charles and Peak Eleanora - which occur in the interzone between the Mediterranean climate of the south coast and the arid zone to the north. The reptile fauna of the south coast is less diverse than that of the semi-arid and arid zones. This may be related to rapid temperature fluctuations and frequent summer cloud cover which can cause young to die (Chapman, 1995).

GECKONIDAE / SCINIDAE
Phyllodactylus marmoratus marmoratus was the most commonly recorded gecko, it was widespread and moderately abundant. *P. m. marmoratus* from the mountain peaks may be one of several sub-species (K. Aplin, pers. comm.).
The most commonly recorded skinks were *Ctenotus labillardieri* and *Egernia napolionis* which were widespread and abundant on both granite and quartzite with the exception of Peak Charles and Peak Eleanora; and Mt Ragged where only *E. napolionis* was recorded. *Hemiergis peronii peronii* was also widespread.

ELAPIDAE
Lake Cronin Snake *Brachyaspis atroceps* was collected from the summit of Peak Eleanora on granite and low scrub. This species is known from less than five collections from the vicinity of Lake Cronin, east of Hyden which is some 200 km north-west of Peak Eleanora. The snake is considered vulnerable because of its limited distribution. This record has substantially extended its range.
The crowned snake *Notechis coronatus* was the most frequently recorded snake, followed by the tiger snake *Notechis scutatus occidentalis* which was recorded from Ellen Peak, Bluff Knoll, Porongurup Range, Mt Lindesay and Mt Ragged. It is probably present at all sites with the exception of the more arid Peak Charles and Peak Eleanora. The Mt Ragged population is at the north-eastern limit of its range.

Frogs
Amphibian diversity was low throughout except on Bluff Knoll in the creek-line between the Bluff and Coyanarup Peak where four species were recorded in this survey and another three previously (records of the WA Museum). Amphibian fauna in quartzite Barren Ranges was found to be depauperate because of the hardness of the substrates (Chapman, unpub.). With the exception of Bluff Knoll there is little surface water for species with this requirement.
The below average rainfall in 1994 and 1995 may also have affected frog populations which has been the case in the Fitzgerald River area during the same period (Angela Sanders pers. comm.).

Crinia georgiana was the most commonly recorded species, occurring at all the sites with the exception of Hume Peak and Magog (Stirling Range), Peak Eleanora, Peak Charles and Mt Ragged. It normally occurs where there is shallow water in winter.
Metacrinia nichollsii was recorded in this study from Ellen Peak, Toolbrunup and Mt Lindesay, and from Bluff Knoll in 1992 (WA Museum records). Restricted to the karri

Table 5.2. Reptiles / Frogs recorded in Mountain Survey

REPTILES & AMPHIBIANS	Ellen Pk	Bluff Knoll	Toolbrun.	Magog	Mondurup	Hume	Porong.	Mt Lindesay	Manypeaks	Thumb Pk	P Elean.	P Charles	Mt Ragged
GECKONIDAE													
Crenactylus o. ocellatus											#S	#S	
Gehyra variegata											#S		
Nephrurus millii											#S	#S	
Phyllodactylus m.	#S	#S	#S	#S	#S	#S	#S	#S	#S		#S		
marmoratus													
PYGOPODIDAE													
Aprasia repens											#S		
Delma australis						#S					#S		
Delma fraseri											#S		
Pygopus lepidopodus						#S				#S			
SCINIDAE													
Bassiana trilineata					#S		#S	#S					
Ctenotus labilliardieri	#S	#S	#S	#S	#S	#S	#S	#S	#S	#S			
Egernia kingii		#S											
Egernia napolionis	#S	#S	#S	#S	#S	#S	#S	#S	#S	#S			#S
Egernia pulchra pulchra	#S	#S											
Hemiergis peronii	#S	#S	#S	#S	#S	#S	#S	#S	#S		#S	#S	
Lerista distinguenda											#S		
Lerista dorsalis												#S	
Lerista microtis								#S					
Morethia butleri											#S	#S	
Morethia obscura			#S		#S						#S		
Tiliqua rugosa					#S	#S							

#S = trapped / seen active

Table 5.2. Reptiles / Frogs recorded in Mountain Survey

	Ellen Pk	Bluff Knoll	Toolbrun.	Magog	Mondurup	Hume	Porong.	Mt Lindesay	Manypeaks	Thumb Pk	P Elean.	P Charles	Mt Ragged
VARANIDAE													
Varanus rosenbergi		$\#^{S}$					$\#^{S}$	$\#^{S}$					
ELAPIDAE													
Brachyaspis atroceps											$\#^{S}$		
Notechis coronatus	$\#^{S}$	$\#^{S}$		$\#^{S}$				$\#^{S}$		$\#^{S}$			
Notechis curtus	$\#^{S}$	$\#^{S}$							$\#^{S}$				
Notechis scutatus		$\#^{S}$	$\#^{S}$					$\#^{S}$					$\#^{S}$
occidentalis													
Pseudonaja affinis											$\#^{S}$		
FROGS													
HYLIDAE													
Litoria adelaidensis		$\#^{x}$								$\#^{S}$			
Litoria moorei									$\#^{S}$				
LEPTODACTYLIDAE													
Crinia georgiana	$\#^{S}$	$\#^{S}$	$\#^{S}$		$\#^{S}$		$\#^{S}$	$\#^{S}$		$\#^{S}$			
Limnodynastes dorsalis		$\#^{x}$											$\#^{S}$
Neobatrachus kunapalari													$\#^{S}$
Pseudophyrne nichollsii	$\#^{S}$		$\#^{HC}$					$\#^{S}$					
Ranidella pseudinsignifera	$\#^{S}$	$\#^{S}$	$\#^{HC}$										
Ranidella subinsignifera		$\#^{S}$											
Geocrinia leai		$\#^{S}$											

#S = trapped / seen active #HC = heard calling belt in the extreme southwest of Western Australia extending east to Denmark, the Stirling Range populations are outliers occupying moist areas in the eastern peaks. The Ellen Peak population is at the eastern limit of its range.

Geocrinia leai was a new record for the Stirling Range.

Both *Ranidella pseudinsignifera* and *Ranidella subinsignifera* were identified from specimens from Bluff Knoll. However, as it is only possible to differentiate between these species by their call only one of the two species, more probably the former, may occur there.

Neobatrachus kunapalari was recorded only from Mt Ragged. It is usually found on impervious soils in the southwest and arid zone (Tyler *et al.*, 1994).

Birds - Threatened Taxa

Three Rare species (Dept. of Conservation & Land Management, 1996) occur within the study area.

Noisy Scrub-Bird *Atrichornis clamosus*

Status: Endangered

In 1961 the presumed extinct Noisy Scrub bird was rediscovered at Two Peoples Bay, east of Albany. Translocations of Noisy Scrub-birds from the Two Peoples Bay populations, as part of the Noisy Scrub-bird Recovery Plan, to Mount Manypeaks in 1983 and 1985 resulted in a population of Noisy Scrub-birds in the area between Normans Inlet and Waychinicup River.

The 1992 census (used to provide an index of the total population) showed a total of 100 singing males in the area. Virtually every gully on the mountain now contains at least one singing male and numbers have increased rapidly since 1989. The Manypeaks population now contains the second largest number of singing males and there is sufficient habitat for growth and expansion for some time (Danks et al., 1994). In 1992 the singing males on Mt Manypeaks represented 31.1% of the total for the area between Oyster Harbour and Cheyne Beach.

Western Bristlebird *Dasyornis longirostris*

Status: Endangered

The Western Bristle Bird occurs in heath on the lower slopes of Mt Manypeaks, its current distribution is limited to the coastal strip from Two Peoples Bay east of Albany to just east of the Cheyne Beach town-site. There is a gap in its distribution then until the Fitzgerald River National Park.

Western Whipbird *Psophodes nigrogularis*

Status: Vulnerable

The Western Whipbird was recorded from several mountains in the Stirling Range from Hume Peak in the west to Ellen Peak in the east; and from Thumb Peak, Barren Range. It is considered to be common in the Fitzgerald River National Park (Chapman, 1995).

INVERTEBRATE FAUNA

Litter Invertebrate Pitfall Survey

Litter invertebrates were recorded from a total of 33 Orders. The most abundant Orders over the whole period were, in order of magnitude, Collembola, Hymenoptera, Diptera and Amphipoda, followed by Araneae. The abundances of each Order by site, and total abundances for each of the three trapping periods (March, June, August/September) are given in Appendix 9.
Table 5.3 shows total abundances for each order by site for the three trapping periods combined. The high numbers of Collembola recorded is comparable with previous studies, Collembola followed by Hymenoptera (Formicidae), Acarina and Dermaptera were found to be the most abundant orders of soil and litter invertebrates in the West Australian jarrah forest (Postle,1986). The higher number of Acarina in Postle's study is probably due to their prevalence in the soil as soil invertebrates may be up to 40 times more abundant than those in the litter. Ants (Formicidae) accounted for the majority of hymenopterans. High numbers of dipterans have also been recorded from the South African fynbos (Breytenbach & Breytenbach, 1988). The abundance of amphipods is a feature of the wetter areas of the southwest.

There were considerable seasonal variations in abundance in particular orders. In general numbers were higher in March. Hymenoptera were more abundant in March and were the most abundant order overall in this period. Collembola, however, were most abundant in late winter while dipterans did not show as much variation between seasons. Amphipods and Isopods, both decomposers, were significantly more abundant in March than winter. Amphipods occurred largely in sites with deep leaf litter (Porongurup karri forest, Toolbrunup marri woodland, Manypeaks and Mondurup *Eucalyptus megacarpa* mallee- thicket). A phenological study of the southwest has shown decomposer abundance, and presumably rates of decomposition, to be higher in the warmer months in the lower southwest though in Perth the opposite occurs (Koch & Majer, 1980). Hexapod predators appear to be active throughout the year with a decrease in activity in winter both in the lower southwest (Koch & Majer, 1980) and in this survey.

Between site differences were apparent for certain orders. For example considerably higher abundances of Amphipods were recorded in the Porongurup karri site (226), Isopods in marri woodland on Toolbrunup (227, 228), and Opiliones (Bluff Knoll 230 and Porongurup 226).

Two species of Amphipods were recorded *Neorchestia* sp. (restricted to the south coast) and *Austrotroides pectinalis* which is widespread in the southwest.

Formicidae - Ants

Fifty-one ant species were recorded from five sub-families, the largest number of species (21) was recorded from the Formicinae and of these nine were from the genus *Camponotus*. Dolichoderinae was the next largest family with eight species. Elements of the Bassian fauna of cool-temperate Australia were dominant including species from the genera *Prolasius* and *Notoncus*.

A species of *Myrmecorhynchus*, rarely collected in the southwest, was recorded from Mt Lindesay. *Orectognathus*, a genus known largely from the eastern seaboard and tropical northeastern Australia, was recorded from Magog and Bluff Knoll. The genus has previously been collected from the Porongurup Range.

Table 5.3. Total abundances of invertebrates by order for each site for three trapping periods.

	Toolbrun. 227	Toolbun. 228	Porongurup 226	Porongurup 215	B. Knoll 213	B. Knoll 214	B.Knoll 230	Mondurup 217	Mondurup 218	Lindesay 208	Lindesay 231	Magog 232	Magog 209	Total
Haplotaxida										1	1			2
Arhynchobdellae											4			4
Acarina	33	22	34	119	38	21	13	39	49	43	33	89	16	549
Araneae	82	72	139	246	117	105	45	74	122	155	98	76	77	1408
Opilionida	4	4	217	53	58	56	433	21	28	8	5	7	3	897
Scorpionida				17	1			2		1				21
Pseudoscorpionida						1								1
Amphipoda	113	71	1139	69	11	21	3	119		92	23	10	241	1912
Isopoda	77	94	20	33		3		38	1	6	2	3	29	306
Sigmurethra	6	2	26	6	1			2			1	1	3	48
Cyrptopidae							1	1						2
Lithobiida					2	4								6
Scolopendridae			1											1
Julida			2	3					1					6
Sphaerotheriida			2										2	4
Spirobolida		1	1	1					1					4
Spirostreptida	1				3	1	1			15	3			24
Polyzonida			1	1										2
Collembola	230	217	469	509	621	399	501	553	957	1156	313	519	298	6742
Ephemeroptera					1									1
Blattodea	2	2		1			5	22	2	5	8	3	1	51
Isoptera								1	1	1				3
Dermaptera	9	11	8	16	74	41	7	12	19	16	9	7	8	237
Orthoptera			26	37	18	55	99		4	69	60	4		372
Psocoptera			1					3	4					8
Phithiraptera	1													1
Hemiptera	12	9	7	70	13	3	3	13	37	26	7	33	13	246
Thysanoptera												1		1
Coleoptera	35	16	24	48	142	58	136	23	54	118	91	38	60	843
Siphonoptera											1			1
Diptera	416	408	355	790	722	101	293	386	345	251	215	365	506	5153
Lepidoptera	2	5		5	2	1	5	4	2	4		3	2	35
Hymenoptera	69	27	53	870	203	109	187	193	2281	1471	185	245	143	6036
Total orders	16	15	18	19	16	14	14	17	17	18	18	16	15	

Appendix 10a lists ants species recorded in the survey by site. Appendix 10b gives ant abundances by site for each trapping session.

Systematic survey
Forty-two species were recorded from a systematic pitfall invertebrate survey of 6 mountains (13 grids). Species diversity was greatest in the genus *Camponotus* (7 species).

Species richness
Species richness per grid ranged from 0-16 ant species. The sites with the greatest species richness were the Porongurup woodland site (Q.215) and the Mondurup heath site (Q.218), both with 16 species, followed by Mt Lindesay heath (Q.208) and Magog mallee-heath (Q.232) with 14 species. This is unlikely to reflect the total number of species present as two of the sampling periods were in the cooler months. An extra sampling period in summer, when ants may be more active (Majer, 1985) would probably have yielded additional species and as largely soil or litter ants were specifically sampled, arboreal species may have been omitted; subterranean species would also be under-represented. Furthermore as ants are highly sensitive to environmental variables, different species may be patchily distributed within any habitat and therefore under-sampled (Andersen, 1990).

Ant species richness showed a significant ($p<0.01$) positive correlation with plant species richness, level of insolation of the ground layer (based on both aspect and the cover and height of the canopy), the presence of *Iridomyrmex sp conifer group* and plant community structure (Table 5.4). Ant species richness was higher in heath and mallee sites compared with woodland and forest sites.

Table 5.4 *Correlation of ant species richness with plant species richness, structure, insolation, the presence of Iridomyrmex conifer, rainfall, temperature and altitude.*

	Plant species richness	Structure	Insolation	*Iridomyrmex* conifer grp present	Mean annual rainfall	Mean annual temperature	Altitude
Correlation coefficient *r*	0.7**	0.8**	0.7**	0.8**	0.3 NS	0.1 NS	-0.2 NS

** = P< 0.01, NS = not significant.

Ant species richness is considered to provide a good bio-indicator of the abundance and richness of both other invertebrates and plants (Majer, 1983). The abundance of *Iridomyrmex* may reflect an environment favourable for ants (Andersen & Burbidge, 1992). Species richness was not affected by high numbers of dominant *Iridomyrmex*, this is in contrast to other studies where species diversity has been found to be supressed by dominant species (Andersen & Burbidge, 1992).
As most Australian ants nest and forage on the ground the structure of the ground layer, especially the degree of insolation and the amount of litter is considered to be a particularly important habitat variable affecting ant community composition. These factors may influence the abundance of dominant species which in turn regulates the abundance of highly interactive (unspecialised) taxa (Andersen, 1990).

Abundance:

The classification of ant genera into functional groups provides insight into the major processes operating within ant communities and their associated habitats (Andersen, 1990).

Table 5.5 classifies the ant species recorded into functional groups according to Andersen (1990) and Andersen & Burbidge (1992) and gives i) total abundance of each species, ii) total and relative abundance of each functional group and iii) total ant abundance and species richness by site, for the three trapping periods.

The most abundant group overall was the dominant Dolichoderinae (80% of the overall total), in particular *Iridomyrmex* sp. conifer group (78%) which was recorded from six of the 13 grids. They were followed by cold climate specialists (10%) and 'generalised myrmicines' (2.5%).

Excluding *I.* conifer group from the estimate of total abundance the largest group was cold climate specialists (*Prolasius* and *Notoncus* spp.) (45.6% of adjusted total), followed by 'generalised myrmicines' (11.2%) and 'cryptic / sub-cryptic' species (10.2%).

Iridomyrmex is less abundant in the cooler, wetter regions of southern Australia where cold-climate specialists and opportunists are typically the most common epigaeic ants, cryptic species are also more common in these regions (Andersen, 1990).

Large abundances of ants generally correlated with high species richness at a site (eg Porongurup 215, Mondurup 218, Mt Lindesay 208).

Seasonal Differences

A greater number of ant species were surveyed in March (34) compared with the early (24) and late (19) winter sampling periods. However in terms of abundance the total numbers of ants was greatest in August / September (2258), followed by June (1698), compared with March (1602) (Appendix 10b). These figures are largely a result of the high numbers of *Iridomyrmex* conifer group trapped at particular sites. If *I.* conifer group numbers are excluded abundances were greatest in March. Warm climate specialists (*Melophorus* spp., *Adlerzia, Meranoplus*) were only sampled in March, a similar seasonality in *Melophorus* has been observed by Majer (1985) related to diet and seed availability. The activity of most ant species in southern Australia is strongly seasonal with low activity in the cool periods of the year (Andersen, 1990). A decrease in ant activity in winter has been also recorded for Manjimup (lower southwest of WA) (Majer & Koch, 1982). Numbers of cold climate specialists (*Prolasius* and *Notoncus* spp.) were more abundant in early and late winter (223 and 261 respectively) compared with March (61).

Community analysis.

Multivariate analysis of the 42 ant species recorded in the systematic pitfall survey divides the sites into one major group and two minor groups. The former consists of the Mt Lindesay, Mondurup and Bluff Knoll sites, Magog 232 and Porongurup 215. The latter consisted of i) the woodland sites Magog 209 and Toolbrunup 228 (no ants were recorded from Toolbrunup 227) and ii) the karri forest site Porongurup 226; all sites of very low ant species richness. A dendrogram showing the three groups is given in Figure 5.1, the Two-way table derived from the analysis is given in Appendix 11. Table 5.6. shows average values for ant species richness, plant species richness and vegetation structure for the three community groups

This classification is not definitive as with greater sampling and more data a better understanding of these ant communities may be possible.

Table 5.5. Abundances of ant species recorded in systematic pitfall survey, and abundances and relative abundances of functional groups.

FORMICIDAE	Tool 228	Porong 226	Porong 215	Bluff Knoll 213	Bluff Knoll 214	Bluff Knoll 230	Mond 217	Mond 218	Mt Lind. 208	Mt Lind. 231	Magog 209	Magog 232	Total No.	% of total	I.conifer group excluded
Dominant Dolichoderinae														%	%
Iridomyrmex sp. conifer group			900				119	1101	2081	24		119	**4344**		
Iridomyrmex 'vicina'				1	38			50		1		7	**97**		
Papyrius sp. 1										4			**4**		
													4445	79.9	8.4
Associated subordinate Camponotinae															
Camponotus sp.1				3	2		6	5		1			**17**		
Camponotus sp.2		7				2				11		1	**21**		
Camponotus sp.3			2					11	13			7	**33**		
Camponotus sp.4					2								**2**		
Camponotus sp.5								3				2	**5**		
Camponotus sp.7				6		1							**7**		
Camponotus sp.9									2				**2**		
Polyrhachis patiens										1			**1**		
													88	1.6	7.2
Climate specialists															
Hot climate															
Melophorus sp.1.			3	5	1			26				5	**40**		
Melophorus sp.2				1									**1**		
Melophorus sp.3			1										**1**		
Adlerzia sp.1					1								**1**		
Meranoplus sp.1					9			4		3			**16**		
													58	1	4.8
Cold climate															
Prolasius sp.1	4		8		2	3	1		68	69	29	22	**206**		
Prolasius sp.2					2	13	1	19	191	4	18	4	**252**		
Prolasius sp.3			11										**11**		
Notoncus sp.1			1			1		1	53	2	12		**70**		
Notoncus sp.2			4	1					3				**8**		
Myrmechorhynchus sp.1									5				**5**		
Dolichoderus sp.1					1	2			2				**5**		
													557	10	45.6

Table 5.5. *Abundances of ant species recorded in systematic pitfall survey, and abundances and relative abundances of functional groups.*

FORMICIDAE	Tool 228	Porong 226	Porong 215	Bluff Knoll 213	Bluff Knoll 214	Bluff Knoll 203	Mond 217	Mond 218	Mt Lind. 208	Mt Lind. 231	Magog 209	Magog 232	Total No.	% of total	% *I.conifer* excluded
Opportunists															
Rhytidoponera inornata				35	16	17	1	6				18	**93**		
Rhytidoponera sp.1									1				**1**		
Rhytidoponera sp2				1									**1**		
Ochetellus 'glaber'								8	1			3	**12**		
													107	1.9	8.7
Cryptic/sub-cryptic															
Cryptic species															
Amblyopone sp.1			5										**5**		
Amblyopone sp.2		2											**2**		
Strumigenys sp.1							1						**1**		
Sub-cryptic species															
Tapinoma sp.1			1										**1**		
Plagiolepis sp.1			5										**5**		
Doleromyrma 'darwinianus'			20			1	11	42	36				**110**		
													124	2.2	10.2
Generalist Myrmicinae															
Crematogaster sp.1						5	9	51	6			18	**89**		
Monomorium leae			1					32				1	**34**		
Pheidole sp.			8				1	4					**13**		
													136	2.5	11.2
Large solitary foragers/ specialist predators															
Myrmecia sp.1					4					14		2	**20**		
Myrmecia sp.2			1				2	1				3	**7**		
Myrmecia sp.3					2								**2**		
Orectognathus sp.1				1									**1**		
Platythyrea sp.1			16						1				**17**		
													47	0.8	3.9
Total numbers	**4**	**9**	**987**	**54**	**80**	**45**	**152**	**1364**	**2463**	**134**	**59**	**212**	**5562**		
Total Species	1	2	16	9	12	9	10	16	14	11	3	14			

Figure 5.1 Dendrogram showing 3 community groups defined from ant presence / absence data set.

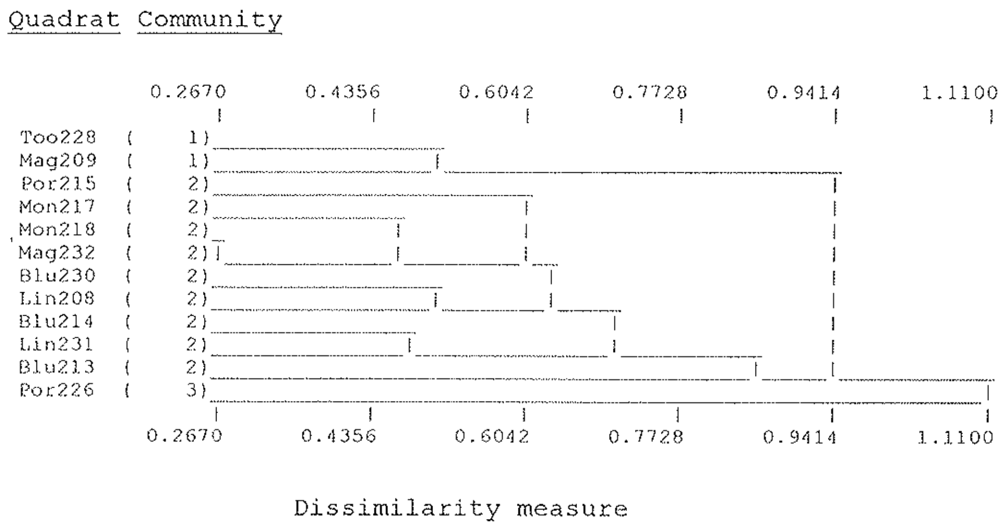


Figure 5.2 Dendrogram showing 4 community groups defined from spider presence / absence data set.

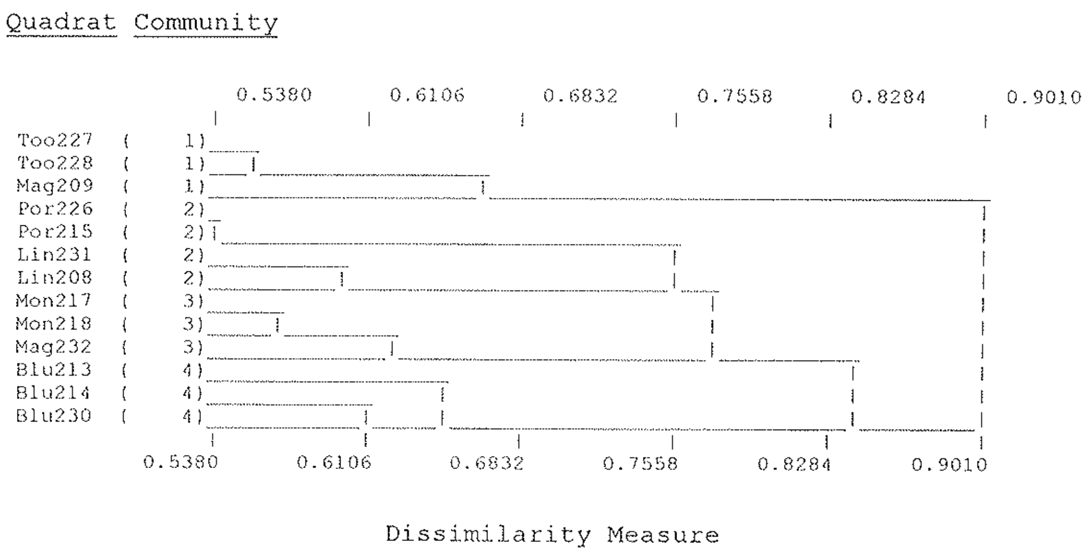


Table 5.6. Average values for ant species richness, vegetation structure and plant species richness for the three group classification.

	Community Type 1	Community Type 2	Community Type 3
Ant sp. richness	2	12.4	2
Vegetation structure*	1	2.6	1
Plant sp richness	26	34	23

* woodland / forest = 1, low woodland / mallee = 2, heath = 3

Gastropoda - Snails and Slugs

Snails

All the land snails of the Stirling Range have strong Gondwanan affinities and are believed to have radiated before the split of the continents (Main, 1993).

Table 5.7 shows Gastropod species recorded during the survey wiith a total of 11 snail species from three families and two species of slug from the family Limacidae. Several of the snails have restricted distributions with at least two endemic to the Stirling Range (*Bothriembryon glauerti* and *Insullaoma* sp.). A species from the family Punctidae (? genus), collected from Toolbrunup, appears to be newly recognised and may also be endemic to the Stirling Range.

The taxonomy of the genus *Paralaoma* (Punctidae) and *Pernagera* (Charopidae) requires further work. While certain members of these families may be widespread others have more restricted distributions and may be endemic (Shirley Slack-Smith, pers comm).

The genus *Bothriembryon* is largely confined to the southern areas of Western Australia. Some of these species appear to have small areas of distribution and may be quite rare while the habitats of some species have contracted. The *Bothriembryon* species from Thumb Peak appears to be endemic to the quartzite ranges of the Fitzgerald River National Park. *Bothriembryon revectus* (Mt Lindesay) is a species apparently confined to the area between Pemberton and Denmark. *Bothriembryon notatus*, recorded from Mt Manypeaks, also has a limited distribution (Shirley Slack-Smith, pers comm).

Bothriembryon brazieri is known from the Stirling Range and Porongurup Range as well as the area to the east of the Stirlings and to the south-west of the Porongurups.

An undescribed and rarely seen species of *Strangesta* from the carnivorous family Rhytididae was also collected during the study period by WA Museum staff from the south-facing lower slopes of Ellen Peak.

Slugs

Two introduced species of slugs from the family Limacidae were recorded, both from the Porongurup Range site.

The species *Limax maximus Linnaeus*, while widespread in south-eastern Australia, is apparently rare in south-western Australia. The other species *Lehmannia nyctelia* is now widespread in the south-west.

Table 5.7. Snails and Slugs Recorded in Mountain Survey

* = introduced species

	Ellen Pk	Bluff Knoll	Toolbrunup	Magog	Mondurup	Hume Pk	Porongorup	Mt Lindesay	Manypeaks	Thumb Pk	Pk Charles	Mt Ragged
CLASS GASTROPODA												
Order Sigmurethra												
Bulimulidae												
Bothriembryon brazieri					#S		#S					
Bothriembryon dux												
Bothriembryon glauerti	#O	#S	#O									#O
Bothriembryon notatus									#O			
Bothriembryon revectus								#S				
Bothriembryon sp.										#S		
Charopidae												
Charopid indet.			#S									
Pernagera sp							#S		#S			
Punctidae												
Insullaoma sp.				#S								
? *Paralaoma* sp.			#S									
Paralaoma sp.				#X								
Punctidae sp ?genus			#S									
Limacidae												
**Limax maximus linnaeus*							#S					
**A7Lehmannia nyctelia*							#S					

#S = collected in pitfall survey.
#O = collected opportunistically.

Arachnida - Spiders, Harvest Spiders, Scorpions and Pseudoscorpions

Araneae - Spiders

During the survey 141 spider species from 32 families were recorded. Families with the greatest number of species were Salticidae (16), Zodariidae (10) and Nemesiidae, Amaurobiidae and Stiphidiidae (9). Appendix 12 shows spider species recorded at all invertebrate survey sites and other Arachnid species including harvest spiders, scorpions and pseudoscorpions.

Mygalomorphae (Trapdoor Spiders)

Mygalomorphs are an ancient group of spiders and include several Gondwanan relics which persist in cool, wet mountainous habitats. Fifeteen (15) species were recorded from three families. The largest of these was Nemesiidae, the families Idiopidae and Migidae both have Gondwanan origins.

Six species are considered to be endemic to the Stirling Range. These endemics included one Critically Endangered species, an undescribed species of *Moggridgea* (Dept. of Conservation & Land Management, 1994b;1995b). Migidae is a Gondwanan family with specific counterparts in southern Africa and the genus *Moggridgea* is the only representative of the family in the southwest (Main, 1993). This fire-sensitive species was previously only known from the eastern Stirling Range and Toolbrunup Peak, both recently burnt. This survey located a new population on Magog, extending its known range. Since then another population has been recorded from Mt Talyuberlup near Magog. Further collections are required to determine the taxonomic status of the Magog specimen as it displays some differences to specimens from previous locations (B. Main, pers comm).

The genus *Neohomogona* is considered to be endemic to the Stirling and Porongurup Ranges and has close relatives (the genus *Homogona*) in mountainous areas in eastern Australia. A newly recognised species of the genus collected from Toolbrunup proved different from *Neohomogona stirlingii* previously recorded from the Range. This species may be restricted to Toolbrunup whereas the species recorded from Mondurup in the western Stirling Range in this survey appeared to be the same as *Neohomogona stirlingi*.

A second newly recognised species of *Neohomogona* was collected from Mt Manypeaks, extending the range of the genus. It may be restricted to this mountain.

Two endemic species of *Eucyrtops*, a southwest Australian genus, are known from the Stirling Range, one was recorded from Bluff Knoll in this survey, the second from Ellen Peak. An undescribed species was also recorded from Thumb Peak which may be endemic.

The species *Stanwellia*, another Gondwanan genus, recorded from the Stirling Range (Bluff Knoll creek-line and Ellen Peak summit area) is endemic to the Range. It was previously known only from the Cascades area of Bluff Knoll. The species from the Porongurup Range is known from a few wet areas in the southwest and is another relic species.

An undescribed species of *Chenistonia* from Mt Ragged has also been collected further east of the mountain. *Chenistonia* sp. 1 (Porongurups, Manypeaks, Stirling Range) is also known from the Albany region.

Araneomorphae

One hundred and twenty-six species were recorded from 29 families of Araneomorphs.

Families with Gondwanan affinities include Archaeidae, Toxopidae, Cycoctenidae, Gallieniellidae, Micropholcommatidae, Nicodamidae and Orsolobidae.

A newly recognised species of the genus *Austrarchaea* (family Archaeidae) was recorded from the summit area of Ellen Peak. The genus is known from two other localities in the southwest and is otherwise known from localised areas on the east coast of Australia. The family also occurs in South Africa and Madagascar.
The genus *Toxops* (family Toxopidae) has been described from Tasmania and is known elsewhere in the southwest from Torndirrup National Park and West Cape Howe. A newly recognised species collected from Bluff Knoll and Ellen Peak in this survey is likely to be endemic to the Stirling Range.
Ambicodamus marae (family Nicodamidae) was recorded from the Stirling Range and the Porongurup Range site which are outlier populations of its main distribution within the karri forest of the extreme southwest.
Tasmanoonops mainae (family Orsolobidae), previously collected from West Cape Howe, was recorded from the Stirling Range, Mt Manypeaks, Porongurup Range, Mt Lindesay and Mt Ragged.
Collections of *Baiami montana* (family Stiphidiidae) from Mt Lindesay and Mt Manypeaks extended its distribution beyond the Stirling and Porongurup Ranges.

Araneae Systematic Survey

Species richness ranged from nine to 27 species per grid. Sites with the greatest species richness were Porongurup Q215, Bluff Knoll Q214, and Mt Lindesay Q208 with 27, 26 and 22 species respectively.
The sites which recorded the greatest abundances of spiders were Porongurup Q215 (246 individuals), Mt Lindesay Q208 (155 individuals) followed by Porongurup Q226 (139 individuals). Species richness and total abundances per sites are shown in Table 5.8.

Table 5.8. Spider species richness and total abundances of spiders, systematic survey sites.

	Tool 227	Tool 228	Por. 226	Por. 215	B. Knoll 213	B. Knoll 214	B. Knoll 230	Mon. 217	Mon 218	Lind. 231	Lind. 208	Mag 209	Mag 232
No. species	9	9	14	27	21	26	15	18	19	13	22	14	18
Total abundance	82	72	139	246	117	105	45	74	122	98	155	77	76

Spider species richness showed a positive correlation with ant species richness, the level of insolation of the ground layer (based on both cover and height of the canopy and aspect) and plant community structure (Table 5.9). Spider species richness was lower in the forest and woodland sites compared with heath and mallee sites.

Table 5.9. *Correlation of spider species richness with altitude, mean annual rainfall and temperature, plant and ant species richness, plant community structure and insolation.*

	Altitude	Mean annual rainfall	Mean annual temperature	Plant species richness	Structure	Insolation	Ant species richness
Correlation coefficient *r*	0.01 NS	0.17 NS	-0.06 NS	0.47 NS	0.67*	0.67*	0.74**

* =*P<0.05* **= *P<0.01 NS = not significant*

Seasonal Differences

Spider abundances were greatest in March and least in August / September. The number of species recorded was also highest in March compared with late winter. However the abundances and numbers of species of Mygalomorphs recorded were highest in winter (June).

Community Analysis

Multivariate analysis of the 100 species recorded in the systematic survey divides the sites into two major divisions, the Toolbrunup and Magog woodland sites and the remaining sites from Mt Lindesay, Porongurup Range and the Stirling Range. Further subdivision results in 4 community groups: i) Toolbrunup and Magog woodland sites, ii) Porongurup and Mt Lindesay sites, iii) Mondurup and Magog heath / mallee-heath and iv) Bluff Knoll sites (Figure 5.2). Table 5.10 shows the average values for spider and plant species richness, altitude, mean annual temperature, and plant community structure in the four community groups. Vegetation structure appears to be an important factor influencing the species richness and composition of both ant and spider communities.

Table 5.10. Average values for altitude, plant community structure, mean annual temperature & rainfall, plant & spider species richness and litter cover for the four community groups derived from community analysis.

	Altitude	Community Structure[1]	Mean annual Temp.	Mean annual rainfall	Plant sp. richness	Spider sp. richness	Litter cover[2]	No. of pitfall grids
Toolbrunup / Magog 209	780	1	13.3	842.7	23.7	10.7	3	3
Porongurup / Mt Lindesay	480	2	13.9	984.5	39	19	1.8	4
Mondurup / Magog 232	723.3	2.3	13.4	837.7	30.3	18.3	2.3	3
Bluff Knoll	1013	3	12.3	955.7	27.3	20.7	1.3	3

[1]*Community structure: 1=forest/woodland 2= low woodland/mallee 3=heath*
[2]*Litter cover 1=>70% 2= 30-70% 3= <30%*

As can be seen from the dendrogram (Fig 5.2) the spider sites demonstrating greatest similarity in species composition occur within a particular mountain area (with the exception of the Magog sites). This contrasts with the ant analysis (Fig.5.1) where sites from different mountains (eg Bluff Knoll and Mt Lindesay) show close associations. This suggests that the ant fauna has a fairly widespread distribution in comparison to the spider fauna which demonstrates greater levels of endemism. Of the 100 spider species 55 recorded were only recorded from one site and this again may indicate a high degree of endemism though under-sampling may also be a factor.

Opilionida - Harvest Spiders

Five species of harvest spiders were recorded from four families. A recently described species from the family Caddidae, *Hesperopilio mainae*, significant for its Gondwanan origins, was collected from four mountains in the Stirling Range, Mt Manypeaks and Mt Lindesay.

Pseudoscorpionida
One species of the genus *Pseudotryannochthonius* (family Chthoniidae), a Gondwanan genus, was collected from Bluff Knoll and Ellen Peak. The species is considered to be endemic to the Stirling Range (M.Harvey pers comm). *Synsphyronus apimelus* (family Garypidae) known from Toolbrunup (not recorded this survey) is also an endemic.

6. THREATS TO MOUNTAIN ECOSYSTEMS

The Impact of Plant Disease on Plant Communities

The major plant disease assessed during the study was the soil-borne fungus *Phytophthora cinnamomi* which produces the disease symptoms commonly termed "dieback". It is at present the most widely distributed pathogen in the southwest of Western Australia.

P. megasperma, although not as widespread and with a less extensive range of hosts than *P.cinnamomi*, is also a potential threat to Thumb Peak (currently dieback free).It was first recorded on the south coast at East Mount Barren in the Fitzgerald River National Park where it is associated with considerable plant deaths in *Banksia speciosa*.

Several aerially dispersed canker causing fungi are present in the study area, notably *Botryosphaeria ribis* and *Cryptodiaporthe* sp. These have caused the decline of particular species such as *Banksia coccinea* in the Stirling Range. *Armillaria luteobubalina*, a native root rot fungus, attacks a wide range of plant species and is spread by air-borne spores and in infected soil. These diseases are not considered at present as significant a threat to mountain ecosystems as *P. cinnamomi*.

The impact of dieback - *Phytophthora cinnamomi*

Table 6.1 shows dieback hazard rating and disease impact for each 10x10m quadrat. The majority of the Stirling Range sites as well as the Mt Lindesay, Thumb Peak and Mt Ragged sites have a very high hazard rating based upon floristics, soil characteristics and annual rainfall. The absence of accurate rainfall measurements for Mt Ragged limits the assessment of dieback hazard for this mountain. The plant communities of these sites have a significant Proteaceous component and include a large number of susceptible species. For example quadrat 233 Mondurup Peak in the western Stirling Range with a total of 52 species has ten species rated highly susceptible to *P.cinnamomi*. Of 55 species in quadrat 237 Thumb Peak, 13 are considered to be highly susceptible to the disease.

APPENDIX 13 lists the dieback susceptibility ratings of specific taxa assessed during this survey or available from previous studies.

Within the Stirling Range variation in rainfall, soil type, topography and drainage further affect dieback hazard. For example the eastern Stirling Range sites have higher rainfall than the western end of the Range, soils with predominantly greater clay content and landforms prone to impeded drainage eg. saddle and plateau areas. These factors may contribute to the higher disease impact at these sites.

The impact of *Phytophthora cinnamomi* on community floristics

Mountains currently infected with *Phytophthora cinnamomi* include Mt Lindesay and the middle to eastern Stirling Range sites (Magog, Bluff Knoll and Ellen Peak). Both Magog and Mt Lindesay, have remnant pockets of un-infected vegetation on the upper slopes. The eastern Stirling Range sites appear to have minimal dieback free areas.

The western Stirling Range sites, Mondurup and Hume Peak, remain dieback free although there is infection on the lower slopes of the former.

Table 6.1. Dieback hazard (low, high, very high) and disease impact (0-2) for flora quadrats

Quadrat No	Mountain quadrats used in ANOVAS	Dieback Hazard	Disease Impact	Quadrat No	Mountain	Dieback Hazard	Disease Impact
207	Mt Lindesay	VH	2	227	Toolbrunup	H	0
208	Mt Lindesay	VH	0	228	Toolbrunup	H	0
231	Mt Lindesay	VH	1	215	Porongurup	H	0
233	Mondurup	VH	0	216	Porongurup	L	0
218	Mondurup	VH	0	226	Porongurup	L	0
204	Hume Pk	VH	0	201	Manypeaks	H	0
205	Hume Pk	VH	0	202	Manypeaks	H	0
206	Hume Pk	VH	0	219	Manypeaks	H	0
217	Mondurup	VH	0	220	Thumb Pk	VH	0
232	Magog	VH	1	221	Thumb Pk	VH	0
209	Magog	H	0	237	Thumb Pk	VH	0
210	Magog	VH	0	222	Mt Ragged	VH	0
213	Bluff Knoll	VH	2	223	Mt Ragged	VH	0
214	Bluff Knoll	VH	2	224	Pk Charles	L	0
230	Bluff Knoll	VH	2	225	Pk Charles	L	0
229	Bluff Knoll	VH	2	235	Pk Eleanora	L	0
238	Bluff Knoll	VH	2	236	Pk Eleanora	L	0
211	Ellen Pk	VH	2				
212	Ellen Pk	VH	2				
234	Ellen Pk	VH	2				

A one-way analysis of variance (ANOVA) compared the following factors between dieback-free or recently-infected sites (dieback impact 0 &1) and those with a long history of infection (dieback impact 2).
i) the number of species highly susceptible to dieback (susceptibility rating of 10-12)
ii) the number of proteaceous species,
iii) the number of epacrid species
iv) the number of species from the Papilionaceae
v) the number of myrtaceous species
vi) species richness
vii) the number of sedge species from the Cyperaceae and Restionaceae
was conducted on the 19 quadrats from super-group 1 (Stirling Range - Mt Lindesay community) of the seven major community groups derived from the floristic analysis. Percentage protective foliage cover of the species groups assessed was not included in the analysis as several of the sites were burnt in 1991 and protective foliage cover was still low. The results are shown in Table 6.2 .

Table 6.2 Impact of dieback on floristic structure. Mean number of i) highly susceptible species (susceptibility rating of 10-12) and ii) species from selected families, at 12 "healthy" sites and seven "old infested" sites.

Group	**Healthy / Recently Infested**	**Old-Infested**	**P from ANOVA**
All species	37.7	32.1	0.26 NS
Highly Susceptible	6.8	3.9	0.016*
Proteaceace	7.4	2.4	0.001**
Epacridaceae	3.4	3.6	0.84 NS
Papilionaceae	2.9	1.7	0.17 NS
Myrtaceae	6.3	7	0.45 NS
Cyperaceae & Restionaceae	2.4	4.1	0.06 NS

** = $P<0.01$, *= $P<0.05$

The number of Proteaceous species were significantly less abundant (**$P<0.01$) in the long infected sites as were the number of highly susceptible species (*$P<0.05$). The Epacridaceae failed to show a significant difference, showing a slower decline than proteaceous species possibly due to an abundance of soil-stored seed. Differences in species richness were not significant, though increased richness in infected sites in the initial post-fire years may have contributed to this. Future monitoring of the more recently burnt sites and an assessment of the long-term dieback succession may well reveal a loss of species richness. Quadrat 213 Bluff Knoll, in long unburnt heath and thicket had ten fewer species than quadrat 230 nearby which was burnt in 1991, both are 'old-infested' sites.

The impact of *Phytophthora cinnamomi* on plant community structure

Most of the high impact sites in this study were also burnt in 1991 so the structural impact of *P. cinnamomi* could not be measured. However many of the species lost from high impact sites are long-lived proteaceous species which are major components of the overstorey as can be seen from old "skeletons" of *Banksia solandri, Banksia oreophila* and *Dryandra* spp. *Banksia brownii* skeletons (more than 2 high) are still visible on the Bluff Knoll plateau. These species are being replaced largely by sedges (Cyperaceae and Restionaceae) less than one metre in height.

The impact of *Phytophthora cinnamomi* on the eastern Stirling Range Montane Plant Community and endemic species

The impact of *P. cinnamomi* on both floristics and structure is most apparent in the eastern Stirling Range where the community is in the process of significant change and where several members of the community are under threat from the disease. *Persoonia micranthera,* a plant species assumed to be highly susceptible to *P. cinnamomi* and confined to the eastern Stirlings was not located during this survey and may be extinct. *Banksia brownii,* a Declared Rare species, is now locally extinct

on the Bluff Knoll plateau although a small number of seedlings were located during the survey in the saddle between Bluff Knoll and Coyanarup Peak. Its previous contribution to the community both floristically and structurally is evidenced by burnt "skeletons" still visible and from old photography (Plate 1a,1b). *Dryandra montana*, a critically endangered species, is currently known from 72 mature specimens and some ten seedlings (Plate 1c,1d). *Andersonia axilliflora*, also endemic to the eastern Stirling Range, is highly susceptible to *P. cinnamomi* which is impacting heavily on seedling establishment post-fire. No individuals of these latter two species occur within dieback free areas. The post-fire establishment of *Leucopogon gnaphalioides*, endemic to the Stirling Range but whose major occurrence is in the eastern part of the Range, is being similarly affected (Plate 1e). Deaths were observed in *Sphenotoma drummondii*, also highly susceptible, (main occurrence in the eastern Stirling Range), despite growing in skeletal soils on rocky exposures. The high moisture levels in its habitat render it prone to infection. Seedlings of species such as *Banksia solandri* and *Isopogon latifolius,* formerly abundant on Bluff Knoll and Ellen Peak as determined from older photography (eg. Plate 2a), are patchy in distribution and relatively low in numbers compared with the densities observed in these photographs. Widespread deaths were also observed in *Dryandra concinna, Adenanthos filifolius* (both Stirling Range endemics), *Sphenotoma* aff. *dracophyllioides* (Plate 1e) and *Banksia oreophila. Lambertia fairallii*, Declared Rare, and confined to two populations, one on Ellen Peak and the other in the middle of the Range, is also highly susceptible to and threatened by dieback.
The rate of change in community floristics can be demonstrated by the loss of two species (*Andersonia echinocephala* and *Isopogon latifolius)* from quadrat 213, Bluff Knoll (Plate 2b) during the course of the study. All mature specimens of a third species, *Andersonia axilliflora*, also died although regeneration of seedlings continues under the old canopy (Plate 2c). Summer rainfall events (1995-96) may have escalated disease activity. A fourth species, *Banksia brownii*, was already lost from the quadrat at the beginning of the survey, but is readily identifiable from its conspicuous leaf litter which persists in this unburnt pocket.
While highly susceptible species are largely members of the families Proteaceae and Epacridaceae a range of species from the Myrtaceae and Papilionaceae demonstrated low to variable susceptibility to *P. cinnamomi.* Positive recoveries of *P. cinnamomi* were obtained from dead or dying *Darwinia squarrosa* and *Darwinia collina* (both DRF and endemic to the eastern Stirling Range). There were also positive recoveries from the Stirling Range endemics *Nemcia rubra, Nemcia pulchella, Kunzea montana* and *Calothamnus crassus.* While the latter two species are still abundant in infected sites, at high enough inoculum levels individuals may still succumb. This may reflect site characteristics, for example the *Kunzea* was located on the edge of the walk path.

Plate 1a. *Banksia brownii* skeleton, Bluff Knoll (S.Barrett). **Plate 1b**. Bluff Knoll plateau post-1972 fire, *Banksia brownii* prominent in heath (J.Watson). **Plate 1c**. *Dryandra montana* in long unburnt thicket Bluff Knoll (E.Hickman) **Plate 1d**. *Dryandra montana* seedling infected with *Phytophthora cinnamomi*, Bluff Knoll (E.Hickman). **Plate 1e**. Seedling deaths (*Leucopogon gnaphalioides, Sphenotoma* sp.) due to *Phytophthora cinnamomi*, Bluff Knoll (M.Grant). **Plate 1f.** Dieback-free mallee-heath Stirling Range (M.Grant)
Plate 2a. Ellen Peak (Q234) 1985, showing pink *Isopogon latifolius* and *Banksia solandri* (J.Watson). **Plate 2b**. Quadrat 213 Bluff Knoll, plant deaths due to *Phytophthora cinnamomi* : *Andersonia axilliflora* (foreground) and *Isopogon latifolius* (M.Grant).
Plate 2c. *Andersonia axilliflora* seedling regenerating under long unburnt thicket Bluff Knoll (E.Hickman). **Plate 2d.** Quadrat 238 Bluff Knoll, burnt 1972 and 1991, showing abundance of sedge (*Lepidosperma* sp) (S.Barrett). **Plate 2e**. Quadrat 234 Ellen Peak, burnt 1991, loss of *Banksia solandri* and *Isopogon latifolius* (S.Barrett). **Plate 2f**. Quadrat 230 Bluff Knoll, showing slow seedling growth and seedling deaths (*Sphenotoma* sp.) due to *Phytophthora cinnamomi* (S.Barrett).

Plate 1a

Plate 1b

Plate 1c

Plate 1d

Plate 1e

Plate 1f


Plate 2a


Plate 2b


Plate 2c


Plate 2d


Plate 2e


Plate 2f

On Mt Lindesay endemic species currently at risk due to *P. cinnamomi* include *Andersonia* aff. *setifolia* and *Andersonia* sp. Mt Lindesay (highly susceptible), and *Grevillea fuscolutea* (inferred variable susceptibility).
On Thumb Peak endemic species potentially susceptible to *P. megasperma* include the highly susceptible species *Adenanthos ellipticus* (DRF) and *Adenanthos labilliardieri*. Endemic *Grevilleas* include *G. infundibularis* (Declared Rare), *G. fistulosa* and *G. coccinea* ssp. *lanata*. These species while not rated highly susceptible may be potentially at risk at high levels of inoculum as indicated by *Grevillea* deaths in long infected areas in the Stirling Range.
On Mt Ragged the endemic *Dryandra longifolia* ssp. *archeos* may be assumed highly susceptible based on the responses of other *Dryandra* species.

<u>The impact of fire on plant communities</u>

Important aspects of fire regimes include fire intensity, frequency and the extent of the fire.
Table 6.3 shows the fire histories and fire frequencies (number of times burnt from 1970 to 1995) of the study sites. APPENDIX 14 lists the post-fire regeneration response of selected species assessed during the study or derived from previous studies.
The more frequently burnt sites in this study include Mt Lindesay and the eastern Stirling Range, both burnt in 1991. The latter area retained small unburnt pockets of vegetation in an otherwise high intensity fire which burnt an area of 25,000 hectares. Some small pockets also escaped on Mt Lindesay. Mt Ragged and Peak Charles were also burnt in 1991, 121,600 hectares were burnt in the Mt Ragged fire with virtually no unburnt areas remaining on the mountain. Some 15,000 hectares were burnt in the Peak Charles fire.

Impact of fire on community floristics

The impact of fire on community composition was assessed using the19 quadrats in supergroup 1 (Mt Lindesay - Stirling Range community). The sites were grouped according to fire frequency ie. the number of times burnt in the last 25 years. A one-way analysis of variance (ANOVA) of
i) the number fire-sensitive bradysporous species (ie obligate seeders which have on-plant seed-storage)
ii) total species number
iii) the number of species from the Cyperaceae and Restionaceae
was conducted on these 19 quadrats.
The number of bradysporous species showed a significant difference (**$P< 0.01$) between the two site groups (fire frequencies 1, and frequencies 2 and 4 combined) with greatest numbers in sites of the lower fire frequency (Table 6.4). The number of sedge species was higher in the more frequently burnt sites (**$P<0.01$). Differences in total species number were not significant.
Fire-sensitive bradysporous species such as *Dryandra formosa* and *Isopogon formosus* are absent from the summit area of Mt Lindesay. This contrasts with the situation in small unburnt areas of heath and thicket fringing the granite slopes where these species are common.
The impact of *P. cinnamomi* is a confounding factor in this analysis as all of the sites burnt twice in 25 years are heavily impacted by dieback and the seed banks of bradysporous species may already be depleted by loss of individuals due to the disease. However two of the sites from Mt Lindesay were disease-free or in the initial stage of infection.

Observations in the eastern Stirling Range suggest that fire in this environment, where the disease is already present, may increase site susceptibility to *P. cinnamomi*. Burnt areas where key species were present pre-fire as assessed by inspection of burnt "skeletons" manifested widespread seedling deaths due to *P. cinnamomi* post-fire. The under-developed root systems of obligate seeders may increase vulnerability to the disease as may factors such as loss of leaf litter, altered soil temperatures and modified drainage characteristics which result from fire. Altered hydrology post-fire may be the most significant factor in mountain areas where lack of vegetation cover may augment the effects of slope on water movement. In this situation the disease may be spread by water rather than needing root to root contact.

Table 6.3. Fire history and fire frequency of flora quadrats

Quadrat	Mountain	Fire Frequency	Year burnt	Quadrat	Mountain	Fire Frequency	Year burnt
	Mt Lindesay	4	1991, 1981, 1975, 1973	227	Toolbrunup	0*	unburnt 1980
208	Mt Lindesay	4	1991, 1981, 1975, 1973	228	Toolbrunup	0*	unburnt 1980
231	Mt Lindesay	4	1991, 1981, 1975, 1973	215	Porongurup	1	1972
233	Mondurup	1	March 1983, April 1969, pre-1943	216	Porongurup	1	1976
218	Mondurup	1	March 1983, April 1969, pre-1943	226	Porongurup	1	1972
217	Mondurup	1	March 1983, April 1969, pre-1943	201	Manypeaks	1	1978, 1955
205	Hume Pk	1	March 1974,	202	Manypeaks	1	1978, 1955
206	Hume Pk	1	March 1974,	219	Manypeaks	1	1978, 1955
204	Hume Pk	1	March 1974,	220	Thumb Pk	1	1985
232	Magog	1	March 1983, 1945/46	221	Thumb Pk	1	1985
209	Magog	1	March 1983, 1945/46	237	Thumb Pk	1	1985
210	Magog	1	March 1983, 1945/46	222	Mt Ragged	1	1991
213	Bluff Knoll	0	late 1950s	223	Mt Ragged	1	1991
214	Bluff Knoll	2	April 1991, Feb 1972, late 1950s	224	Pk Charles	1	unburnt 1991
230	Bluff Knoll	1	April 1972, late 1950s	225	Pk Charles	1	late 1940s/50s, 1991
229	Bluff Knoll	2	April 1991, Feb 1972, late 1950s	235	Pk Eleanora	0	ca 100 years ago
238	Bluff Knoll	2	April 1991, Feb 1972, late 1950s	236	Pk Eleanora	0	ca 100 years ago
211	Ellen Pk	1	largely unburnt 1991, early 1960s				
212	Ellen Pk	1	Feb 1972, early 1960s				
234	Ellen Pk	2	April 1991, Feb 1972, early 1960s				

* Burnt in wild-fire January 1996

Table 6.4. The impact of fire on floristic structure. Mean number of i) bradysporous species (fire-response 1) and ii) sedge species at sites of fire frequency 1 and frequencies 2&4.

	No. of times burnt in 25 years 1971-1996		
GROUP	**2 & 4**	**1 & 0**	P (from ANOVA)
No. of quadrats	6	13	
No. of species			
All species	38.7	34	NS
Bradysporous seeder species	0.8	4.9	0.002**
Cyperaceae & Restionaceae	4.4	2.3	0.01**

**P<0.01, *P<0.05 NS = not significant

The most obvious difference between burnt and unburnt dieback-affected areas in the eastern Stirling Range thicket community is the predominance of an undescribed *Lepidosperma* species in frequently burnt areas with virtually no occurrence of the same in long unburnt dieback-affected heath and thicket (Plate 2d, 2e) Table 6.5 shows differences in the number of sedge species (families Cyperaceae and Restionaceae) and the percentage canopy cover of these families at sites with varying fire histories.

Table 6.5. Percentage cover and number of species from the families Cyperaceae and Restionaceae in dieback affected thicket and heath of different fire ages, Eastern Stirling Range

Quadrat	Fire frequency (25yrs)	Years burnt	Dieback Impact	No. species Cyperaceae & Restionaceae	% canopy cover Cyperaceae & Restionaceae
Bluff Knoll 213	0	pre-1972	2	2	3
Ellen Pk 212	1	1972	1	2	15
Ellen Pk 234	2	1972, 1991	2	5	35
Bluff Knoll 238*	2	1972, 1991	2	3	70
Bluff Knoll 230	1	1991	2	4	20

*additional site, not included in floristic analysis

There appears to be a trend towards a greater percentage canopy cover of sedges in the more frequently burnt dieback-affected sites. These differences, however, were not statistically tested.
The *Lepidosperma* sp. which may have been abundant in damper areas such as creek-lines as confirmed by photography and anecdotal evidence, appears now to be extending its distribution by colonising gaps in the canopy created by *P. cinnamomi* after fire. The thicket community of the eastern Stirling Range could thus be be gradually transformed into a sedgeland by the synergistic effect of fire and *P. cinnamomi*.

Further monitoring of the shrub seedlings which are currently still persisting in these areas and which are less susceptible to *P. cinnamomi*, for example the myrtaceous thicket species *Kunzea montana* and *Beaufortia anisandra*, will be necessary to ascertain the final composition and structure of the community.

Rates of post-fire regeneration

Five of the mountains in the study were burnt in 1991. Rates of regeneration varied with vegetation structure and environmental conditions. The slowest rates of regeneration were evident at higher altitude sites such as Bluff Knoll quadrat 230 on the exposed summit plateau with an average plant height of 10.9 cm at five years post-fire implying an average growth rate per annum of 2.3 cm in this period (Plate 2f). Rates of regeneration on the Bluff Knoll plateau appear to have been faster following the 1972 fire (G. Keighery pers. comm.), low annual rainfall in the seasons following the 1991 fire may influence the current slow regeneration. However, the 1972 fire may not have been as intense as significant areas of the plateau were unburnt as seen from old aerial photography.
Figure 6.1 shows plant heights measured along diagonal transects comparing regeneration in burnt (230,229) and unburnt sites on Bluff Knoll (213), Figure 6.2 shows the same for Ellen Peak (234,212).
The slow regeneration of the summit heath on both Bluff Knoll and Ellen Peak contrasts with that of mallee-heath below the summit. While the greater height measurements in the mallee site (Q229) are largely due to eucalypt species, shrub regeneration, both seedlings and resprouters, is considerably faster than on the summit. The "peaks" in height measurements in the burnt quadrat 234 correspond with the faster post-fire growth of the *Lepidosperma* sp. compared with shrub seedlings.
APPENDIX 15 gives the same data for burnt sites on Mt Lindesay, Mt Ragged and Q214 and 238 Bluff Knoll.

Fig 6.1 Plant height in burnt (Q230) and unburnt (Q213) heath, and burnt mallee-heath (Q229) Bluff Knoll

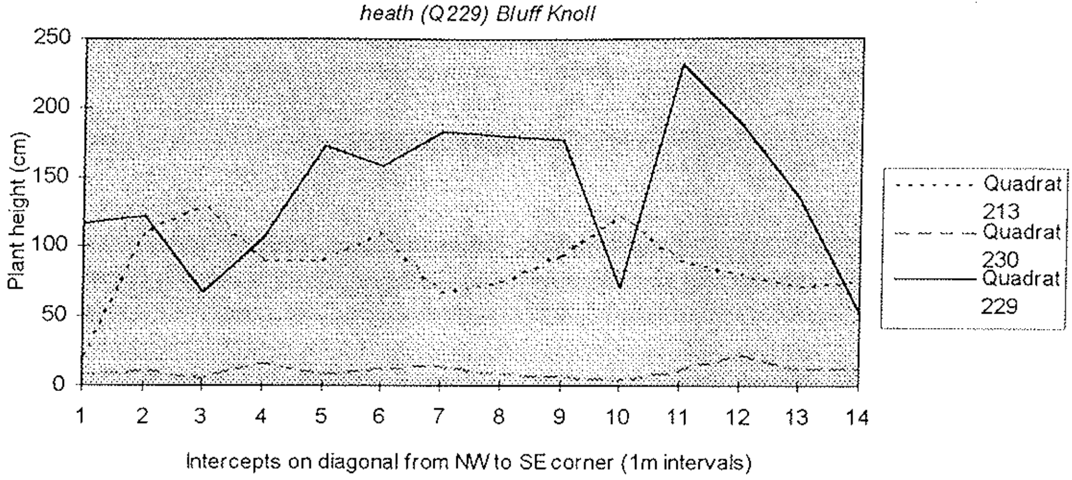
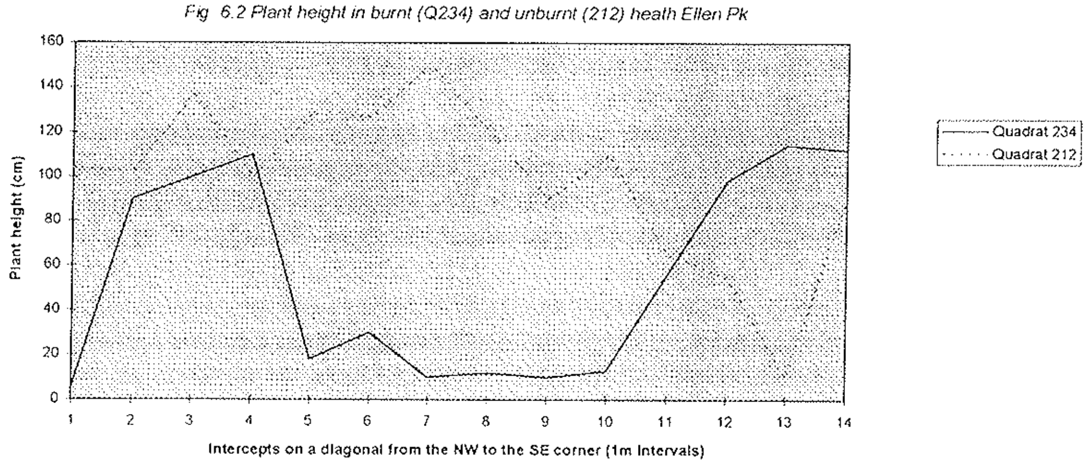


Fig 6.2 Plant height in burnt (Q234) and unburnt (212) heath Ellen Pk



Juvenile Period

The assessment of juvenile period or time to first flowering, an important factor in determining vulnerability to fire was not within the scope of this study. However, a number of perennial species in the Bluff Knoll - Ellen Peak sites had not flowered at 5 years post-fire including the dominant shrub species *Kunzea montana, Banksia oreophila, Banksia solandri, Banksia brownii, Dryandra concinna, Dryandra montana, Dryandra formosa, Dryandra baxteri, Isopogon latifolius, Adenanthos filifolius,* and *Andersonia axilliflora.* Species which had not flowered since fire on Mt Ragged included *Dryandra longifolia* ssp. *archeos, Dryandra armata* var. *nova, Kunzea baxteri, Petrophile fastigiata* and *Banksia media.* On Mt Lindesay *Petrophile* *diversifolia* was not observed flowering. Both on Mt Ragged and Peak Charles *Callitris preissii* ssp. *verrucosa* had not flowered within the study period. *Callitris* is notable for its very slow growth rate, first seed-set post-fire appears to commence from 15 years on (L.McCaw, pers. comm.).

The impact of fire and *Phytophthora cinnamomi* on fauna.

Vertebrate fauna

The lack of quantitative trapping data makes it difficult to assess changes in mammal abundance with time since fire however some trends are apparent from the limited quantitative data, opportunistic records and general observations. *Mus musculus* appeared to be abundant post-fire at Mt Ragged (4.5 - 5 years post-fire) and Pk Charles (4 years post-fire) although *Mus* have huge fluctuations in populations which are independent of vegetation age. In contrast *Mus* was not recorded in the recently burnt (1991) areas in the eastern Stirling Range or Mt Lindesay.

Rattus fuscipes appeared to have made a good recovery at both Mt Lindesay and Ellen Peak (4 years post-fire) although as in the case of *Mus*, population fluctuations occur. Other species present at the latter site included *Antechinus flavipes, Setonix brachyurus, Isooden obesulus* and *Trichosorus vulpecula*. The presence of small unburnt pockets of two different ages combined with the fast regeneration of *Eucalyptus megacarpa - Allocasuarina decussata* low-woodland in the moist areas below the rocky peak may have contributed to the range of species present. The rocky summit areas of the mountains may also be important in providing refuge for fauna during fire.

Tarsipes rostratus was present at five years post-fire on the summit plateau of Bluff Knoll in areas of very slow regeneration though small unburnt pockets remain near-by. There was evidence of *Pseudocheirus occidentalis* in a very small unburnt pocket on Mt Lindesay at five years post-fire.

In contrast no native mammal species were recorded from Mt Ragged although a dasyurid scat was collected from the mountain. This may be largely due to the severity - both intensity and extent - of the fire and the absence of unburnt remnants. Similarly *Mus* was the only mammal species recorded from Pk Charles at four years post-fire.

The more commonly observed reptile species eg *Egernia napolionis, Ctenotus labilliardieri* and *Phyllodactylus m. marmoratus* appeared to be equally abundant in sites burnt in 1991 compared with unburnt sites. These species which occupy rocky crevices and exposures are likely to escape the direct impact of fire.

The amphibian fauna in the creek-line on Bluff Knoll appeared to have recovered reasonably well at four to five years post-fire in particular the widespread species *Crinia georgiana*. However both *Limnodynastes dorsalis* and *Litorea adelaidensis* were not recorded post-fire in this study which may suggest a lower abundance. The latter species being "arboreal" may be more vulnerable and this has been suggested in a previous study (Friend,1993).

While assessing the impact of *P. cinnamomi* on vertebrate fauna was not within the scope of this study the change in plant community structure and biomass must inevitably impact on the habitat of certain species. Changes in community floristics may affect grazers or species with specialised diets such as *Tarsipes rostratus*. While the latter species was recorded from Bluff Knoll in dieback infected vegetation its long-term prognosis is uncertain. It was not trapped on Ellen Peak or Mt Lindesay in infected areas. Changes in the composition of leaf litter and its invertebrate fauna may indirectly affect certain dasyurid species. *Rattus fuscipes* is considered to respond more to structural changes (Wilson *et al.*, 1994). *Setonix brachyurus* may also be more affected in the long-term by structural changes. The latter species is now utilising a range of vegetation types in the Ellen Peak area including heath and thicket. As these communities are altered structurally it will be restricted to less susceptible vegetation such as *Eucalyptus megacarpa - Allocasuarina decussata* woodland.

Invertebrate fauna

Classification of invertebrates to at least the morphospecies level may be necessary to show changes in relation to impacts such as fire (Friend & Williams, 1993) or dieback.
Table 6.6 shows the average abundances of each of the major orders comparing sites long-infected with dieabck to dieback-free or recently infected sites. Numbers of Dermaptera were higher numbers in sites long-infected with dieback (all from Bluff Knoll) which is in contrast to the findings of Nicholls & Burrows (1985) who found dermapterans to be more abundant in dieback-free forest.

Postle *et al.* (1986) found the standing biomass of leaf litter and numbers of soil and litter invertebrates to be generally lower in infected jarrah forest. The results of this study fail to show marked differences, some orders such as Coleoptera and Opilionida were higher in dieback-affected sites while Acarina and Aranae were lower.

Table 6.7. gives the same data comparing sites recently burnt (1991) with those long unburnt. Numbers of Orthoptera were greater in the more recently burnt sites on Bluff Knoll and Mt Lindesay. Numbers of Diptera were more abundant in longer unburnt sites. Friend & Williams (1993) also found that Orthoptera peaked in the early seral stage while numbers of Diptera were most abundant at 40 years post-fire. However while Friend & Williams (1993) found Coleopterans also to be more abundant in long unburnt sites the opposite was true in this study with Coleopterans being more abundant in the recently burnt sites. Identification of Coleopterans to species level and categorisation into herbivores / predators may explain this trend in relation to both fire and dieback.

These differences between studies may be indicative of firstly the variation in responses of specific ecological communities to impacts such as fire or dieback, and secondly of the need to classify beyond the ordinal level.

Table 6.6. Average abundances of major orders in i) three sites long-infected with P. cinnamomi ii) 10 dieback-free or recently infected sites

Average abundance	Acarina	Aranae	Opilionida	Orthoptera	Coleoptera	Hymen.	Hemiptera	Diptera	Collembolla	Dermaptera
Sites old-infected	24	89	182	57.3	112	166.3	15.3	372	507	40.7
DB free / recently infected	47.7	114.1	35	20	50.7	552.9	22.7	403.7	522	11.5

Table 6.7. Average abundances of major orders in i) sites burnt in 1991 ii) sites burnt more than 10 years previously.

Average abundance	Acarina	Aranae	Opilionida	Orthoptera	Coleoptera	Hymen.	Hemiptera	Diptera	Collembolla	Dermaptera
sites burnt 1991 (4 sites)	71.8	100.8	125	70.8	100	692.8	16.5	215	592	18.3
> 10 years unburnt (9 sites)	48.8	111.7	43.9	9.9	48.9	361.9	23	477	485	18.2

Ants

Ant communities are considered to be ideal bio-indicators of environmental change. Relative abundances of functional groups vary predictably with climate, vegetation type and disturbance and are highly sensitive to environmental variables.
A notable feature of habitat disturbance in mesic regions of southern Australia is a breakdown in the dominance of *Iridomyrmex* leading to an increase in abundance of unspecialised taxa (Andersen, 1990). Opportunist species of *Rhytidoponera* appear to be especially sensitive of disturbance in these areas. Opportunists and/or generalised myrmicines have been observed to consistently increase in relative abundance after fire (Andersen, 1990).
The number and composition of pitfall grids systematically surveyed in this study limits the assessment of impacts such as fire and dieback however some observations are possible from the data. The percentage of opportunistic species was greatest in sites long-infected by *Phytophthora cinnamomi* (Bluff Knoll sites) compared with dieback-free or recently infected sites (Table 6.8).

Table 6.8. Relative abundance of opportunistic species trapped in systematic pitfall survey.

Quadrat	Tool 227	Tool 228	Por. 226	Por. 215	Bluff Knoll 213	Bluff Knoll 214	Bluff Knoll 230	Mon 217	Mon 218	Mt Lind. 208	Mt Lind. 231	Mag 209	Mag 232
Relative abundance 'opportunistic' species (%)	0	0	0	0	66	19	39	<1	1	<1	0	0	10
Relative abundance of generalised myrmicines (%)	0	0	0	1	0	1	11	7	6	<1	0	0	8

An analysis of variance (ANOVA) of the numbers of 'opportunistic' species recorded per grid was conducted on 9 sites of the major community group derived from the multivariate analysis (Mt Lindesay, Bluff Knoll and Mondurup sites, Porongurup 215 and Magog 232). The sites were grouped as i) old-infested sites and ii) dieback-free or recently-infected sites.
There was a significant difference ($P<0.05$) in the numbers of opportunist ants, largely *Rhytidoponera ornata*, in the old-infested sites (Table 6.9). While this may be due to the impact of *Phytophthora* on the community it may also be that opportunistic species are more common in these sites, all of which are from Bluff Knoll, where dominant *Iridomyrmex* species are less abundant. The analysis is also limited by the low number of replicates.
Numbers of 'opportunistic' and / or 'generalised myrmicines' in more recently burnt sites (1991) failed to show a significant difference from those longer unburnt.

Table 6.9. Mean ant species richness, mean abundance of 'opportunistic' ant species and mean ant abundance (all species) for three 'old-infested sites' and six dieback-free or 'recently-infected' sites.

	'old-infested sites'	dieback-free or 'recently-infected'	P value from ANOVA
Ant species richness	10	13.7	0.065 NS
Abundance of 'opportunistic' species	23	6.3	*0.04
Total abundance (all species)	59.3	885.3	0.18 NS

* = P<0.05

While the differences in species richness were not statistically significant in this example it may be expected that as *Phytophthora cinnamomi* reduces plant species richness over time that ant species richness, which is strongly correlated with plant species richness, will in turn be affected.
High mean abundances in the dieback-free or recently-infected sites may be attributed in part to high numbers of *Iridomyrmex* sp.conifer group, this also resulted in considerable within-group variation. Excluding *I.*conifer group there was a mean total ant abundance of 161.3 in this group, still considerably higher than that of the old-infested sites (59.3).

Spiders

Analysis of both spider species richness and spider abundance failed to show a significant difference between sites long-infected by *Phytophthora cinnamomi* and dieback-free or more recently infected sites. Both Site 213 (long-unburnt heath on Bluff Knoll) and Site 214 (creek-line plot in the saddle between Bluff Knoll and Coyanarup Peak, burnt 1991) were characterised by relatively high spider species richness, in particular the latter site which had the second highest number of species in the survey after Porongurup 215.
While plant species richness has been reduced in Site 213 as a result of *P. cinnamomi* this does not appear to translate directly into loss of spider species richness. However, as with plant communities, it may be necessary to investigate particular spider families or functional groups to quantify the impact of *P. cinnamomi*. Again, as in the case of plant communities, further monitoring will be necessary to determine the final composition of these communities. The sites sampled do not represent the 'worst case scenarios' (commonly termed 'grave-yard sites') of dieback-affected vegetation in the eastern Stirling Range.
In contrast to Sites 213 and 214, Site 230 (Bluff Knoll, burnt 1991) recorded the lowest abundance of spiders of all the sites in the systematic survey and considerably lower species richness than Site 213 nearby. None of the relic mygalomorph endemics were recorded from this site. This may reflect the severity of the 1991 fire and the extremely slow rates of vegetation regeneration in this site.

Analysis of both spider species richness and spider abundance failed to show a significant difference between sites recently burnt (1991) and sites more than 10 years post-fire.
Mygalomorphs, long-lived, sedentary ground dwelling spiders with limited dispersal range of juveniles are likely to be more vulnerable to fire. Both *Moggridgea* and

Neohomogona are relics of an era which predates fire as a recurrent phenomena Main & Gaull, 1993). However the data from this survey is insufficient to show any trends, lack of any difference may reflect too few replicates. The response of several endemic trapdoor spiders to fire has been studied by Main & Gaull (1993) who emphasise the adverse affects of high intensity and / or frequent fires on *Moggridgea*, in particular, but also on *Stanwellia, Neohomogona* and *Eucyrtops.*

Recreational Impacts

Table 6.10 shows the level of use and recreational impacts at each of the mountain sites.
The sites with the highest usage at present are Bluff Knoll and the Porongurup Range site followed by Toolbrunup.
Thumb Peak is within a Restricted Area of the Fitzgerald River National Park Biosphere which is currently closed to all access to prevent the spread of dieback. Hume Peak is within the proposed Special Conservation Zone for the Stirling Range National Park and a permit is required for pedestrian access to the area. Mt Manypeaks is closed to general pedestrian access, again for disease control. Mondurup Peak is subject to seasonal closure ie. while wet soil conditions persist to prevent the accidental spread of dieback.

In general most of the negative impacts, namely side path formation, path erosion, bare-ground occurrences, camp-fire remains and litter are concentrated towards the summit areas.
Side path formation is associated with poorly defined routes and difficult terrain on the summit area of Magog and Mt Manypeaks, and Ellen Peak. On the summit of Bluff Knoll and Mt Lindesay side paths have formed where people have explored or accessed viewing points. Side paths have also formed on Mt Lindesay in areas of poor track condition between granite outcrops.

With moderate to highly erodible soils and steep inclines, the paths on the quartzite ranges (Stirling Range, Thumb Peak and Mt Ragged sites) appear to be more at risk of track erosion particularly in the middle - upper sections of these paths where they run perpendicular to the contour lines as for example the mid-slope sections of Mondurup and Magog. In contrast Toolbrunup, where the track has been realigned to follow more closely the contours, shows less evidence of erosion. Although the Bluff Knoll track has been realigned, a combination of heavy use and increased water run-off associated with decreased vegetation cover post-fire has resulted in significant track erosion. Track erosion was generally exacerbated by high rainfall events during summer (1995-96). On Mt Lindesay the use of motor-bikes on the walk track has further exacerbated problems, the ruts so formed providing a channel for further erosion. In addition damage has been sustained to moss beds on granite exposures while soil transfer facilitates the spread of plant disease. On the eastern side of Mt Lindesay gully erosion up to 0.5 m in depth has resulted from an old four-wheel-drive track to the summit.

Litter levels generally correlate with the level of visitor use though none of the sites had a serious litter problem despite relatively low levels of input into litter collection.

Table 6.10. Recreational Impacts

	Mt Lindesay	Hume Pk	Mondurup	Magog	Toolbrunup	Bluff Knoll	Ellen Pk	Porongurup	Manypeaks	Thumb Pk	Mt Ragged	Pk Charles	Pk Eleanora
Level of use[1]	1	0	1	1	2	3	1	3	0	0	1	1	1
Access	track	route	track	track	track	walk-way	route	track	route	route	track	track	route
Side paths	minimal	0	0	multiple	minimal	multiple	multiple	minimal	minimal	0	0	0	0
Path erosion[2] (mid-upper slopes)	D, E - old FWD track	A	C-D	C-D	B-C	C-E	C-D	B-C	A	A	B-C	A	A
Soil erodibility	moderate	moderate	moderate	moderate - high	moderate - high	moderate - high	moderate - high	moderate- high	low - moderate	low - moderate	low - moderate	low - moderate	low - moderate
Impeded Drainage	+	0	0	0	+	+	+	0	+	0	0	0	0
Overnight stays	0	0	0	+	0	+	+	0	+	0	0	0	0
Bare ground occurences	0	0	0	+	0	0	+	0	0	0	0	0	0
Evidence of camp-fires	0	0	0	+	0	+	+	0	0	0	0	0	0
Litter[3]	2	0	1	1	2	3	1	2	1	0	1	1	0
Visitor numbers p/a			track counter 1993:1000			track counter 1993:8000	visitor book 94/95:175				visitor book 94/95:116		

[1]level of use: 0 = permit required. 1 = low. 2 = moderate. 3= high.
[2]path erosion: A = nil, B = potential to erode with time, C = up to 5cm, D = 5-15cm E = 16+ cm
[3]litter: 1 = 1-5 pieces, 2 = 6-20, 3 = > 20

The presence of toilet paper on the mountains, particularly Bluff Knoll, although degradable, is a significant visual impact.
The number of bare ground occurrences and fire rings were not high which indicates that the impact of camping is not great at current levels of use but needs to be monitored particularly in relation to the ridge walk of the eastern Stirlings. The Arrows" a favourite camping area on the walk from Ellen Peak to Bluff Knoll was not included in this survey.

Path drainage is important in relation to both erosion and the risk of spreading dieback (Watson & Passmore, 1993). In wet conditions pooling of water occurs near the summit areas of Bluff Knoll, Toolbrunup and Mt Lindesay and the lower slopes of Mt Lindesay and Mt Manypeaks. While confined largely to small sections of the path these wet areas provide ideal sites for the transfer of *Phytophthora* via soil collected on walking boots (Gillen & Watson, 1993). Moist soil conditions prevail for much of the year on the higher peaks particularly near mountain summits associated with run-off from rock faces, for example on the rocky summits of Ellen Peak and Magog. The steep climb to these summits on muddy loam soils again provides ideal conditions for soil and disease transfer.

The current distribution of *Phytophthora cinnamomi* in the Stirling Range, and especially the location of apparently recent infections, suggests that humans have continued to disperse the fungus (Gillen & Watson, 1993; Wills, 1993). It is apparent that the fungus has spread to many of the peaks through the transport of infected soil, mostly by foot access as a result of both recreational and other activities. There appears to be a correlation between the higher, more significant and more readily accessible peaks and the distribution of the fungus.
In some areas at certain times of year there may also be the potential for spread of the fungus by animal movement, in particular by larger animals such as Western Grey kangaroo (*Macropus fulginosus*).

7. DISCUSSION

Vegetation & Floristics

The survey highlights the significance of the mountain flora which has high numbers of narrow range endemic species and taxa of conservation significance. Several newly recognised species were recorded. Families with large numbers of endemics included the Proteaceae, Epacridaceae, Myrtaceae and Papilionaceae. The genera *Darwinia* and *Nemcia* were notable for their high degree of speciation. Further taxonomic work may well reveal more species in the latter group.

The number of endemics may be attributed to high levels of speciation and the refugial nature of the mountains which were subject to a sequence of periods of alternating connection and isolation and fluctuating climates. The over-lap of endemic species between mountain areas, for example between the Stirlings and the Barrens, Stirlings - Manypeaks, Mt Lindesay - Stirlings - Barrens, suggests a flora that was perhaps more widespread in more mesic conditions in the past. The extinction of nearby lowland populations is probably related to the onset of dry conditions in the Holocene. The persistence of mountain populations may be attributed to a more favourable moisture balance on the mountains (Hopkins *et al.*, 1993). In the case of *Darwinia,* in the Stirling Range, it has been suggested that landscape dissection, combined with climatic and microclimatic factors, provided geographical isolation and thus facilitated taxonomic divergence (Hopkins *et al.*, 1993). It is possible also that a few of the restricted species have never been widespread, either due to being recently derived or through being unable to spread as a result of conservative breeding or dispersal systems.

Several unique vegetation communities were identified including the Eastern Stirling Range Montane Thicket Community. However more extensive and intensive flora survey would facilitate greater evaluation of other mountain communities. A range of peaks in the Stirling Range, both in dieback-free and dieback-infected areas, were not included in this survey which limits assessment of the Stirling Range as a unit. Degradation of the mountain communities by weed species is not a significant threat at present except in the case of the Porongurup Range site. Weeds were more abundant in the lithic communities where exposed soil allows for colonisation by wind-blown weed seed. Small weed infestations in tracks or lithic areas provide the potential for more extensive colonisation post-fire.

Vertebrate Fauna

Changes in the mammal fauna of the mountains since European colonisation has occurred, similar to the situation elsewhere in the southwest. For example a number of species known historically or from skeletal remains from the Stirling Range (Friend & Muir, 1993) and Peak Charles (How *et al.*, 1988) appear to be locally extinct. While it may have been hoped that the fox would not have impacted on the fauna of the more remote or higher mountains, this has not been the case.

As a result of the fauna survey there is now a basic inventory of the mountain fauna which may be built upon. Despite the limitations of trapping in these inaccessible environments important populations of threatened mammals were identified using a range of techniques such as hair tubes and scat analysis. In particular quokka (*Setonix brachyurus*) was recorded from four mountains in the Stirling Range and Mt Manypeaks. The number of mainland quokka are considered to have declined significantly (Dept. of Conservation & Land Management, 1996) with only small populations persisting. The moist environment of the mountain peaks and gullies, where run-off from rocky areas is considerable, may ensure an adequate diet through summer as has been observed by Storr (1963) in their more common habitat in mainland swamps.

Other threatened species recorded included Ringtail Possum (*Pseudocheirus occidentalis*) (new populations from Mt Lindesay and Manypeaks), Tammar Wallaby (*Macropus eugenii*) from Ellen Peak and Dibbler (*Parantechinus apicalis*) from Thumb Peak. Although not confirmed, there is a strong possibility that the Critically Endangered Gilbert's Potoroo (*Potorous tridactylus gilbertii*) may occur on Mt Manypeaks.

Species that were considered to be apparently rare in the Stirling Range (Friend & Muir, 1993) were recorded from several mountains in the Range. These included mardo (*Antechinus flavipes*), quenda (*Isoodon obesulus)* and brush-tail possum (*Trichosurus vulpecula*). Tammar, considered to be potentially extinct in the Stirling Range, was recorded from Ellen Peak.

The mountains were generally depauperate in reptiles with the exception of Peak Charles and Peak Eleanora. The cool, moist environment of the south coast and edaphic factors results in a considerably reduced assemblage of ectothermic vertebrates (How *et al*., 1987).

The presence of the Lake Cronin Snake (*Brachyaspis atroceps*) on Peak Eleanora was a significant find, extending its range considerably.

Frog diversity was also low which may be related to the rocky substrate and lack of surface water or to a series of dry seasons. Following drought, frog species richness was found to increase from two to eight species and reptile species richness doubled during a pit-fall survey in the Stirling Range National Park (Rose, 1995). More frogs were recorded from the moister environment of the higher eastern peaks of the Stirling Range where outlying populations of *Metacrinia nichollsii* persist at the limit of their range.

Invertebrate Fauna

As for the vertebrate fauna, the invertebrate survey has provided base-line data on invertebrate communities, in particular for spiders, ants and snails.

Many relic Gondwanan species of invertebrates have been recorded in the Stirling Range (Main, 1993). Pockets of habitat remaining in sheltered gullies and slopes with a more mesic climate provide refuge for invertebrates that can no longer exist in drier sites. Several species of spiders and land snails, including a number of endemic species, have a closer relationship to groups in mountainous areas of eastern Australia, Tasmania , New Zealand and other Gondwanan continents than they do to species in areas surrounding the Stirling Range.

This survey identified several newly recognised relic species and extended the range of species previously known.

A new population of the critically endangered and fire-sensitive mygalomorph (trapdoor spider) *Moggridgea sp* was located on Magog during the survey. All previously known locations of this species in the eastern Stirling Range and Toolbrunup have been recently burnt.

A newly recognised species of *Neohomogona* collected from Toolbrunup, distinct from the previously known *Neohomogona stirlingii,* may be endemic to the mountain. This again indicates periods of isolation of the peaks in the geological past when sea levels were higher. A third species, from Mt Manypeaks, extends the distribution of the genus beyond the Stirling and Porongurup Ranges.

Other Gondwanan relic taxa of significance recorded included species from the genera *Toxops* and *Austrarchaea*.

Several of the snails recorded in the survey had a restricted distribution or were endemic to a particular mountain area including one newly recognised species.

Ant communities are considered to be ideal bio-indicators of environmental change (Majer, 1983) reflecting both the abundance and richness of other invertebrates and plants. Ant species richness in this study showed a significant correlation with both plant and spider species richness. Particular groups of ants such as 'opportunistic' species may increase with disturbance. High numbers of 'opportunistic' species and lower overall abundances recorded from sites long-infected with *Phytophthora cinnamomi* may reflect the impact of the disease on ant community structure.

Threats to Mountain Ecosystems

The major threat to the mountain ecosystems, with the exception of those mountains with low dieback hazard (ie. Peak Charles, Peak Eleanora and particular Porongurup Range sites), is unequivocally *Phytophthora*, in particular *Phytophthora cinnamomi*. The devastating effect of the disease on the Eastern Stirling Range Montane Community resulted in it being given Critically Endangered status. A range of species, including taxa endemic to both the eastern Stirling Range and to the Range as a whole, are being threatened by the disease.

Phytophthora cinnamomi alters not only species composition but also plant community structure as resistant species, especially herbaceous perennials and in particular sedges, become more prevalent. The implications for ecosystems include loss of biomass, loss of community productivity, loss of species indirectly through loss of shade effects of the canopy for herbaceous species, possible weed invasion due to the removal of the canopy, loss of refuge for smaller animals and loss of food sources for birds and mammals (Wills & Keighery, 1994). It has been found that *Phytophthora cinnamomi* infested communities have a lower diversity and abundance of both plants and animals in upland areas of Victoria (Wilson *et al* ., 1989).

In more frequently burnt sites in the eastern Stirling Range community sedges, in particular an undescribed *Lepidosperma*, appear to be colonising gaps in the community created by the disease. The apparently high level of impact of the disease in these areas suggests that in this community, when the disease is present, fire may increase site susceptibility to the disease. This may be attributed to changes in soil microclimate or hydrology, both of which are exacerbated by the slow regeneration of this community, or to the greater susceptibility of seedlings.

Slow rates of regeneration post-fire were most evident on exposed areas of the higher eastern peaks of the Stirling Range. Suitable conditions for plant growth may be limited to times when both sufficiently high temperatures and soil moisture co-occur. Low mountain temperatures may be a limiting factor while high wind speeds encountered on exposed mountain areas, in particular on the higher peaks, will also limit plant growth both directly (wind-pruning) and indirectly (evaporation). Slow rates of seedling growth will influence the time it takes to replenish seed banks. The juvenile periods of the mountain flora was not fully assessed as several key species had not yet flowered post-fire in this study.

In the case of Mt Ragged and Peak Charles, lower annual rainfall will influence post-fire regeneration, for example *Callitris preissii* ssp. *verrucosa* demonstrates very slow growth and has a long juvenile period.

While it has been suggested that a fire-free interval of double the length of the juvenile period is appropriate (Gill & Nicholls, 1989) it may be desirable to quantify the seed loads of key species to ascertain whether seed banks have been replenished in particular communities. Although double the juvenile period may be an appropriate interval for healthy ecosystems this may not so for those already stressed by plant disease. In the latter case seed banks are already depleted by loss of individuals therefore it must be ensured that the seed banks of the remaining population are maximised before fire.

Friend & Williams (1993) suggest that the invertebrate fauna of the uplands in the Stirling Range, with its Gondwanan relic species may require a lower fire frequency than the 20 year interval suggested for lowland areas in the Stirlings. The eastern

Stirling Range has been burnt under high intensity conditions at this frequency since the turn of the century (late 1930s, 50s, 1972, 1991). Studies by Main & Gaull (1993) emphasise the fire sensitivity of relic species of trapdoor spiders (Mygalomorphs), in particular *Moggridgea* and recommend that their habitat in the moist gullies and creeks be excluded from prescribed burns where possible.

The major implication for recreation in high dieback hazard sites is the potential to introduce and spread *Phytophthora*. In view of the impact on infected communities it is imperative that access to dieback free mountains such as Hume Peak, Mondurup Peak and Thumb Peak is strictly controlled. Where dieback-free areas on a mountain persist access may be channelled to avoid introduction of the disease.

The affects of uncontrolled access including disease spread, multiple path formation and trampling, is likely to increase as visitor numbers grow and therefore requires further monitoring.

Path maintenance is an ongoing concern in an environment subject to high rates of erosion (Gillen & Watson, 1993; Watson & Passmore, 1993). Well drained paths are also important in order to minimise the spread of *Phytophthora*.

8. RECOMMENDATIONS

1. Flora

On the basis of their restricted distribution and / or threatened status (in particular the threat posed by *Phytophthora cinnamomi)* the following changes to the Declared Rare and Priority List and 'Threatened' status are recommended:

Taxa	Current Status	Proposed Status
Laxmannia sp. Mt Lindesay SB.sn	-	P2
Hibbertia sp. Porongurup	DRF	P1
Leucopogon gnaphalioides	-	DRF/vulnerable
Andersonia aff. *setifolia* (SB 129)	-	P2
Darwinia sp. Mt Ragged	-	P2
Nemcia vestita	-	P2
Nemcia luteifolia ms	-	P2
Nemcia crenulata	-	P2
Nemcia sp. Magog (SB 55)	-	P2
Nemcia sp. Ellen Pk (SB 245	-	P2
Gastrolobium acrocaroli ms	-	P2
Comesperma aff. *drummondii* (SB 465)	-	P2
Persoonia micranthera	P1	DRF/Critically endangered
Banksia solandri	P4	P3
Dryandra concinna	P4	P3
Dryandra foliolata	P4	P3
Dryandra longifolia ssp. *archeos*	-	P2
Adenanthos filifolius	-	P3
Isopogon latifolius	-	P3
Stylidium sp. Stirling Range(SB115)	-	P4
Poaceae genus sp. SB 221195	-	P2
Grevillea fuscolutea	P2	P1
Calothamnus aff. *crassus*	-	P2
Lasiopetalum aff. *cordifolium*	-	P2
Andersonia sp. Mt Lindesay	-	P1
Daviesia mesophylla	-	P2
Sphenotoma aff. dracophylloides (SB 54)	-	P3

Andersonia axilliflora (P2) and *Sphenotoma drummondii* (P3) were proposed and upgraded to DRF status during the project.

2. Threatened Ecological Communities (TECs)

The definition of status of threat to ecological communities as defined by the "Threatened Ecological Communities Project" (Department of Conservation & Land Management, unpublished) are given in Appendix 16.

The Eastern Stirling Range Montane Thicket Community was proposed as a "Critically Endangered" threatened ecological community during the project on the basis of the threat to the community posed by *Phytophthora cinnamomi*.

The following communities are also proposed for TEC status on the basis of their limited distribution and the threat posed by *Phytophthora:*

Proposed status : Vulnerable
2.1 Mt Lindesay granite community.
2.2 Mt Ragged mallee / heath community.
2.3 Thumb Peak - Mid-Mt Barren - Woolbernup Hill mallee-heath community

3. **Further survey**

3.1 Additional survey of mountain areas of the Stirling Range not included in this survey to enable more explicit assessments to be made of the mountain communities present, the distribution of rare and endemic species and the distribution and impact of *Phytophthora cinnamomi.*

3.2 Survey of the Russell Range (Cape Arid National Pk) to compare its flora and communities with that of the nearby Mt Ragged community.

3.3 Survey of the quartzite mountains within the Fitzgerald River area ie. the Barren Ranges, the Whoogerups, Eyre Range and individual mountains to allow a more complete assessment of the flora and communities of these mountains.

4. Weeds

4.1. Weed control programme for the granite areas and their fringing vegetation in the Porongurup Range site.

4.2. Weed control program for the Toolbrunup track to minimise spread into recently burnt vegetation.

5. Fauna

Feral Animals: The extensive "Western Shield" Fox Control Programme due to be commenced by the Department of Conservation & Land Management in September 1996 will effectively ensure baiting of the Stirling Range, Mt Manypeaks, the Porongurup Range, the Fitzgerald River National Park and Mt Lindesay.

Gilbert's Potoroo (*Potorous tridactylus gilbertii*): Further survey to ascertain whether the Critically Endangered Gilbert's Potoroo is present on Mt Manypeaks will be undertaken as part of the Potoroo Interim Management Plan (Dept. of Conservation & Land Management).

5.1. Fauna survey to determine the full extent of quokka (*Setonix brachyurus*) populations within the Stirling Range and their habitat.

5.2. Additional survey of mountain areas of the Stirling Range not included in this survey to enable more explicit assessments to be made of the invertebrate communities present, the distribution of relic and endemic species and the impact of *Phytophthora cinnamomi* and fire on these communities.

6. Dieback - ***Phytophthora cinnamomi***

The Eastern Stirling Range Community:
On the basis of its critically endangered status a recovery plan for the community will be prepared, and its implementation co-ordinated by Western Australian Threatened Species and Communities Unit (WATSCU).

Potential management interventions currently being explored include a trial of aerial spraying of part of the community with phosphonate.

6.1.To prevent infection of currently disease-free areas the following recommendations are made:
- Closure of the Mondurup Track, Stirling Range National Park, which is currently open on a seasonal basis.
- Close ridge-top area between Mt Magog and Talyuberlup, Stirling Range National Park, to protect existing dieback-free pockets. Allow continued access to Magog.
- Continue with the restrictions to access which are currently in operation for Hume Peak, Stirling Range National Park (proposed Special Conservation Zone), Thumb Peak, Fitzgerald River National Park (Wilderness Zone) and Mt Manypeaks, Waychinicup National Park.

6.2. Biannual monitoring of flora quadrats established in this survey and those existing from previous studies, to evaluate changes in disease distribution and impact with time and to increase understanding of disease behaviour (eg dieback - fire interactions) in high and very high dieback hazard sites.

6.3. Assessment of the impact of *Phytophthora cinnamomi* on key fauna species, namely *Moggridgea* and quokka (*Setonix brachyurus).*

7. Fire

The fact that the Stirling Range National park is an isolated remnant poses a threat to the survival of fauna if most of the park were to burn in one event. This implies the need for appropriate fire management to ensure that fires are patchy in nature. Intervention must be based on ecological principles. In the absence of sufficient data to accurately determine appropriate fire regimes it is better to err on the side of conservatism in recommending burn frequencies. Wild-fires due to lightning will continue to occur regardless of proposed fire regimes however fire suppression will be an option in some cases.

7.1. Based on the slow rates of regeneration of the Eastern Stirling Range Community, the high fire frequencies experienced this century, the possibility of a synergistic effect between fire and dieback in this community, and recommendations from Main & Gaull (1993) in relation to mygalomorph spiders, a fire-free interval of 40 years is recommended for this community.

7.2. Post-fire research to determine appropriate fire regimes for all of the mountain areas surveyed. Determining time to first flowering of key fire-sensitive species and the time to replenish seed banks would be one aspect in ascertaining the minimal fire-free interval required. Long-term monitoring of key Mygalomorph species is another.

7.3. Exclusion of fire from Magog - Talyuberlup until *Moggridgea* populations are sufficiently recovered at other sites or new populations are located.

7.4. Exclusion of fire from the south-eastern gully of Toolbrunup, burnt in 1996 but which largely escaped the 1980 fire, until Mygalomorph populations, in particular *Moggridgea*, recover.

7.5. While rates of regeneration of vegetation may be faster in Stirling Range mountain communities which occur at lower altitudes (< 700 m a.s.l), a conservative approach is again advised.
As a minimum a fire-free interval of 25-30 years is recommended on an interim basis. Longer may be preferable where the community is already stressed by dieback.

7.6. Based on the lower annual rainfall of Peak Charles and Mt Ragged, slow vegetation growth rates and the long juvenile period observed in *Callitris*, a minimum fire-free period of 30 - 40 years is recommended.

8. Recreation

8.1 Adequate marking of routes, in particular the Ellen Peak and the Magog summit areas, to prevent further multiple track formation.

8.2. Prevention of the use of trail bikes on Mt Lindesay

8.3. Rehabilitation of the old 4WD track on Mt Lindesay

8.4. General track maintenance to prevent further deterioration of track condition eg Bluff Knoll track, Mt Lindesay track and to reduce opportunities for pooling of water.

8.5. Investigate alternative track construction techniques which may minimise track erosion due to run-off, in particular for the Bluff Knoll track.

8.6. Monitor visitor numbers to all sites.

8.7. Monitor the use of the eastern Stirling Range ridge walk for signs of over-use eg trampling and multiple track formation and the impact of overnight stays such as litter and bare ground occurrences.
Where site degradation is apparent or rare flora are threatened increased marking of the route may be required and camping restricted to designated areas.

9. Education

9.1. Provide interpretive information to emphasise the unique and rare flora, fauna, and ecological communities present in the mountains.

9.2. Provide educational material for visitors regarding the threats to mountain communities and their impact.

9.3. Provide specific educational material in relation to mechanisms of disease transfer and dieback hygiene, in particular boot hygiene. Educate regarding the effects of trampling particularly post-fire. Provide Mountain Back-country ethics brochure to include advice regarding waste management and the prohibition of camp-fires.

9. REVIEW OF THE METHODOLOGY AND ITS APPLICATION TO OTHER AREAS

Project Design

The methodology utilised in the survey was characterised by:
- a quadrat-based flora survey.
- vertebrate fauna survey using mammalian hair-sampling techniques, predator and non-predator scat analysis, and opportunistic survey.
- systematic invertebrate fauna survey using standardised pitfall grids filled with a preservative solution.
- assessment of recreational impacts using specific indicators.

Several suggestions are made here to improve the methodology used, however for the majority time and the effort required to access the study sites was the limiting factor.

Vegetation / Flora

There were several advantages in utilising a quadrat-based flora survey. The data generated lends itself to floristic analysis techniques which assists in determining the range of communities present. The floristic data enables quantitative analysis of community floristics and structure in relation to impacts such as dieback to be performed.
Other survey techniques may have been quicker to perform permitting a greater area to have been surveyed. However, with less detail it would have been more difficult to quantitatively assess impacts.

The use of transects along altitudinal gradients may be a useful additional technique to assess changes in vegetation with altitude. However the precipitous terrain on many of the mountains would have been a limiting factor. The inclusion of a greater number of quadrats on the lower slopes of the mountains would also be useful for the same reason.

The study identified several communities within the Stirling Range however the inclusion of a greater number of mountains in the survey is likely to have identified additional mountain communities and yielded valuable data in relation to the distribution of rare and endemic species.

A greater number of quadrats, selected for specific dieback and fire histories, would have been useful in providing additional data for the analysis of these impacts (ANOVAS).

Assessments of the impact of fire were generally limited by the time frame of the study. Monitoring of key species is necessary to assess time to first flowering or more importantly to assess when seed banks are replenished.
Vegetation height measurement also needs to be continued to see when height increases begin to plateau and also to assess variation in growth rates in relation to time. Photographic monitoring should ideally continue over the same period.

Fauna

The use of mammalian hair sampling techniques and predator and non-predator scat analysis added significantly to the species recorded by standard trapping techniques. The latter was greatly limited by the difficulty in transporting trapping and camping equipment including water supplies up the mountains and the unsuitable terrain for pit-traps. With the exception of Dibbler (*Parantechinus apicalis)* all

mammal species which were trapped were also detected by 'non-standard' techniques. Hair-sampling techniques have also been successful for Dibbler in other surveys (Natasha Baczocha, pers comm).
A greater emphasis on these techniques from the onset may have saved considerable time and added further records to the data.
Reptile and frog data may have been limited by the absence of larger pitfall traps and lack of trap nights. Smaller reptiles and frogs were however collected in the small invertebrate cups.

The invertebrate pitfall survey using standardised grids facilitated quantitative analysis of data however more extensive and intensive survey would have permitted greater statistical analysis of data. The three sampling periods allowed seasonal comparisons to be made although a fourth sampling period would have been desirable, particularly to add to the ant data.
In retrospect more data with less field hours may have resulted from using the technique currently employed by the Western Australian Museum for invertebrate surveys (Mark Harvey, pers comm). This technique employs larger pitfalls part-filled with ethylene glycol, left *in situ* for several months.

Recreation

Recreational impacts were not assessed in great detail. The use of track counters would provide valuable data on visitor numbers. Photographic monitoring of tracks at selected points would also provide more detailed information on track condition.
A greater emphasis could also be placed on the assessment of visitor / user perceptions and attitudes.

Volunteer Assistance

The use of volunteers was extremely helpful throughout the project particularly when working in remote areas and to help with the transport of equipment. The logistics of the project, in particular in relation to the fauna survey, meant that physical assistance was frequently essential.
The geographical spread of the study area, however, made the co-ordination of volunteers more difficult than if the study had focussed on one particular area as volunteer availability varied with site.
In other studies greater participation of local user groups may be desirable.

Application of the Methodology to Other Areas

The principles of the methodology used in this survey should provide a useful model for conducting similar studies elsewhere in Australia.
The flora survey design is applicable to most environments, the fauna survey methodology is particularly suited for use in areas of either mountainous or inaccessible terrain.
Depending upon the threats to any particular ecosystem the emphasis may vary, for example in an alpine environment greater emphasis may be placed on the assessment of recreational impacts and the monitoring of trampling. The principles underlying the assessments of these threats will, however, be similar.
Where dieback (*Phytophthora*) and the impact of frequent fire are significant threats the methodology is particularly applicable.

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APPENDIX 1. HAIR SAMPLING DEVICES USED IN MOUNTAIN SURVEY

APPENDIX 1. HAIR SAMPLING DEVICES USED IN MOUNTAIN SURVEY

FIG (1) HAIR SAMPLING CONE

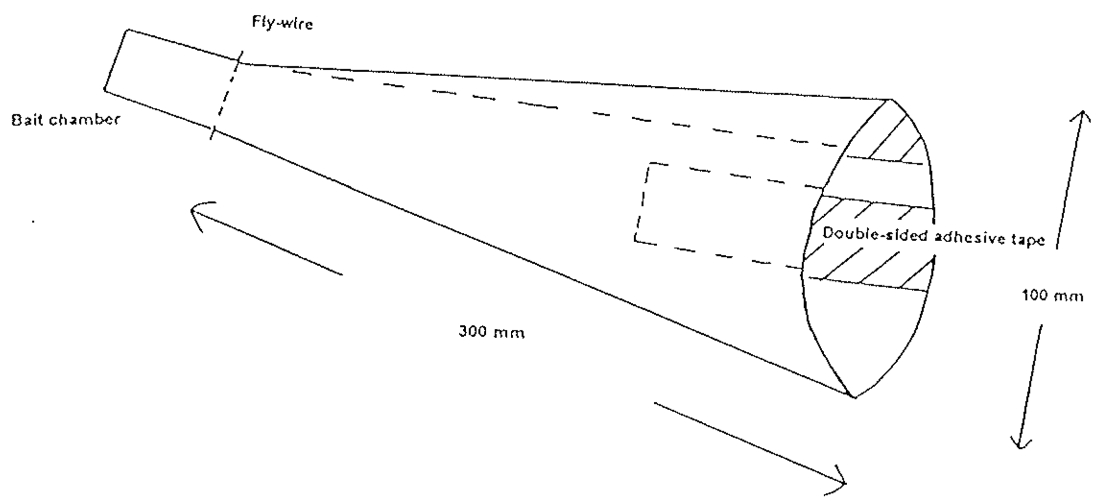
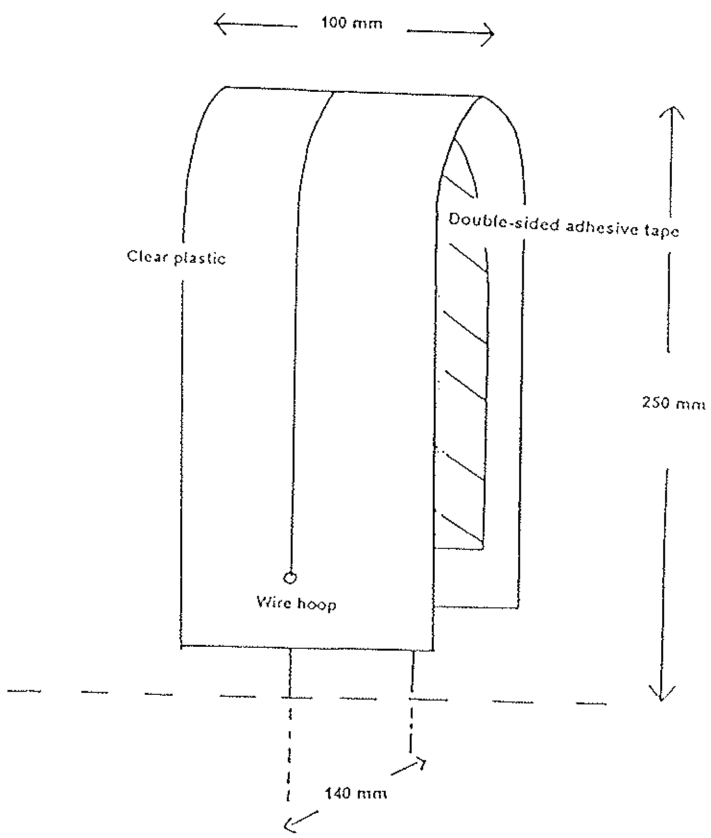


FIG (2) HAIR SAMPLING RUN-THRU



APPENDIX 2

FLORA LIST FOR THE BIOLOGICAL SURVEY OF MOUNTAINS IN SOUTHERN WESTERN AUSTRALIA

- SHOWING SPECIES LOCATION BY MOUNTAIN AND THE NUMBER OF RECORDS FOR EACH MOUNTAIN

- INCLUDES SPECIES RECORDED FROM BOTH WITHIN AND OUTSIDE FLORA QUADRATS

CODES FOR MOUNTAINS:

MANYPEAKS	=	MT MANYPEAKS
TOOLB.	=	TOOLBRUNUP PEAK , STIRLING RANGE
HUME	=	HUME PEAK, STIRLING RANGE
LINDESAY	=	MT LINDESAY
MAGOG	=	MT MAGOG, STIRLING RANGE
ELLEN PK	=	ELLEN PEAK, STIRLING RANGE
B.KNOLL	=	BLUFF KNOLL, STIRLING RANGE
PORONG.	=	PORONGURUP RANGE SITE (HAYWARD PEAK - NANCY PEAK)
MONDURUP	=	MONDURUP PEAK , STIRLING RANGE
THUMB	=	THUMB PEAK, BARREN RANGES
RAGGED	=	MT RAGGED, CAPE ARID NATIONAL PARK
PKCH.	=	PEAK CHARLES, PEAK CHARLES NATIONAL PARK
PKEL.	=	PEAK ELEANORA, PEAK CHARLES NATIONAL PARK

* = INTRODUCED SPECIES

xFl = NOT ENCOUNTERED FLOWERING DURING THE SURVEY

x = SPECIES NOT RECORDED THIS SURVEY (DATA FROM WA HERBARIUM DATA-BASE)

	Manypeaks	Toolb.	Hume	Lindesay	Magog	Ellen Pk	B.Knoll	Porong.	Mondurup	Thumb	Ragged	PkCh.	PkEl.
FERNS													
Adiantaceae													
Adiantum aethiopicum								1					
Cheilanthes austrotenuifolia	1			1				2				1	1
Dennstaedtiaceae													
Pteridium esculentum	1	1		2				3					
Lindsaeaceae													
Lindsaea linearis				1		1							
Aspleniaceae													
Asplenium aethiopicum		1		1	1			1					
Asplenium flabellifolium	1	3			1	1	1	1				1	
Pleurosorus rutifolius												1	1
GYMNOSPERMS													
Cupressaceae													
Callitris preissii										1	1	1	
MONOCOTYLEDONS													
Anthericaceae													
Agrostocrinum scabrum										1	1		
Borya constricta												1	1
Borya longiscapa				1									
Borya nitida	1												
Borya sphaerocephala								1					
Chamaescilla corymbosa var. corymbosa				1				2	1				
Johnsonia lupulina				2									
Laxmania sp. Mt Lindesay SB.sn				1									
Laxmannia minor				1									
Thysanotus dichotomus												1	2
Thysanotus isantherus				1									
Thysanotus multiflorus				1									
Thysanotus patersonii								1					
Thysanotus pauciflorus							1						
Tricoryne tenella													1
Colchicaceae													
Burchardia congesta				1									
Burchardia multiflora				1									
Cyperaceae													
Cyathochaeta sp. Mt Ragged (SB 659)											1		
Gahnia decomposita							1						
Gahnia sp.1 Mt Lindesay (xfl)				1									
Isolepis aff. congrua (SB 535)		1				1	1						
Isolepis congrua								1					
Isolepis nodosa												1	
Lepidosperma aff. tenue													

	Manypeaks	Toolb.	Hume	Lindesay	Magog	Ellen Pk	B.Knoll	Porong.	Mondurup	Thumb	Ragged	PkCh.	PkEl.
Mt Ragged (SB 651)											2		
Lepidosperma aff. pubisquameum (SB 658)													1
Lepidosperma aff. tenue													
Thumb Pk (SB 325.1)										3			
Lepidosperma angustatum	3			1				2					
Lepidosperma brunonianum	1											1	1
Lepidosperma drummondii	1											2	1
Lepidosperma effusum	1							1					
Lepidosperma gladiatum	3			2				2					
Lepidosperma resinosum var. pleianthemum													1
Lepidosperma aff. viscidum													
Thumb Pk (SB 681)										2			
Lepidosperma sp. G (Whaite 4172)			3						1	2			
Lepidosperma sp nov.													
Big Heads A.George 11294										1			
Lepidosperma sp. Stirling Ra (SB 42)		1			1	3	4						
Lepidosperma squamatum				1									
Lepidosperma tenue		1			1	2	1		1				
Lepidosperma ustulatum											2		
Lepidosperma viscidum			1	1								1	
Mesomelaena graciliceps				3									
Mesomelaena stygia subsp . stygia										1	1		
Mesomelaena tetragona				1						1			
Schoenus aff. caespititius (SB 324.1)									1				
Schoenus brevisetis											2		
Schoenus caespititius			1							2			
Schoenus efoliatus						1	2						
Schoenus laevigatus			1										
Schoenus odontocarpus				1									
Schoenus sp. Stirling Ra. Perth 04067878							1						
Schoenus subflavus				1									
Tetraria capillaris		2	1	2	2	4	5	1	2	1			
Tetraria octandra			1								1		
Tricostularia neesii var. neesii			1										
Dasypogonaceae													
Calectasia cyanea				1									
Calectasia grandiflora										1			
Dasypogon bromeliaefolius			1	1									
Kingia australis	1		1	1	1	2	2		1				
Lomandra hastilis										2			
Lomandra integra				1									
Lomandra mucronata											1		
Lomandra nigricans			1	2	1		1						
Lomandra pauciflora	1	2		1		1	1						
Lomandra preissii			1										
Lomandra sericea			3										

	Manypeaks	Toolb.	Hume	Lindesay	Magog	Ellen Pk	B.Knoll	Porong.	Mondurup	Thumb	Ragged	PkCh.	PkEl.
Haemodoraceae													
Conostylis setigera subsp. setigera			1	1									
Haemodorum paniculatum				1									
Haemodorum sp. x fl									1				
Haemodorum spicatum							1						
Hypoxidaceae													
Hypoxis occidentalis var. occidentalis								1					
Iridaceae													
Patersonia occidentalis	1		1	1						1			
Patersonia umbrosa				2									
*Romulea rosea								1					
Juncaceae													
*Juncus bufonius								1					
*Juncus capitatus								1					
Juncus pallidus								1					
Luzula meridionalis								1					
Orchidaceae													
Caladenia falcata													1
Caladenia flava	1												
Caladenia flava subsp. sylvestis	1												
Caladenia marginata								1					
Caladenia nana					2								
Caladenia reptans				1					1				
Corybas dilatatus								1					
Corybas recurvus		2		1	1			2					
Cryptostylis ovata		2		1	2	1	1	1	1		1		
Cyanicula caerulea ms				2					1				
Cyanicula sericea ms				1	1								
Cyrtostylis huegelii								1					
Cyrtostylis robusta		1			1								
Elythranthera brunonis				1							1		
Elythranthera emarginata				1									
Eriochilus dilatatus ssp. undulatus ms					1				1				
Eriochilus dilatatus subsp. dilatatus ms	1	1			1								
Eriochilus helonomos						1							
Eriochilus scaber				1									
Leptoceras menziesii				2									
Microtis media ssp. media								1					
*Monadenia bracteata				2				1					
Prasophyllum sp.1 xfl				1									
Pterostylis aff. nana (SB 142)	1	1		1	2	1		1	1				
Pterostylis roensis													1
Pterostylis vittata				1					1				
Thelymitra aff. macrophylla (SB 572)				1	2	1	1	1			2		
Thelymitra azurea					1								
Thelymitra flexuosa				1									

	Manypeaks	Toolb.	Hume	Lindesay	Magog	Ellen Pk	B.Knoll	Porong.	Mondurup	Thumb	Ragged	PkCh.	PkEL
Thelymitra macrophylla		2			1		1						
Thelymitra pauciflora												1	
Thelymitra sp. (SB 163)	1												
Thelymitra spiralis var. spiralis				1									
Poaceae													
Agrostis aemula var. aemula								1					
*Agrostis gigantea	1												
*Aira caryophyllea													1
*Aira cupaniana		1		1				1				1	
*Aira praecox		2			1			1	1				
Amphipogon amphipogonoides				2			1						
Amphipogon laguroides						1	1						
Amphipogon turbinatus											1		
*Avena barbata		1						1				1	
*Avena sativa												1	
*Briza maxima								1					
*Briza minor								1					
*Bromus madritensis								1					
Danthonia caespitosa	1	2			1	1	1	1					
Deyeuxia inaequalis		1											
Deyeuxia quadriseta								1					
*Holcus lanatus								1					
Microlaena stipoides								1					
Neurachne alopecuroidea				1									
Poa drummondiana													1
Poa homomalla								1					
Poa porphyroclados	1	4			2			1					
Poa serpentum								2					
Poaceae genus sp. SB. 221195								1					
Spartochlo scirpoidea												2	2
Stipa hemipogon													1
Stipa mollis						1		1					
Stipa pycnostachya					1								
Tetrarrhena laevis	2	2						3					
*Vulpia bromoides								1					
*Vulpia myuros												2	1
*Vulpia myuros forma megalura					1								
Phormiaceae													
Stypandra glauca	1	2		1			1	1				2	2
Restionaceae													
Anarthria gracilis				1									
Anarthria prolifera	1		3	1	1	2	3		1	3			
Hypolaena fastigiata											1		
Lepyrodia hermaphrodita									1				
Loxocarya fasciculata			1	1									
Loxocarya flexuosa	1		1			3	2		1	1	1		

	Manypeaks	Toolb.	Hume	Lindesay	Magog	Ellen Pk	B.Knoll	Porong.	Mondurup	Thumb	Ragged	PkCh.	PkEl.
Loxocarya pubescens											2		
Centrolepidaceae													
Centrolepis strigosa												1	
Xanthorrhoeaceae													
Xanthorrhoea platyphylla		1	3		2	1			2	3			
Xanthorrhoea preissii				3			1	1					
Xyridaceae													
Xyris sp. Bluff Knoll							1						
DICOTYLEDONS													
Aizoaceae													
Carpobrotus modestus								1			1	1	
Carpobrotus virescens													1
Apiaceae													
Actinotus glomeratus			2				1			3			
Actinotus rhomboideus		2				2	4						
Daucus glochidiatus													1
Hydrocotyle callicarpa												1	
Hydrocotyle hirta								2					
Platysace commutata			2		1								
Platysace compressa	2				1		1	1		1	1		
Platysace deflexa										1			
Platysace effusa										1	2		
Platysace filiformis				2						1			
Platyscae sp. Stirling (JM Fox 88/262)		1				1	3						
Trachymene anisocarpa								1					
Trachymene coerulea var. coerulea								1					
Trachymene ornata												1	2
Trachymene pilosa								2					
Xanthosia collina									1				
Xanthosia pusilla				2									
Xanthosia rotundifolia var. hypoleuca		1	3		4				1				
Xanthosia rotundifolia var. rotundifolia	3	1		1		4	5						
Xanthosia sp. Fitzgerald (RD Royce 9266)										1			
Asteraceae													
*Arctotheca calendula								1					
Brachyscome pusilla													1
*Carduus pycnocephalus								1					
*Cirsium vulgare		1						1					
*Conyza bonariensis								1					
*Cotula bipinnata		1						2					
Gnaphalium sphaericum						1							
Helichrysum macranthum	1	1				1	1	1					
Hyalosperma cotula								1					

	Manypeaks	Toolb.	Hume	Lindesay	Magog	Ellen Pk	B.Knoll	Porong.	Mondurup	Thumb	Ragged	PkCh.	PkEl.
*Hypochaeris glabra	1	2		2	1	1	1	2	1			1	1
Lagenifera huegelii								1					
Millotia tenuifolia				1		1						1	
Olearia aff axillaris Stirling Ra (SB 290)		2			1	1	1		1				
Olearia axillaris var. erimicola (SB 394)												1	2
Olearia paucidentata		2											
*Pseudognaphalium luteoalbum	1												
*Senecio diaschides								1					
Senecio glomeratus		2			1	1	1	1					
Senecio hispidulus								3					
Senecio picridioides												1	
Senecio amosissimus		1						1					
*Sigesbeckia orientalis								1					
Siloxerus filifolius								1					
*Sonchus asper		1											
*Sonchus oleraceus		1			1							1	1
*Ursinia anthemoides												1	1
Waitzia acuminata													1
Brassicaceae													
*Cardamine sp. (SB 512)								1					
Caesalpiniaceae													
Labichea lanceolata subsp. brevifolia											1	2	2
Caryophyllaceae													
*Cerastium glomeratum		1						1					
*Stellaria media								1					
Casuarinaceae													
Allocasuarina campestris												1	2
Allocasuarina decussata				1		2	2						
Allocasuarina fraseriana				1									
Allocasuarina humilis			3				1		1	3	1		
Allocasuarina trichodon					1				2	1			
Boraginaceae													
Halgania viscosa													1
Crassulaceae													
Crassula colorata var. colorata				1	1			1					
Crassula exserta											1	2	
Crassula peduncularis			1										
Campanulaceae													
Wahlenbergia gracilenta													1
Wahlenbergia multicaulis		1											
Convolvulaceae													
Dichondra repens								1					
Dilleniaceae													
Hibbertia aff. aurea (SB 446)			1										
Hibbertia amplexicaulis				2				1					
Hibbertia argentea		2					1		1				

	Manypeaks	Toolb.	Hume	Lindesay	Magog	Ellen Pk	B.Knoll	Porong.	Mondurup	Thumb	Ragged	PkCh.	PkEl.
Hibbertia commutata				1									
Hibbertia cunninghamii								1					
Hibbertia furfuracea	2						1	1					
Hibbertia glomerata				1									
Hibbertia gracilipes													
Hibbertia microphylla				1							1		
Hibbertia mucronata													
Hibbertia nutans										1		1	
Hibbertia perfoliata													1
Hibbertia pilosa				2				1					
Hibbertia polyclada			2					1					
Hibbertia pungens													
Hibbertia recurvifolia												1	1
Hibbertia serrata										1			
Hibbertia sp. Porongurups ms								1					
Hibbertia subvaginata				2				2					
Hibbertia verrucosa										2			
Droseraceae													
Drosera aff. lasiantha (SB 682)				1									
Drosera erythrogyne	1		1	2									
Drosera glanduligera	1												
Drosera huegelii			2	1				1					
Drosera huegelii dwarf form (SB 633)									1				
Drosera macrantha						2	1						
Drosera microphylla				1						1	1	1	
Drosera modesta	2												
Drosera pallida			2				1						
Drosera platystigma				1									
Drosera pulchella													
Drosera scorpioides							1						
Drosera stolonifera subsp. monticola		2			2	1	1		1	1			
Epacridaceae													
Andersonia sp. (SB 652)													
Andersonia aff. setifolia (SB 129)									1				
Andersonia axilliflora				1		2	3						
Andersonia caerulea			1	1									
Andersonia echinocephala		2	1		1	2	2						
Andersonia grandiflora									3	2			
Andersonia lehmanniana subsp. lehmanniana					1	1	1		1				
Andersonia sprengelioides				1									
Andersonia sp. Mt Lindesay				1									
Astroloma baxteri			2										
Astroloma ciliatum				1									
Astroloma epacridis													
Astroloma pallidum			2	1									2

	Manypeaks	Toolb.	Hume	Lindesay	Magog	Ellen Pk	B.Knoll	Porong.	Mondurup	Thumb	Ragged	PkCh.	PkEl.
Astroloma tectum										1	1		
Leucopogon acicularis							1						
Leucopogon aff. assimilus (SB 385)			1						1				
Leucopogon apiculatus											2		
Leucopogon assimilis	1												
Leucopogon atherolepis			2				1	1	2				
Leucopogon australis	3			2									
Leucopogon corynocarpus			1										
Leucopogon cuneifolius												1	2
Leucopogon flavescens var. brevifolius										2			
Leucopogon gibbosus										1			
Leucopogon glabellus	1			1									
Leucopogon gnaphalioides		1				1	1		1				
Leucopogon lasiophyllus									1				
Leucopogon lasiostachyus			1										
Leucopogon mollis			1						1				
Leucopogon multiflorus											1		
Leucopogon obovatus				1				2					
Leucopogon oxycedrus	1												
Leucopogon parviflorus		2		2	3	3	2	1	1				
Leucopogon propinquus	1	1						1					
Leucopogon reflexus				1									
Leucopogon sp. Thumb Pk (SB 323.1)										1			
Leucopogon sp. Mt Ragged (SB 669)											1		
Leucopogon tenuis						1							
Leucopogon unilateralis	1	1	1	1	2	1	1		2	2			
Leucopogon verticillatus	1							1					
Lysinema ciliatum			1	1						1	1		
Lysinema fimbriatum							1						
Lysinema obovatum										1	1		
Monotoca oligarrhenoides		1			1		1		1		2		
Monotoca tamariscina	1			1	1		1						
Sphenotoma aff. dracophylloides (SB 54)		1	1	3	4	2	5		2				
Sphenotoma capitatum			1										
Sphenotoma dracophylloides	1		1							2			
Sphenotoma drummondii	1	3			1	1	1		1				
Sphenotoma parviflorum				1									
Sphenotoma squarrosum										1			
Styphelia hainesii											1		
Styphelia tenuiflora			2	1					1				
Euphorbiaceae													
Amperea conferta					1								
Amperea micrantha							1		1				
Beyeria ? latifolia (SB 670)											1		
Calycopeplus marginatus										1			
Monotaxis grandiflora										1	1		

	Manypeaks	Toolb.	Hume	Lindesay	Magog	Ellen Pk	B.Knoll	Porong.	Mondurup	Thumb	Ragged	PkCh.	PkEl.
Phyllanthus calycinus												1	1
Poranthera ericoides										1			
Pseudanthus virgatus										1			
Ricinocarpus glaucus var. glaucus	2			1				1					
Stachystemon polyandrus										1			
Gentianaceae													
*Centaurium erythraea								2					
Goodeniaceae													
Coopernookia georgei										1			
Dampiera deltoidea										1			
Dampiera eriocephala									2				
Dampiera fasciculata						2	1			1			
Dampiera hederacea				1									
Dampiera juncea			1										
Dampiera lavandulacea											1		
Dampiera linearis	1	1	3	3	2	1	4		2				
Dampiera loranthifolia										3			
Dampiera parvifolia											2		
Dampiera tenuicaulis												1	2
Goodenia caerulea			1										
Goodenia decursiva											1		
Goodenia scapigera						1	1		1	1		1	1
Goodenia stenophylla										1			
Scaevola auriculata	1							1					
Scaevola brookeana											2		
Scaevola tenuifolia										1			
Velleia foliosa		1			1	2	5		1				
Velleia trinervis				1									
Gyrostemonaceae													
Cypselocarpus haloragoides											1		
Haloragaceae													
Glischrocaryon aureum											1		
Gonocarpus benthamii						2	2						
Gonocarpus diffusus				1				1					
Gonocarpus rudis							1						
Gonocarpus sp. (SB 637)								1					
Gonocarpus sp. (SB 642)				1									
Geraniaceae													
Erodium cygnorum subsp. cygnorum								1					
Pelargonium australe	1					1		2				1	1
Pelargonium littorale								1					
Lamiaceae													
Hemigenia podalyrina				1									
Hemigenia westringioides													1
Microcorys barbata										1			
Microcorys glabra							1						

	Manypeaks	Toolb.	Hume	Lindesay	Magog	Ellen Pk	B.Knoll	Porong.	Mondurup	Thumb	Ragged	PkCh.	PkEl.
Microcorys longiflora										1			
Microcorys subcanescens											1		
Prostanthera serpyllifolia subsp microphylla												1	
Loganiaceae													
Logania nuda												1	
Logania serpyllifolia				1						1			
Phyllangium paradoxum	1			1			1						
Lauraceae													
Cassytha glabella forma glabella	1			2	1		3		1	3	2	2	1
Cassytha pomiformis						1							
Cassytha racemosa forma racemosa								1					
Lentibulariaceae													
Utricularia menziesii				1					1				
Utricularia multifida				1				1					
Loranthaceae													
Nuytsia floribunda										1			
Menyanthaceae													
Villarsia calthifolia								1					
Villarsia marchantii								1					
Mimosaceae													
Acacia alata				1									
Acacia barbinervis					1								
Acacia baxteri			1										
Acacia browniana var. browniana				2									
Acacia cedroides										2			
Acacia incongesta												2	1
Acacia crassiuscula				1							1		
Acacia disticha										1			
Acacia divergens		1		1									
Acacia drummondii subsp. elegans Porongurup variant								1					
Acacia drummondii subsp. candolleana										2			
Acacia drummondii subsp. elegans	2	1	1		2	1	1		1				
Acacia heteroclita subsp. valida MS								2					
Acacia jibberdingensis													2
Acacia lasiocalyx													2
Acacia luteola			1										
Acacia moirii subsp. dasycarpa										1			
Acacia myrtifolia	2					1	1		1		2		
Acacia saligna													1
Acacia subcaerulea										1			
Acacia veronica		2											
Paraserianthes lophantha								1					

	Manypeaks	Toolb.	Hume	Lindesay	Magog	Ellen Pk	B.Knoll	Porong.	Mondurup	Thumb	Ragged	PkCh.	PkEl.
Myoporaceae													
Myoporum tetrandrum								2					
Myrtaceae													
Agonis aff. floribunda (SB 490)											2		
Agonis aff. marginata (SB 150)							3		1				
Agonis hypericifolia	1		3	2	1		1		1				
Agonis juniperina	2												
Agonis linearifolia var. conspicua	1			2		1	1	2		4			
Agonis linearifolia var. linearifolia						2	1						
Agonis marginata	2												
Agonis marginata x linearifolia (SB 126a)	3												
Agonis obtusissima										1			
Agonis parviceps				3	3	3	1		1				
Agonis parviceps x linearifolia (SB 326)							3						
Agonis spathulata			1							2	1		
Agonis undulata										1			
Astartea fascicularis		1				3	4		1				
Astartea sp. (SB 340.5)										2			
Baeckea aff. ovalifolia (SB 340.6)										1			
Baeckea behrii												1	
Beaufortia anisandra			2			3	2		2	3			
Beaufortia bracteosa											1		
Beaufortia cyrtodonta			1										
Beaufortia decussata		1	1	1	2	2	4		2				
Calothamnus aff. crassus				1									
Calothamnus affinis			1										
Calothamnus crassus		1			4	4	6		3				
Calothamnus gracilis										1			
Calothamnus macrocarpus										1			
Calothamnus pinifolius										1			
Calothamnus quadrifidus											1	2	2
Calothamnus tuberosus												1	1
Calytrix asperula									1				
Chamelaucium ciliatum complex (SB 349)											1		
Darwinia collina							1						
Darwinia lejostyla						3							
Darwinia macrostegia									1				
Darwinia sp. Mt Ragged											1		
Darwinia sp. Thumb Pk (KRN 4847)										1			
X Darwinia sp. Pk Charles													
Darwinia squarrosa							1						
Darwinia vestita				1									
Eucalyptus acies										3			

	Manypeaks	Toolb.	Hume	Lindesay	Magog	Ellen Pk	B.Knoll	Porong.	Mondurup	Thumb	Ragged	PkCh.	PkEl.
Eucalyptus acies x preissiana (SB 327.4)										1			
Eucalyptus calophylla		2		1	3		1	1					
Eucalyptus calophylla var. rosea					1								
Eucalyptus conferruminata										2			
Eucalyptus diversicolor								1					
Eucalyptus doratoxylon	1		1			1	1		3		2		
Eucalyptus erectifolia			1		2	1	1						
Eucalyptus marginata	1			3	1		1						
Eucalyptus megacarpa	1	1		1	3	2	1	1	2				
Eucalyptus occidentalis													
Eucalyptus pachyloma x staeri												1	
Eucalyptus preissiana									1				
Eucalyptus staeri			3						1	1			
Eucalyptus talyuberlup													
Eucalyptus tetraptera						1							
Grevillea fasiculata var. linearis			2								1		
Homalospermum firmum				1			1						
Hypocalymma cordifolium	1												
Hypocalymma myrtifolium						3	2						
Hypocalymma phillipsii		3			3								
Kunzea baxteri									1				
Kunzea ericifolia	1										1		
Kunzea montana		1	1		1	3	6		2				
X Leptospermum confertum													
Leptospermum erubescens										1			
Melaleuca blaeriifolia												1	1
Melaleuca citrina					3	1	1	2					
Melaleuca diosmifolia	1									1			
Melaleuca elliptica													
Melaleuca fulgens													1
Melaleuca microphylla	1			1		1	1				1	2	2
Melaleuca pentagona var. subulifolia											1		
Melaleuca scabra											2		
Melaleuca striata											1		
Melaleuca thymoides			3	2						3			
Melaleuca uncinata							2		1				
Melaleuca viminea subsp. demissa												1	1
Regelia velutina										1			
Rinzia oxycoccoides										1			
Rinzia schollerifolia			1	1						2			
Thryptomene australis										1			
Thryptomene saxicola													1
Verticordia plumosa				1				3					
Olacaceae													
Olax phyllanthi										2			

	Manypeaks	Toolb.	Hume	Lindesay	Magog	Ellen Pk	B.Knoll	Porong.	Mondurup	Thumb	Ragged	PkCh.	PkEl.
Orobanchaceae													
*Orobanche minor								1					
Oxalidaceae													
Oxalis corniculata								3					
Papilionaceae													
Aotus genistoides			2		1		3		3				
Bossiaea dentata	1									2			
Bossiaea rufa											1		
Bossiaea webbii				1									
Brachysema subcordatum								2					
Callistachys lanceolata										1			
Chorizema diversifolium								1					
Chorizema glycinifolium			1										
Chorizema nervosum											1		
Chorizema reticulatum				1									
Daviesia crenulata			1										
Daviesia emarginata										3			
Daviesia grossa											1		
Daviesia incrassata				1									
Daviesia inflata				1									
Daviesia obovata						1				1			
XDaviesia mesophylla						1							
Daviesia preissii		1							1				
Daviesia striata										2			
Dillwynia pungens	1									1	1		
Eutaxia epacridoides				2									
Eutaxia obovata	1			1				1					
Eutaxia sp. Mt Lindesay (SB 340.4)				1									
Eutaxia virgata					1	1	1		1				
Gastrolobium acrocaroli ms (SB 475)												2	
Gastrolobium bilobum	1						1				1		
Gastrolobium brownii				1									
Gastrolobium pycnostachyum											1		
Gastrolobium velutinum							1						
Gompholobium confertum			1	1									
Gompholobium knightianum										2	1		
Gompholobium ovatum				1									
Gompholobium venustum										1			
Gompholobium villosum			1			1	1		1				
Hardenbergia comptoniana								1					
Hovea chorizemifolia				1									
Hovea elliptica								1					
Hovea trisperma			1	1					1				
Jacksonia compressa										3			
Jacksonia elongata ms										1			
Kennedia beckxiana											1		

	Manypeaks	Toolb.	Hume	Lindesay	Magog	Ellen Pk	B.Knoll	Porong.	Mondurup	Thumb	Ragged	PkCh.	PkEL
Kennedia eximia											1		
Latrobea tenella var. tenella			1						2				
Mirbelia dilatata		2						1					
Mirbelia microphylla													1
Mirbelia spinosa				1									
Nemcia aff. rubra (SB 611)					2				2				
Nemcia coriacea	2		3							1			
Nemcia crenulata		1											
Nemcia leakeana						3	3						
Nemcia pulchella					2	1	1						
Nemcia rubra		1			1		1		1				
Nemcia sp. Ellen Pk (SB 245)						1							
Nemcia sp. Magog (SB 55)					1								
Nemcia vestita		3											
Pultenaea ericifolia			1										
Pultenaea reticulata				1									
Pultanea sp. (SB 478)				1									
Sphaerolobium alatum				1					1				
Sphaerolobium grandiflorum				2									
Sphaerolobium linophyllum									1	1			
Sphaerolobium scabriusculum										1			
Sphaerolobium vimineum			1				1			1	1		
Pittosporaceae													
Billardiera bicolor var. bicolor												1	
Billardiera coriacea											1	1	
Billardiera granulata	1							1					
Billardiera variifolia	2		3	2	2				2				
Cheiranthera filifolia var. filifolia													1
Sollya drummondii	1	4		1	3	3	2						
Sollya heterophylla					1			2		1			
Plantaginaceae													
*Plantago lanceolata								1					
Plantago sp. (SB 647)								1					
Polygalaceae													
Comesperma calymega			1		1								
Comesperma sp. Thumb Pk (SB 465)										1			
Comesperma virgatum				1						1			
Polygonaceae													
Muehlenbeckia adpressa												1	1
*Rumex acetosella								1					
Portulacaceae													
Calandrinia brevipedata								1					
Calandrinia granulifera								1					
Calandrinia liniflora								1					
Calandrinia uniflora		1			1	1						2	

	Manypeaks	Toolb.	Hume	Lindesay	Magog	Ellen Pk	B.Knoll	Porong.	Mondurup	Thumb	Ragged	PkCh.	PkEl.
Primulaceae													
*Anagallis arvensis								1					
Proteaceae													
Adenanthos cuneatus										1			
Adenanthos ellipticus										1			
Adenanthos filifolius			1		1	1	2		1				
Adenanthos labillardierei										3			
Adenanthos obovatus				2					1				
Adenanthos oreophilus										1	1		
Banksia baueri										2			
Banksia baxteri										2			
Banksia brownii		2				1							
Banksia coccinea			1										
Banksia gardneri var. brevidentata			1			1							
Banksia gardneri var. gardneri				1									
Banksia grandis	2	1	1	2	3	1	1		1				
Banksia lemanniana										2			
Banksia media											1		
Banksia nutans var. nutans										2			
Banksia oreophila					1		2		3	3			
Banksia solandri		1			2	2	1		3				
Banksia sphaerocarpa var. sphaerocarpa			3	1									
Banksia verticillata	1												
Banksia violacea										1			
Conospermum caeruleum				1									
Conospermum capitatum						1							
Conospermum dorrienii									1				
Conospermum petiolare			1				1			1			
Conospermum teretifolium										1			
Dryandra armata				2									
Dryandra armata var. nova ms			1						1	3	1		
Dryandra baxteri							1						
Dryandra concinna		1			1	1	1		1				
Dryandra conferta			1										
Dryandra cuneata											1		
Dryandra drummondii		1											
Dryandra falcata										1			
Dryandra foliolata			3		1				4				
Dryandra formosa	1	1		1	3	2	2		1				
Dryandra longifolia subsp. archeos ms											2		
Dryandra montana							1						
Dryandra nivea				2									
Dryandra plumosa			1							2			
Dryandra quercifolia										3			
Grevillea coccinea subsp. lanata										2			

APPENDIX 2

	Manypeaks	Toolb.	Hume	Lindesay	Magog	Ellen Pk	B.Knoll	Porong.	Mondurup	Thumb	Ragged	PkCh.	PkEl.
Grevillea concinna											1		
Grevillea fasciculata			1		2	1	1		2				
Grevillea fistulosa										3			
Grevillea fuscolutea				1									
Grevillea infundibularis										1			
Grevillea muelleri									1				
Grevillea nudiflora											1		
Grevillea pauciflora											1		
Grevillea trifida				1									
Grevillea tripartita										1			
Hakea ambigua		2	3		1		2		2				
Hakea amplexicaulis				1									
Hakea baxteri			2						2				
Hakea ceratophylla	1			1									
Hakea crassifolia			1										
Hakea cucullata			1							1			
Hakea elliptica	3												
Hakea hookeriana										3			
Hakea invaginata var. invaginata												1	
Hakea pandanicarpa											1		
Hakea trifurcata									1				
Hakea varia	1	4	2	2	4	4	3	1	3	1			
Hakea verrucosa											1		
Hakea victoria										2			
Isopogon attenuatus			2		1		1		1				
Isopogon baxteri								1					
Isopogon buxifolius										1			
Isopogon formosus			3	2		1	1			1	1		
Isopogon latifolius		2	1		2	1	1		3				
Isopogon polycephalus											1		
Isopogon sphaerocephalus				1									
Isopogon trilobus										1			
Lambertia ericifolia			2										
Lambertia fairallii						1							
Lambertia inermis										1			
Lambertia uniflora							1		2				
Persoonia coriacea											1		
Persoonia longifolia				2									
X Persoonia micranthera							1						
Persoonia saundersiana			1										
Persoonia coriaceae											1		
Persoonia striata										1			
Persoonia trinervis													1
Petrophile carduacea			1										
Petrophile divaricata			2			1			2	3			
Petrophile diversifolia				1									

	Manypeaks	Toolb.	Hume	Lindesay	Magog	Ellen Pk	B.Knoll	Porong.	Mondurup	Thumb	Ragged	PkCh.	PkEl.
Petrophile fastigiata											2		
Petrophile phylicoides			1							2			
Petrophile teretifolia										1	1		
Stirlingia tenuifolia var. tenuifolia				1						1			
Synaphea polymorpha			1										
Ranunculaceae													
Clematis pubescens		1						1					
Ranunculus colenorum								1					
Rubiaceae													
Opercularia aff. hispidula (SB 493)												1	2
Opercularia apiciflora			1						1				
Opercularia hirsuta										1	1	1	
Opercularia hispidula	2	1		1				1		1		1	
Opercularia vaginata													1
Opercularia volubilis		1			2	1	2	1					
Rutaceae													
Boronia albiflora			3						1	3	2		
Boronia crenulata var. viminea						1	1						
Boronia crenulata var. crenulata	1	1	1	1	1	4	2		2				
Boronia gracilipes	2			2									
Boronia pulchella		1			2	1	2						
Boronia spathulata				2		2	2			3			
Crowea angustifolia var. dentata	1			1									
Drummondita hassellii var. longifolia												2	
Muiriantha hassellii			1			1	1						
Phebalium rude subsp. lineare											1		
Rhadinothamnus euphemiae											1		
Santalaceae													
Choretrum glomeratum var. glomeratum											1		
Exocarpos sparteus					1				2			1	
Leptomeria axillaris							1			3			
Leptomeria scrobiculata			1	1	1	1			2				
Santalum acuminatum												1	1
Santalum spicatum												1	
Sapindaceae													
Dodonaea ? inaequifolia (SB 671)											1		
Dodonaea ceratocarpa								1					
Dodonaea pinifolia												1	1
Rhamnaceae													
Cryptandra congesta				1									
Cryptandra graniticola ms												1	
Pomaderris grandis	1												
Pomaderris myrtilloides										1			
Spyridium montanum		1				1							
Trymalium floribundum													

	Manypeaks	Toolb.	Hume	Lindesay	Magog	Ellen Pk	B.Knoll	Porong.	Mondurup	Thumb	Ragged	PkCh.	PkEl.
subsp. trifidum	1	2		1				1					
Trymalium ledifolium var. ledifolium									1				
Trymalium venustum				1									
Saxifragaceae													
Eremosyne pectinata				1									
Solanaceae													
Anthocercis genistoides												2	
Anthocercis viscosa subsp. viscosa	1										1		
*Solanum nigrum								1					
Scrophulariaceae													
*Bellardia trixago				1	1			2					
*Parentucellia viscosa								1					
Veronica plebeia								3					
Stackhousiaceae													
Stackhousia monogyna													1
Tripterococcus brunonis										1			
Sterculiaceae													
Guichenotia micrantha													1
Lasiopetalum aff. cordifolium				1									
Lasiopetalum compactum										1	1	1	1
Lasiopetalum dielsii		1											
Lasiopetalum quinquenervium										1			
Thomasia aff. rhynchocarpa (SB 498)				1									
Thomasia discolor	1												
Thomasia foliosa													1
Thomasia sp. Toolbrunup (SB 284)		2			1		1						
Stylidiaceae													
Levenhookia pusilla				2	1			1					1
Stylidium adnatum		1						2			1		
Stylidium albomontis										1			
Stylidium amoenum			1	1									
Stylidium articulatum	1						1						
Stylidium breviscapum				1							1		
Stylidium corymbosum var. proliferum	1							1					
Stylidium crassifolium								1					
Stylidium hirsutum				1									
Stylidium imbricatum			1										
Stylidium keigheryi							2						
Stylidium luteum subsp. clavatum										1			
Stylidium piliferum subsp. minor			1	2			2		1				
Stylidium piliferum subsp. piliferum							1						
Stylidium plantagineum					1								
Stylidium repens var. repens				1									
Stylidium rhynchocarpum					1								
Stylidium scandens				2	1	1	2		1				
Stylidium schoenoides			1	1									

	Manypeaks	Toolb.	Hume	Lindesay	Magog	Ellen Pk	B.Knoll	Porong.	Mondurup	Thumb	Ragged	PkCh.	PkEl.
Stylidium sp. nova spathulatum complex (SB 683)				1									
Stylidium sp. Stirling Ra (SB 115)					1	1	2						
Stylidium sp.2 Bluff Knoll x fl							1						
Stylidium spathulatum subsp. glandulosum			1										
Stylidium spinulosum subsp. montanum			2		1	2	1						
Stylidium verticillatum			3						1				
Thymeleaceae													
Pimelea angustifolia	1			1		1	1		1	1			
Pimelea brevifolia											2		
Pimelea floribunda				1									
Pimelea hispida	1			2									
Pimelea imbricata								1					
Pimelea lehmanniana								1					
Pimelea longiflora				1									
Pimelea physodes										1			
Pimelea spectabilis										2			
Pimelea suaveolens subsp flava				1									
Pimelea sylvestris	1												
Pimelea tinctoria											1		
Tremandraceae													
Platytheca galioides			3										
Platytheca juniperina		1		1						3			
Tetratheca affinis				1									
Tetratheca setigera			3		1				1				
Tremandra diffusa	1			1		1							
Tremandra stelligera	1			1				2					
Urticaceae													
Parietaria debilis		1											1
Violaceae													
Hybanthus floribundus											1		

APPENDIX 3

LOCATION AND ALTITUDES OF PLOTS USED IN FLORA SURVEY AND ADDITIONAL INVERTEBRATE SURVEY SITES

* = FLORA QUADRATS ALSO USED IN INVERTEBRATE SURVEY

APPENDIX 3. PLOT LOCATION AND ALTITUDE

Mountain area	Quadrat no.	Location: Lat. (S)	Long.(E)	Altitude (m)
Mt Manypeaks*	201	34°53'40.3"	118°16'01.9"	520
Mt Manypeaks	201.1	34°53'40"	118°16'	550
Mt Manypeaks*	202	34°53'40.3"	118°16'01.9"	530
Toolbrunup, Stirling Ra	203	34°23'17"	118°2'50.8"	1000
Toolbrunup, Stirling Ra	203.1	34°23'17"	118°2'50.8"	1030
Hume Pk Stirling Ra	204	34°20'12.7"	117°44' 24.5"	500
Hume Pk, Stirling Ra	205	34°20'15.7"	117°44'25.8"	570
Hume Pk, Stirling Ra	206	34°20'15.72	117°44'25.8"	570
Mt Lindesay	207	34°50'20"	117°18'30""	445
Mt Lindesay*	208	34°50'20"	117°18'30"	420
Mt Lindesay	208.1	34°50'39.6"	117°18'3.9"	350
Mt Magog, Stirling Ra*	209	34°23'58.8"	117°56'40"	800
Magog, Stirling Ra	209.1	34°23'58"	117°56'30"	840
Mt Magog, Stirling Ra	210	34°23'58.8"	117°56'41.7"	800
Ellen Pk, Stirling Ra	211	34°21'32.4"	118°19'45.7"	940
Ellen Pk Stirling Ra*	211.1	34°21'32.7"	118°19'50"	950-1000
Ellen Pk Stirling Ra	212	34°21'32"	118°19'43.1"	930
Bluff Knoll, Stirling Ra*	213	34°22'36.6"	118°15'10"	1070
Bluff Knoll, Stirling Ra	213.1	34°22'30"	118°15'17"	1070
Bluff Knoll, Stirling Ra*	214	34°22'56.1"	118°14'54.7"	900
Porongurup Ra Hayward pk*	215	34°40'55.8"	117°51'58.6"	570
Porongurup Ra Nancy pk	216	34°40'59.7"	117°51'35.5"	620
Porongurup Ra	216.1	34°41'	117°52'	500-650
Mondurup Pk, Stirling Ra*	217	34°24'18"	117°48'43.5"	790
Mondurup Pk Stirling Ra*	218	34°2417.5"	117°48'44.7"	760
Mondurup Pk Stirling Ra	218.1	34°24"17'	117°48'46"	800
Mt Manypeaks	219	34°53'40"	118°16'10"	520
Thumb Pk, Barren Ra	220	34°2'4.2"	119°43'24.3"	500
Thumb Pk, Barren Ra	220.1	34°2'5.2"	119°43'24.2"	500
Thumb Pk, Barren Ra	221	34°2'2.2"	119°43'17.7"	470
Mt Ragged*	222	33°26'45.6"	123°28'24.5"	550
Mt Ragged	223	33°26'47.6"	123°28'19.5"	475
Pk Charles	224	32°53'5.4"	121°9"44.4"	580
Pk Charles	224.1	32°53'3"	121°9'48"	600-650
Pk Charles	225	32°53"7"	121°9' 51.2"	500
Porongurup Ra, Hayward Pk*	226	34°40'56"	117°52'30"	500
Toolbrunup, Stirling Ra*	227	34°23'11.4"	118°2'51"	780
Toolbrunup, Stirling Ra*	228	34°23'11"	118°2'51"	800
Bluff Knoll Stirling Ra	229	34°22'49.5"	119°15'15.2"	780
Bluff Knoll Stirling Ra*	230	34°22'32.4"	118°15'17.28"	1070
Mt Lindesay*	231	34°50'23.4"	117°18'22"	400
Magog, Stirling Ra*	232	34°23'59.8"	117°56'37.5"	650
Mondurup Pk Stirling Ra	233	34°24'6"	117°48'29.8"	600
Ellen Pk Stirling Ra	234	34°21'29.2"	118°19'47.9"	930
Pk Eleanora Pk Charles NP	235	32°57'14.4"	121°9'9.9"	470
Pk Eleanora Pk Charles NP	236	32°57'23.2"	121°9'14.9"	500
Thumb Pk Barren Ra	237	34°1'51.3"	119°43'8.3"	375
Bluff Knoll (not used in floristic analysis)	238	34°22'40"	118o15'	1000
Additional Invertebrate Sampling Sites				
Thumb Pk * (SW gully / creek)	Invert 1	34°2'	119°10'	350
Thumb Pk* (SW gully)	Invert 2	34°2'	119°10'	370
Mt Ragged* (E gully / creek)	Invert 1	33°26' 46"	123°28'26	400
Ellen Pk* northern slope	Invert 1	34°21'20"	118°19' 45"	650

APPENDIX 4.

BYROPHYTES RECORDED IN MOUNTAIN SURVEY

APPENDIX 4. CHECK-LIST OF BRYOPHYTES RECORDED IN MOUNTAIN SURVEY

	Ellen Pk	Bluff Knoll	Toolbrunup	Magog	Mondurup	Hume Pk	Porongurups	Mt Lindesay	Mt Manypeaks	Thumb Pk	Pk Charles	Pk Eleanora	Mt Ragged
Liverworts													
Cephalozia arctica ssp. *antarctica*		#	#										
Chiloscyphus semiteres			#	#	#		#	#			#		#
Frullania falciloba			#										
Hyalolepidozia longiscypha		#											
Jamesoniella colorata	#		#										
Kurzia compacta	#	#											
Pallavicinia lyellii		#											
Riccardia wattsiana		#											
Mosses													
Barbula calycina	#	#			#			#				#	#
Bartramia pseudostricta			#										
Breutelia affinis							#						
Bryum albo-limbatum					#								#
Bryum inaequale										#			
Bryum torquescens				#									
Bryum billardieri	#			#			#	#			#		
Bryum campylothecium							#						
Bryum sp B Catchside 1980												#	
Campylopus australis							#						
Campylopus bicolor	#	#	#				#	#					#
Campylopus introflexus	#	#	#	#	#	#	#				#	#	#
Campylopus flindersii											#		
Campylopopus pyriformis	#												
Ceratodon purpeus											#		
Dicranoloma diaphononeurum	#												
Grimmia laevigata							#						
Hedwigidium integrifoium	#							#					
Hedwigia ciliata		#					#						
Hypnum cupressiforme var cupressiforme	#												
Hypnum cupressiforme var lacunosum							#	#					
Racopilum convolutaceum			#										
Rhacocarpus purpurascens		#											
Rhaphidorrhynchium amoemun							#						
Sematophyllum contiguum			#				#						
Sematophyllum homomallum			#	#	#	#	#	#					
Thuidium sparsum var hastatum			#	#			#						
Triquetrella papillata							#					#	
Zygodon intermedius											#		

APPENDIX 5. PLANT SPECIES ENDEMIC TO THE MOUNTAINS SURVEYED

Key to Endemic Species

eS	endemic to Stirling Range
eL	endemic to the Mt Lindesay - Little Lindesay area
eP	endemic to the Porongurup Range
eM	endemic to Mt Manypeaks
eB	endemic to Barren Ranges and quartzite ranges of the Fitzgerald River National Park
eR	endemic to Mt Ragged
ePC	endemic to Peak Charles
*	species whose main occurrences are within the mountain area described but other populations exist.
X	species not located during this survey (data from WA Herbarium Data-Base).

APPENDIX 5

Family: Anthericaceae	
Borya longiscapa Churchill	eL
Laxmania sp. Mt Lindesay SB.sn	eL
Family: Apiaceae	
Actinotus rhomboideus (Turcz.)Benth.	eS
Platyscae sp. Stirling (JM Fox 88/262)	eS
Xanthosia collina Keighery	eS
Xanthosia rotundifolia DC. var. hypoleuca Diels	eS
Xanthosia sp. Fitzgerald (RD Royce 9266)	eB(Thumb)
Family: Asteraceae	
Olearia aff. axillaris Stirling Ra (SB 290)	eS
Family: Cyperaceae	
Isolepis aff congrua (SB 535)	eS
Lepidosperma aff. tenue Thumb Pk (SB 325.1)	eS
Lepidosperma aff. tenue Mt Ragged (SB 651)	eR
Lepidosperma sp. nov. "Big Heads" A.George 11294	eS
Lepidosperma sp. Stirling Ra (SB 42)	eS
Schoenus sp. Stirling Ra. Perth 04067878	eS
Family: Dilleniaceae	
Hibbertia sp. Porongurups ms	eP
Family: Droseraceae	
Drosera stolonifera Endl. subsp. monticola Lowrie & N.G.Marchant	eS
Family: Epacridaceae	
Andersonia aff. setifolia (SB 129)	eL
Andersonia axilliflora (Stschegl.)Druce	eS
Andersonia echinocephala (Stschegl.)Druce	eS, Thumb
Andersonia grandiflora Stschegl.	eS
Andersonia sp. Mt Lindesay	eL
Leucopogon acicularis	eS
Leucopogon gnaphalioides Stschegl.	eS
[1] Leucopogon lasiophyllus Stschegl.	eS*
[2] Leucopogon lasiostachyus Stschegl.	eS*
Leucopogon sp. Thumb Pk (SB 323.1)	eB
Sphenotoma aff. dracophylloides (SB 54)	eS,L
Sphenotoma drummondii (Benth.)F.Muell.	eS,M
Family: Euphorbiaceae	
Amperea conferta Benth.	eS,B
Family: Goodeniaceae	
Coopernookia georgei Carolin	eB
Dampiera deltoidea Rajput & Carolin	eB
Scaevola brookeana F.Muell.	eR
Velleia foliosa (Benth.)K.Krause in Engl.	eS
Family: Haloragaceae	
Gonocarpus rudis (Benth.)Orchard	eS
Family: Menyanthaceae	
Villarsia calthifolia F.Muell.	eP
Villarsia marchantii Ornduff	eP
Family: Mimosaceae (163)	
Acacia drummondii ssp. elegans Porongurup variant RJ Cummings 938	eP
Acacia heteroclita Meisn.in Lehm. subsp. valida R.S.Cowan & Maslin	eP
Acacia veronica Maslin	eS
Family: Myrtaceae (273)	
Agonis undulata Benth.	eB
[3] Calothamnus aff. crassus	eL*
Calothamnus affinis Turcz.	eS
Calothamnus crassus (Benth.)Hawkeswood	eS
Calothamnus macrocarpus Hawkeswood	eB
Darwinia collina C.A.Gardner	eS
Darwinia lejostyla (Turcz.)Domin	eS
Darwinia macrostegia (Turcz.)Benth.	eS

Darwinia sp. Mt Ragged	eR
Darwinia sp. Peak Charles	XePC
Darwinia sp. Thumb Pk (KRN 4847)	eB
Darwinia squarrosa (Turcz.)Domin	eS
Eucalyptus erectifolia Brooker & Hopper	eS
[4] Eucalyptus talyuberlup D.J.Carr & S.G.M.Carr	eS*
Hypocalymma myrtifolium Turcz.	eS
Hypocalymma phillipsii Harv.	eS
Kunzea montana (Diels)Domin	eS
Leptospermum confertum Joy Thomps.	XeB
Regelia velutina (Turcz.)C.A.Gardner	eB
[5] Rinzia oxycoccoides Turcz.	eB*
Thryptomene saxicola (A.Cunn.ex Hook.)Schauer in Lehm.	eP

Family: Papilionaceae (165)

Brachysema subcordatum Benth.	eP
[6] Daviesia obovata Turcz.	eS,B*
Daviesia mesophylla	XeS
Gastrolobium acrocaroli ms (SB 475)	ePC
Jacksonia compressa Turcz.	eS
Nemcia aff rubra	eS
[7] Nemcia crenulata (Turcz.)Crisp in C.H.Stirt.	eS*
Nemcia leakeana (J.Drumm.)Crisp in C.H.Stirt.	eS
Nemcia pulchella (Turcz.)Crisp in C.H.Stirt.	eS
Nemcia rubra Crisp in C.H.Stirt.	eS
Nemcia sp Ellen Pk (SB 245)	eS
Nemcia sp Magog (SB 55)	eS
Nemcia vestita Domin	eS

Family: Pittosporaceae (152)

Billardiera granulata (Turcz.)E.M.Benn.	eP,M

Family: Poaceae

Poaceae genus sp. (SB 221195)	eP

Family: Polygalaceae (183)

Comesperma sp Thumb Pk (SB 465)	eB

Family: Proteaceae (090)

Adenanthos ellipticus A.S.George	eB
Adenanthos filifolius Benth.	eS,M
[8] Adenanthos labillardierei E.C.Nelson	eB*
[9] Adenanthos oreophilus E.C.Nelson	eB,R*
Banksia oreophila A.S.George	eS,B
Banksia solandri R.Br.	eS
Conospermum dorrienii Domin	eS
Dryandra concinna R.Br.	eS

Family: Proteaceae (090)

Dryandra longifolia ssp. archeos ms	eR
Dryandra montana C.A.Gardner ex A.S.George	eS
Grevillea coccinea Meisn. subsp. lanata P.Olde & N.Marriott	eB
Grevillea fistulosa A.S.George	eB
Grevillea fuscolutea Keighery	eL
Grevillea infundibularis A.S.George	eB
[10] Hakea ambigua Meisn.in Lehm.	eS*
Hakea hookeriana Meissner	eB
[11] Isopogon baxteri R.Br.	eS,M*
Isopogon latifolius R.Br.	eS
[12] Lambertia ericifolia R.Br.	eS*
Lambertia fairallii Keighery	eS
Persoonia micranthera	X eS
Petrophile carduacea Meissner	eS

Family: Rhamnaceae

Cryptandra congesta	eL
Pomaderris grandis F.Muell.	eM
Spyridium montanum	eS

Family: Rutaceae

Drummondita hassellii (F.Muell.)Paul G.Wilson var. longifolia	ePC
Muiriantha hassellii (F.Muell.)C.A.Gardner	eS,M
Phebalium rude Bartl. subsp. lineare (C.A.Gardner)Paul G.Wilson	eR

Family: Sterculiaceae	
[13] Lasiopetalum aff cordifolium	eL*
Lasiopetalum dielsii E.Pritz.in Diels & E.Pritz.	eS
Thomasia sp. Toolbrunup (SB 284)	eS
Family: Stylidiaceae	
Stylidium corymbosum R.Br. var. proliferum Benth	eP,M
Stylidium keigheryi Lowrie & Carlquist	eS
Stylidium sp. Stirling Ra (SB 115)	eS
Stylidium spinulosum R.Br. subsp. montanum Carlquist	eS
Stylidium verticillatum F.Muell.	eS
Family: Tremandraceae	
Platytheca juniperina Domin	eS,B,L
Family: Xyridaceae	
Xyris sp. Bluff Knoll	eS

APPENDIX 5. Foot-notes

[1]Leucopogon lasiophyllus: also occurs on Mt Barker Hill southwest of the Stirling Range

[2]Leucopogon lasiostachys: record exists from the Kalgan River south of the Stirling Range

[3]Calothamnus aff. crassus: recent record from Mt Roe

[4]Eucalyptus talyuberlup: almost confined to the Stirling Range except for outlying population on Pallinup siltstone on Tackalcharup Creek

[5]Rinzia oxycoccoides: Main population the Barren Ranges, record exists from the Manypeaks area

[6]Daviesia obovatum: also occurs at Gairdner River, Fitzgerald River National Park.

[7] Nemcia crenulata: record exists from Thumb Peak, 'Nemcia coriacea' recorded from Thumb Peak in this survey may be the same taxon.

[8]Adenanthos labillardierei: record exists from north of Raventhorpe

[9]Adenanthos oreophilus: main occurrence the quartzite ranges of the Fitzgerald and Mt Ragged, other populations include Mt Desmond near Ravensthorpe and the Ravensthorpe Range

[10]Hakea ambigua: extends to Sukey's Peak near Cranbrook at the western end of the Stirling Range and Geekabee Hill which is geologically part of the Range.

[11]Isopogon baxteri: also occur at South Sister between the Stirling Range and Manypeaks

[12]Lambertia ericifolia: also occurs on the Hamilla Hills (within the Stirling Range National Park) and Sukey's Peak

[13]Lasiopetalum aff. cordifolium: also known from near Mt Frankland

APPENDIX 6 DECLARED RARE AND PRIORITY FLORA

Conservation codes as defined by the Department of Conservation and Land Management 15/9/95

DRF: Declared Rare Flora (= Threatened Flora*)

Taxa which have been adequately searched for in the wild either rare, in danger of extinction, or otherwise in need of protection, and have been gazetted as such, following approval by the Minister for the Environment, after recommendation by the State's Endangered Flora Consultative Committee.

P1: Priority 1 - Poorly Known Taxa

Taxa which are known from one or a few (generally <5) populations which are under threat, either due to small population size, or being on lands under immediate threat eg. road verges, or the plants are under threat from disease, grazing etc. May include taxa with threatened populations on protected lands. Such taxa are under consideration for declaration as "rare flora", but are in urgent need of further survey

P2: Priority 2 - Poorly Known Taxa

Taxa which are currently known from one or a few (generally <5) populations, at least some of which are believed to be under immediate threat (ie. not currently endangered). Such taxa are under consideration for declaration as "rare flora", but are in urgent need of further survey

P3: Priority 3 - Poorly Known Taxa

Taxa which are known from several populations, at least some of which are not believed to be under immediate threat (ie. not currently endangered). Such taxa are under consideration for declaration as "rare flora", but are in need of further survey

P4: Priority 4 - Poorly Known Taxa

Taxa which are considered to have been adequately surveyed for and which, whilst being rare are not currently threatened by identifiable factors. These taxa require monitoring every 5-10 years.

Threat Categories (Department of Conservation and Land Management, 1994b)

'Threatened taxon' means any extant animal or plant taxon declaed under Section 23F(2) of the *Wildlife Conservation Act* as "likely to become extinct or rare".

CE: Critically Endangered

'Critical' means taxa that are facing extermely high probability of extinction in the wild in the immediate future and in need of immediate research and/or management actions.

E: Endangered

'Endangered' means taxa that are not Critical but are facing a very high probability of extinction in the near future and in need of urgent research and/or management actions.

V: Vulnerable

'Vulnerable' means taxa that are not Critical or Endangered but are facing a high probability of extinction in the wild in the medium-term future and are in need of research and monitoring.

APPENDIX 6.

	CONSERVATION STATUS
Family: Anthericaceae	
Borya longiscapa Churchill	P2
Thysanotus isantherus R.Br.	P3
Family: Apiaceae	
Actinotus rhomboideus (Turcz.)Benth.	P2
Platyscae sp. Stirling (JM Fox 88/262)	P2
Trachymene anisocarpa (Turcz.)B.L.Burtt	P2
Xanthosia collina Keighery	P3
Xanthosia rotundifolia DC. var. hypoleuca Diels	P3
Xanthosia sp. Fitzgerald (RD Royce 9266)	P2
Family: Aspleniaceae	
Asplenium aethiopicum (Burm.f.)Bech.	P4
Family: Cyperaceae	
Schoenus sp. Stirling Ra. Perth 04067878	P2
Family: Dilleniaceae	
Hibbertia argentea Steud.	P3
Hibbertia sp. Porongurups ms	DRF/E
Family: Epacridaceae	
Andersonia axilliflora (Stschegl.)Druce	DRF
Andersonia echinocephala (Stschegl.)Druce	P3
Andersonia grandiflora Stschegl.	P3
Leucopogon apiculatus R.Br.	P3
Leucopogon lasiostachyus Stschegl.	P2
Leucopogon multiflorus	P2
Sphenotoma drummondii (Benth.)F.Muell.	DRF
Sphenotoma parviflorum F.Muell.	P3
Family: Euphorbiaceae	
Calycopeplus marginatus Benth.	P3
Family: Goodeniaceae	
Coopernookia georgei Carolin	DRF/V
Dampiera deltoidea Rajput & Carolin	P2
Goodenia stenophylla F.Muell.	P4
Scaevola brookeana F.Muell.	P2
Velleia foliosa (Benth.)K.Krause in Engl.	P3
Family: Haloragaceae	
Gonocarpus rudis (Benth.)Orchard	P2
Family: Menyanthaceae	
Villarsia calthifolia F.Muell.	DRF/E
Villarsia marchantii Ornduff	P4
Family: Mimosaceae	
Acacia disticha Maslin	P2
Acacia drummondii ssp. elegans Porongurup variant RJ Cummings 938	P2
Acacia heteroclita Meisn.in Lehm. subsp. valida R.S.Cowan & Maslin	P2
Acacia moirii E.Pritz. subsp. dasycarpa Maslin	P3
Acacia veronica Maslin	P3
Family: Myrtaceae	
Calothamnus affinis Turcz.	P3
Calothamnus crassus (Benth.)Hawkeswood	P2
Calothamnus macrocarpus Hawkeswood	P2
Darwinia collina C.A.Gardner	DRF/V
Darwinia lejostyla (Turcz.)Domin	P4
Darwinia macrostegia (Turcz.)Benth.	DRF/V
Darwinia sp. Peak Charles	P2
Darwinia sp. Thumb Pk (KRN 4847)	P2
Darwinia squarrosa (Turcz.)Domin	DRF/V
Eucalyptus acies Brooker	P3
Eucalyptus erectifolia Brooker & Hopper	P4
Hypocalymma phillipsii Harv.	P3
Leptospermum confertum Thompson.	P2
Melaleuca diosmifolia Andrews	P3

APPENDIX 6

Family: Papilionaceae	
Brachysema subcordatum Benth.	P4
Chorizema nervosum T.Moore	P1
Chorizema reticulatum Meisn.in Lehm.	P3
Daviesia obovata Turcz.	P2
Gastrolobium brownii Meisn.in Lehm.	P3
Jacksonia compressa Turcz.	P4
Jacksonia elongata ms	P3
Kennedia beckxiana (F.Muell.)F.Muell.	DRF/V
Family: Pittosporaceae	
Billardiera granulata (Turcz.)E.M.Benn.	P4
Sollya drummondii C.Morren	P2
Family: Proteaceae	
Adenanthos ellipticus A.S.George	DRF/V
Adenanthos labillardierei E.C.Nelson	P4
Banksia brownii Baxter ex R.Br.	DRF/V
Banksia solandri	P4
Banksia verticillata R.Br.	DRF/V
Dryandra concinna R.Br.	P4
Dryandra foliolata R.Br.	P4
Dryandra montana C.A.Gardner ex A.S.George	DRF/ CE
Grevillea coccinea Meisn. subsp. lanata P.Olde & N.Marriott	P3
Grevillea fistulosa A.S.George	P2
Grevillea fuscolutea Keighery	P2
Grevillea infundibularis A.S.George	DRF/V
Hakea hookeriana Meissner	P2
Lambertia fairallii Keighery	DRF/V
Persoonia micranthera	P1
Family: Rhamnaceae	
Cryptandra congesta	P2
Pomaderris grandis F.Muell.	P4
Spyridium montanum Rye	P2
Family: Rutaceae	
Drummondita hassellii (F.Muell.)Paul G.Wilson var. longifolia	DRF/V
Muiriantha hassellii (F.Muell.)C.A.Gardner	P2
Phebalium rude Bartl. subsp. lineare (C.A.Gardner)Paul G.Wilson	P1
Family: Rubiaceae	
Opercularia hirsuta	P2
Family: Sterculiaceae	
Lasiopetalum dielsii E.Pritz.in Diels & E.Pritz.	P2
Thomasia discolor Steud.	P3
Family: Stylidiaceae	
Stylidium articulatum R.Br.	P2
Stylidium corymbosum R.Br. var. proliferum Benth.	P2
Stylidium keigheryi Lowrie & Carlquist	P2
Stylidium plantagineum Sond.	P2
Stylidium verticillatum F.Muell.	P3
Family: Thymelaeaceae	
Pimelea physodes Hook.	P4
Family: Xyridaceae	
Xyris sp. Bluff Knoll	DRF/V

APPENDIX 7

TWO WAY TABLE SHOWING PRESENCE / ABSENCE OF PLANT SPECIES BY COMMUNITY TYPE FOR 7 GROUP CLASSIFICATION

SPECIES CODES INTERPRETED PAGE 117

Appendix 7. Two-way table showing plant species by community type

```
Species                  Community
Code
             3   5   4      7        2    6           1

            222|22|2222|2222222222|22222|2222|2222222222222222222
            001|22|2232|0102001101|11222|2233|0001300301311131213
            129|23|0170|2684331398|56678|4556|4568378190271244930
               |  |   .|.... .....|     |    |
               |  |   1|1111 11111|     |    |
               |  |    |          |     |    |
               |  |    |          |     |    |
               |  |    |          |     |    |
               |  |    |          |     |    |
ACABAR         |  |    |          |     |    |         *
DAMALA         |  |    |          |     |    |         *
SEDGE3         |  |    |          |     |    |         *
NEMRUB         |  |    |          |     |    |   *     *
DRYCON         |  |    |          |     |    |         *  *  *
EUCERE         |  |    |          |     |    |        **     *
NEMCRE         |  |    |          |     |    |        **
DARSQU         |  |    |          |     |    |               *
STYSCAGR       |  |    |          |     |    |               *
ACTGLO         |  |*** |          |     |    | **
PETDIV         |  |*** |          |     |    | ****
ALLHUM         | *|*** |          |     |    |*** *          *
BORALB         | *|*** |          |     |    |***
DRYARMAF       | *|*** |          |     |    |*   *
ANAPRO        *|  |*** |          |     |    |*** **       ***
BEAANI         |  |*** |          |     |    |** **      ***  *
XANPLA         |  |*** |          |    *|    |*****   **  *  *
AGOLINCO    *  |* |****| **       | *   |    |     *      * *
BORSPA         |  |*** |          |     |    |     **     **   *
AGOHYP         |  |    |          |     |    |*** ***  *     *
ISOATT         |  |    |          |     |    |**  *    *     *
GAHSP3         |  |    |          |     |    | ** *          *
HAKAMB         |  |    |          |    *|    |*****          *
LEUATH         |  |    |          |     |    |** **
OPEAPI         |  |    |          |     |    | *  *
BILVAR      *  |  |    |          |     |    |*** ** *** *
XANROTHY       |  |    |        * |    *|    |*** *   ***
DAMLIN       * |  |    |          |     |    |********* * * ** *
MELTHY         |  |    |          |     |    |*** ***         **
STYPILMI       |  |    |          |     |    |*   ** *         *
ALLTRI         |  |*   |        * |     |    |   **
GREFAS         |  |    |        * |     |    |   **    *     *
DAMERI         |  |    |          |     |    |   **
LAMUNI         |  |    |          |     |    |   **
LATTENTE       |  |    |          |     |    |  ***
DARMAC         |  |    |          |     |    |   *
TETSP2         |  |    |          |     |    |   *
AOTGEN         |  |    |          |     |    | ****    **   * **
ISOLAT         |  |    |          |     |    |  ***   ***     *
DRYFOL         |  |    |         *|     |    |*****    **
BANSOL         |  |    |          |     |    |   **   *****  *
NEMRUBAF       |  |    |          |     |    |   **   **
KINAUS         |  |    |          |     |    |*  *     *  **
LEPSCR         |  |    |          |     |    |  **      * *
DAVPRE         |  |    |          |     |    |    *
HIBARG         |  |    |          |     |    |    *
LEUASSAF       |  |    |          |     |    |    *
EUCPRE         |  | *  |          |     |    |    *
PTEVIT         |  |    |  *       |     |    |    *
SPHALA         |  |    |          |     |    |    * *
HAKBAX         |  |    |          |     |    |  * *     *
HOVTRI         |  |    |          |     |    |  * **
            ---+--+----+----------+-----+----+-------------------
ASTBAX         |  |    |          |     |    | **
GREFASLI       |  |    |          |     |    | **
PLACOM         |  |    |        * |     |    | **
SCHLAE         |  |    |          |     |    |  *
STYTEN         |  |    |          |     |    |  *
BANSPHSF       |  |    |          |     |    |***  *
EUCSTA         |  |    |          |     |    |***
LOMSER         |  |    |          |     |    |***
PLAGAL         |  |    |          |     |    |***
ISOFOR         |  |    |  *       |     |    |***
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STYVER        |  |    |           |      |    |****
TETSET        |  |    |           |      |    |*** *
HIBPOL        |  |    |           |      |    |* *
LAMERI        |  |    |           |      |    |* *
NEMCOR      **|  |*   |           |      |    |***
COMCAL        |  |    |           |      |    | *
DAMJUN        |  |    |           |      |    | *
GOOCAE        |  |    |           |      |    | *
HAKCUC        |  |  * |           |      |    | *
          ----+--+----+-----------+------+----+--------------------
ACADIV        |  |    |           |     *|    |        *
LASDIE        |  |    |           |     *|    |
MIRDIL        |  |    |           |     *|    |
OLEPAU        |  |    |           |     *|    |
ACAVER        |  |    |           |    **|    |
THOSOLAF      |  |    |           |    **|    |
CORREC        |  |    |   *       |  ****|    |         *
POAPOR        |  |    |     *   * |***** |    |         *
TETLAE     *  |  |    |           |***** |    |
TRYFLOTR  *   |  |    |           |   ***|    |
ERIDILUN      |  |    |           |      |    |         *  *
NEMLUT        |  |    |           |      |    |         *
THEAZU        |  |    |           |      |    |         *
          ----+--+----+-----------+------+----+--------------------
ACADRUEL   ** |  |**  |         * |      |    |    *   **   *  *
EUCMEG     *  |  |    |           |*     |    |    *  ******  **
LEUUNI        |  |*  *|      *  * |      |    |   *   * *  **
AGOPAR        |  |    |           |      |    |     **********  *
LEUPAR        |  |    |           |    **|    |     * **********
BEADEC        |  |    |           |      |    |  **  *  ***  **** *
SPHDRAAF      |  |    |         * |     *|    |  * ********  ******
HAKVAR       *|  |    |     *** * | *  **|    |* *** ***********
TETCAP        |  |    |       * * |*   **|    |*   ** *    ********
BORCRECR    * |  |    |       *   |      |    | * * *      *******
BANGRA        |  |    |           |      |    |      *****   *
DRYFOR       *|  |    |   *     **|   *  |    |        ***  **   *
DROSTOMO      |  |    |         * |    **|    |         * * *
EUCCAL        |  |    |           |   ***|    |       ****      *
LOMPAU        |  |    |           |    **|    |       *      *  *
ADEFIL        |  |    |           |      |    |   *           *  **
ANDAXI        |  |    |       *   |      |    |               *  **
ANDECH        |  | ** |           |      |    |   **       *  *  **
BANORE        |  |** *|           |      |    |   **       *     **
DROHUE        |  |    |   *       |      |    |* * *         **   *
LOXFLE        | *|  * |           |      |    |  *          ***  **
AGOMARAF      |  |    |           |      |    |*  *            * **
GOMVIL        |  |    |           |      |    |*                 *
ASTFAS        |  |    |      *   *|      |    |             ***** *
LEPSP4        |  |    |      ***  |      |    |             * **  *
CALCRA        |  |    |      *****|      |    |   *    ***********
KUNMON        |  |    |      *****|      |    |   *         ******
VELFOL        |  |    |      *****|      |    |               *** *
XANROTRO   ***|  |    |      ***  |      |    |      *      *** ***
ANDLEHLE      |  |    |         * |      |    |               *
SEDGE2        |  |    |           |      |    |               *
AGOLINLI      |  |    |       *   |      |    |             *
GNASPH        |  |    |       *   |      |    |
DARLEJ        |  |    |           |      |    |            ***
GONBEN        |  |    |           |      |    |            **    *
LINLIN        |  |    |           |      |    |              *
HYPMYR        |  |    |       *   |      |    |            **   *
NEMLEA        |  |    |       *   |      |    |            *****
STYSPIMO      |  |    |       *   |      |    | **          *   *
ALLDEC        |  |    |           |      |    |     *       * **
DAMFAS        |  |    |           |      |    |             * **
BORCREVI      |  |    |           |      |    |             *
ERHELO        |  |    |           |      |    |             *
ACTRHO        |  |    |     ****  |      |    |              *   **
ISOCONAF      |  |    |      ***  |      |    |
LEUGNA        |  |    |      **  *|      |    |                   *
ASPFLA        |  |    |**  ****** |   *  |    |
DANCAE        |  |    |**   ***** |      |    |
HELMAC        |  |    |**    ***  |      |    |
SPHDRU        |  |    |*     *****|   ** |    |
PLACOMp    *  |* |   *|**    **** |      |    |                  **
CALLIN        |  |    |  * * ** * |*     |*   |
HYPGLA        |  |    |*******  **|*     |  * |        *
STYGLA        |  |    |*  **** *  |*     |* **|
OLEAXIAF      |  |    |       ** *|     *|  **|
HYPPHI        |  |    |     **    |     *|    |        ****
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THEMAC				**			** * *
NEMVES				**	*		
SENGLO				*** *			
SOLDRU				***	**		* ** *
BORPUL				* *			*
THEMACAF				* * *			
MONTAM				**			*
OPEVOL				***	**		*
STYSP1				***			*
CRYOVA		*		** * * *	*		* *
PTENANAF				*** * *	*		* *
CALNAN				*			* *
MELBLA				*	**		**
SOLHET			*	*	*		
AIRPRE				* ** **			
BAUJUN				* **			*
EUTVIR				**			
ANDPAR				*			
CALASP				*			
LEPHER				*			
CHACORCO				* *			
UTRMEN				* *			

AGOPARLI							* *
LYSFIM							*
SCHROD							*
STYSP2							*
PIMANG							* *
STYART				* *			*
CYAAVE							*
HOMFIR							*
STYKEI							*

ACAHETVA				*	*		
CENERY				*	*		
CHACOR				*	*		
TRAPIL				*	*		
COTBIP				* *	*		
BRASUB				*	*		
HIBBRA				*	**		
THRSAX				*	**		
ASPAET				** *			
CRACOLCO				** *			
BELTRI				**			
GONDIF				**			
UTRMUL				**			
CHEAUS				***	*	*	
LEVPUS				** *		*	*
CARMOD				* *			
PELAUS				** * *	*		
MILTEN				** *			
EUTOBO	*			*	*		
OPEHIS	**		*	**	* *		
LEPANG	**				**		* *
LEUOBO					**		*
PTEESC	*				***		**
TREDIF				* *	*		*
HIBCUN					*		
STYCRA					*		

BILGRA	*				*		
CIRVUL					*		
EUCDIV					*		
LEPEFF					*		
RANCOL					*		
SENRAM					*		
CLEPUB					**		
HYDHIR					* *		
MYOTET					* *		
SENHIS				*	* *		
STYADN				*	* *		
OXACOR					***		
VERPLE					***		

AGMALI	***						
HAKELL	***						
AGOJUN	**						
RICGLAGL	**						
LEUAUS	***						**
AGOMAR	*			*			

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CALFLA     * |  |     |*         |     |    |
ANTVISVI   * |  |     |          |     |    |
GASBIL     * |  |     |          |     |    |
LEPBRU     * |  |     |          |     |    |
LEUASS     * |  |     |          |     |    |
LEUPRO     * |  |     |          |     |    |
MELDIO     * |  |     |          |     |    |
KUNERI      *|  |     |          |     |    |
LEUOXY      *|  |     |          |     |    |
MELMIC      *|  |     |          |     |    |
LEUVER      *|  |     |          |  *  |    |
PATOCC      *|  |     |          |     |    |     *
          ---+--+-----+----------+-----+----+------------------
AGRGIG       |  |     |*         |     |    |
BANVER       |  |     |*         |     |    |
DROGLA       |  |     |*         |     |    |
ELYBRU       |  |     |*         |     |    |
ERIDILDI     |  |     |*         |     |    |
PSELUT       |  |     |*         |     |    |
BORNIT       |  |     |**        |     |    |
STYCORPR     |  |     |**        |     |    |
CROANGDE     |  |     |* *       |     |    |
MITPAR       |  |     |* *       |     |    |              *
DROMOD    *  |  |     |*         |     |    |              *
          ---+--+-----+----------+-----+----+------------------
CALMAC       |  |    *|          |     |    |
COOGEO       |  |    *|          |     |    |
DILPUN       |  |    *|          |     |    |
LEPSP3       |  |    *|          |     |    |
REGVEL       |  |    *|          |     |    |
XANHED       |  |    *|          |     |    |
          ---+--+-----+----------+-----+----+------------------
ACACON       |  |     |   *      |     |*   |
CRAEXS       |  |     |   *      |     |*   |
GRASP1       |  |     |   *      |     |*   |
AVEBAR       |  |     |   * *    |     |*   |
HYDCAL       |  |     |          |     |*   |
NEMSP1       |  |     |          |     |**  |
SONOLE       |  |     |       *  |     |*   |
ANTGEN       |  |     |   *      |     | *  |
DRUHASLO     |  |     |   *      |     | *  |
CALPRE       |* |     |          |     | *  |
GAHSP2       |  |     |          |     | *  |
HIBMUC       |  |     |          |     | *  |
EXOSPA       |  |     |          |     | *  |   *
BORCON       |  |     |   *      |     |    |
CALTUB       |  |     |   *      |     |    |
CENSTR       |  |     |   *      |     |    |
ISONOD       |  |     |   *      |     |    |
LOGNUD       |  |     |   *      |     |    |
PLERUT       |  |     |   *      |     |    |
SENPIC       |  |     |   *      |     |    |
THEPAU       |  |     |   *      |     |    |
URSANT       |  |     |   *      |     |    |
          ---+--+-----+----------+-----+----+------------------
ACAJIB       |  |     |          |     |  **|
ACALAS       |  |     |          |     |  **|
ALLCAM       |  |     |          |     |  **|
ASTEPA       |  |     |          |     |  **|
HIBPUN       |  |     |          |     |  **|
ERESP1       |  |     |          |     |   *|
PERTRI       |  |     |          |     |   *|
SANACU       |  |     |          |     |   *|
THOFOL       |  |     |          |     |   *|
CALQUA       |  |     |          |     |****|
LABLANBR     |  |     |          |     |****|
MELFUL       |  |     |          |     |****|
OPEHISAF     |  |     |          |     |****|
SPASCI       |  |     |          |     |****|
TRAORN       |  |     |          |     |* **|
LEPDRU    *  |  |     |          |     |** *|
DAMTEN       |  |     |          |     | ***|
LEUCUN       |  |     |          |     | ***|
THYDIC       |  |     |          |     | ***|
DODPIN       |  |     |          |     | ** |
LASCOM       |  |     |          |     | * *|
AIRCUP       |  |     |   * *    |     |  * |      *
LEPERU       |  |     |   *      |     |  * |
MACAUS       |  |     |   *      |     |  * |
CALFAL       |  |     |          |     |  * |
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CARVIR      |  |    |          |     |  * |
DAUGLO      |  |    |          |     |  * |
LEPSP6      |  |    |          |     |  * |
PTEROE      |  |    |          |     |  * |
STISP1      |  |    |          |     |  * |
         ---+--+----+----------+-----+----+------------------
ACABROBR    |  |    |          |     |    |     **
DRYNIV      |  |    |          |     |    |     **
EUTEPA      |  |    |          |     |    |     **
HIBSUB      |  |    |          |     |    |     **
JOHLUP      |  |    |          |     |    |     **
PIMHIS      |  |    |          |     |    |     **
SPHVIM      | *|  * |          |     |    |     **
XANPRE      |  |    |          |*    |    |     **         *
AMPAMP      |  |    |       *  |     |    |     * *       *
STYSCA      |  |    |          |     |    |    ** *  *    *
EUCMAR      |  |    |          |     |    |     ***  *     *
LOMNIG      |  |    |          |     |    |*    ***  *     *
HIBPIL      |  |    |          |     |    |     * *
MESGRA      |  |    |          |     |    |     ***
ANDCAE      |  |    |          |     |    |*    *
CONSETSE    |  |    |          |     |    |*    *
LOXFAS      |  |    |          |     |    |*    *
RINSCH      |  |    |          |     |    |*    *
ASTPAL      |  |    |          |     |    |**   *
DROMIC      |  |    |          |     |    |     *
GOMCON      |  |    |          |     |    |     *
LEUGLA      |  |    |          |     |    |     *
SCHSUBf1    |  |    |          |     |    |     *
SPHPAR      |  |    |          |     |    |     *
STYSCH      |  |    |          |     |    |     *
THYMUL      |  |    |          |     |    |     *
XANPUS      |  |    |  *       |     |    |     *
         ---+--+----+----------+-----+----+------------------
ADEOBO      |  |    |          |     |    |     **
PATUMB      |  |    |          |     |    |     **
PERLON      |  |    |          |     |    |     **
BORGRA   *  |  |    |          |     |    |     **
DROERY      |  |    |*         |     |    |     **
HIBAMP      |  |    |          |*    |    |     **
BOSWEB      |  |    |          |     |    |      *
CYRSPX      |  |    |          |     |    |      *
DAMHED      |  |    |          |     |    |      *
PRASP1      |  |    |          |     |    |      *
PULRET      |  |    |          |     |    |      *
SPHSQU      |  |   *|          |     |    |      *
TRESTE
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            |  |    |          |  *  |    |       *
         ---+--+----+----------+-----+----+-------------------
ANDSETAF    |  |    |          |     |    |     *
BURCON      |  |    |          |     |    |     *
CONCAE      |  |    |          |     |    |     *
DAVINC      |  |    |          |     |    |     *
DAVINF      |  |    |          |     |    |     *
GAHSP1      |  |    |          |     |    |     *
HAKCER      |  |    |          |     |    |     *
ISOSPH      |  |    |          |     |    |     *
LEPGRA      |  |    |          |     |    |     *
LOGSER      |  |    |          |     |    |     *
PETDIVF     |  |    |          |     |    |     *
         ---+--+----+----------+-----+----+-------------------
ACAMYR    **|**|    |          |     |    |   *
EUCDOR      |**|    |          |     |    |  **      *
LEPGLA   ***|**|    | **       | *   |    |      *
MONOLI      |**|    |     *  * |     |    |                 *
CASGLAGL    |**|**  |          |     |** *|   *  *  *     ***
BOSRUF      |* |    |          |     |    |
DROSP1      |* |    |          |     |    |
HAKVER      |* |    |          |     |    |
KENEXI      |* |    |          |     |    |
DAMPAR      |**|    |          |     |    |
DRYLONAR    |**|    |          |     |    |
LEUAPI      |**|    |          |     |    |
LOXPUB      |**|    |          |     |    |
MELPENSU    |**|    |          |     |    |
PETFAS      |**|    |          |     |    |
PIMBRE      |**|    |          |     |    |
SCABRO      |**|    |          |     |    |
SCHSP1      |**|    |          |     |    |
TETSP3      |**|    |          |     |    |
         ---+--+----+----------+-----+----+-------------------
ACADRUPO    |  |    |          |*    |    |
CORDIL      |  |    |          |*    |    |
CYRHUE      |  |    |          |*    |    |
DODCER      |  |    |          |*    |    |
HIBCOM      |  |    |          |*    |    |
HIBPER      |  |    |          |*    |    |
LEUCAP      |  |    |          |*    |    |
LUZMER      |  |    |          |*    |    |
SCAAUR      |  |    |          |*    |    |
THYPAT      |  |    |          |*    |    |
CERGLO      |  |    |   *      |*    |    |
         ---+--+----+----------+-----+----+-------------------
BANGARBR    |  |    |          |     |    |*
BEACYR      |  |    |          |     |    |*
HIBLIN      |  |    |          |     |    |*
LEPSP5      |  |    |          |     |    |*
LEULAS      |  |    |          |     |    |*
LEUMOL      |  |    |          |     |    |*
LEUTEN      |  |    |          |     |    |*
MUIHAS      |  |    |          |     |    |*
PERSAU      |  |    |          |     |    |*
PULTSP      |  |    |          |     |    |*
TETOCT      |  |    |          |     |    |*
         ---+--+----+----------+-----+----+-------------------
ACACED      |  |**  |          |     |    |
BANLEM      |  |**  |          |     |    |
GRECOCLA    |  |**  |          |     |    |
LEPSP2      |  |**  |          |     |    |
PIMSPE      |  |**  |          |     |    |
RINOXY      |  |**  |          |     |    |
PLAJUN      |  |** *|          |     |    |
ADELAB      |  |*** |          |     |    |
DAMLOR      |  |*** |          |     |    |
DAVEMA      |  |*** |          |     |    |
DRYQUE      |  |*** |          |     |    |
EUCACI      |  |*** |          |     |    |
GREFIS      |  |*** |          |     |    |
HAKHOO      |  |*** |          |     |    |
JACCOM      |  |*** |          |     |    |
LEPAXI      |  |*** |          |     |    |
LEPSP1      |  |*** |          |     |    |
MELSTR      |  |*** |          |     |    |
OLAPHY      |  |* * |          |     |    |
MELCIT      |  |*   |          |     |    |
TETSP1      |  |*   |          |     |    |
OPEHIR      |* |*   |          |     |    |
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ACASUB	*	*				
CONTER		*				
DAVOBO		*				
LEUGIB		*				
PLAFIL		*				
GOOSCA		*			*	
AGOSPA	*	**				*
DRYPLU		**				*
SCHCAE		**				**
SPHDRA		**				*
BANBAU		**				
BANNUTNU		**				
DAVSTR		**				
LEUFLABR		**				
LOMHAS		**				
PETPHY		**				
GOMKNI	*	**				
LYSCIL	*	*				
LEPVIS		**	*		**	*
MESTET		*				*
ADECUN		*				
AGOOBT		*				
ASTTEC		*				
BANBAX		*				
CALGRA		*				
CASGLA		*				
GREINF		*				
HAKVIC		*				
HIBVER		*				
JACLEH		*				
MESSTY		*				
PERSTR		*				
SPHSP1		*				
STITEN		*				
STYALB		*				
STYLUTCL		*				
ADIAET			*			
AIRCAR			*			
ANAARV			*			
ARCCAL			*			
BRIMAX			*			
BRIMIN			*			
CALLAT			*			
CALaGRA			*			
CARPYC			*			
EROCYGCY			*			
HYACOT			*			
HYPOCCOC			*			
MICMEDME			*			
ROMROS			*			
STEMED			*			
TRAANI			*			
VILCAL			*			
ADEORE	*					
AGOHY1	*					
ASTSP1	*					
CYPHAL	*					
DAVTER	*					
DRYCUN	*					
EUCTET	*					
GASPYC	*					
GLIAUR	*					
GRECON	*					
HAKPAN	*					
HYBFLO	*					
ISOPOL	*					
LYSOBO	*					
MESSTYST	*					
MICSUB	*					
MONGRA	*					
PHERUDLI	*					
PLAEFF	*					
SCHSUB	*					
SHRSPX	*					
ACACRA			*			
ANDSPR			*			

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BORLON     |  |   |  *      |     |    |
BURMUL     |  |   |  *      |     |    |
CALCYA     |  |   |  *      |     |    |
CRYCONGE   |  |   |  *      |     |    |
CYASER     |  |   |  *      |     |    |
DRYARM     |  |   |  *      |     |    |
ERISCA     |  |   |  *      |     |    |
GREFUS     |  |   |  *      |     |    |
GRETRI     |  |   |  *      |     |    |
HEMPOD     |  |   |  *      |     |    |
LASPETAF   |  |   |  *      |     |    |
LAXBRA     |  |   |  *      |     |    |
LAXSP1     |  |   |  *      |     |    |
LEPMEN     |  |   |  *      |     |    |
LEUREF     |  |   |  *      |     |    |
MONBRA     |  |   |  *      |     |    |
NEUALO     |  |   |  *      |     |    |
PIMFLO     |  |   |  *      |     |    |
STYAMO     |  |   |  *      |     |    |
THEFLE     |  |   |  *      |     |    |
THESPI     |  |   |  *      |     |    |
VERPLU     |  |   |  *      |     |    |
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APPENDIX 7 SPECIES CODES

ACABAR	Acacia barbinervis Benth.
ACABROBR	Acacia browniana H.L.Wendl. var. browniana
ACACED	Acacia cedroides Benth.
ACACON	Acacia congesta Benth.
ACACRA	Acacia crassiuscula J.C.Wendl.
ACADIV	Acacia divergens Benth.
ACADRUCA	Acacia drummondii Lindl. subsp. candolleana (Meisn.)Maslin
ACADRUEL	Acacia drummondii Lindl. subsp. elegans Maslin
ACADRUPO	Acacia drummondii ss elegans Porongorup variant RJ Cummings 938
ACAHETVA	Acacia heteroclita Meisn.in Lehm. subsp. valida R.S.Cowan & Maslin MS
ACAJIB	Acacia jibberdingensis Maiden & Blakely
ACALAS	Acacia lasiocalyx C.R.P.Andrews
ACALUT	Acacia luteola Maslin
ACAMYR	Acacia myrtifolia (Sm.)Willd.
ACASUB	Acacia subcaerulea Lindl.
ACAVER	Acacia veronica Maslin
ACTGLO	Actinotus glomeratus Benth.
ACTRHO	Actinotus rhomboideus (Turcz.)Benth.
ADECUN	Adenanthos cuneatus Labill.
ADEELL	Adenanthos ellipticus A.S.George
ADEFIL	Adenanthos filifolius Benth.
ADELAB	Adenanthos labillardierei E.C.Nelson
ADEOBO	Adenanthos obovatus Labill.
ADEORE	Adenanthos oreophilus E.C.Nelson
ADIAET	Adiantum aethiopicum L.
AGMALI	Agonis marginata x linearifolia (SB 126a)
AGOFLOAF	Agonis aff floribunda (SB 490)
AGOHYP	Agonis hypericifolia Schauer in Lehm.
AGOJUN	Agonis juniperina Schauer in Lehm.
AGOLINCO	Agonis linearifolia var conspicua
AGOLINLI	Agonis linearifolia var linearifolia
AGOMAR	Agonis marginata (Labill.)Schauer in Lehm.
AGOMARAF	Agonis aff marginata (SB 150)
AGOOBT	Agonis obtusissima F.Muell.
AGOPAR	Agonis parviceps Schauer in Lehm.
AGOPARLI	Agonis parviceps x linearifolia (SB 326)
AGOSPA	Agonis spathulata Schauer in Lehm.
AGRGIG	Agrostis gigantea Roth
AIRCAR	Aira caryophyllea L.
AIRCUP	Aira cupaniana Guss.
AIRPRA	Aira praecox L.
ALLCAM	Allocasuarina campestris (Diels)L.A.S.Johnson
ALLDEC	Allocasuarina decussata (Benth.)L.A.S.Johnson
ALLHUM	Allocasuarina humilis (Otto & F.Dietr.)L.A.S.Johnson
ALLTRI	Allocasuarina trichodon (Miq.)L.A.S.Johnson
AMPAMP	Amphipogon amphipogonoides (Steud.)Vickery
AMPLAG	Amphipogon laguroides R.Br.
ANAARV	Anagallis arvensis L.
ANAPRO	Anarthria prolifera R.Br.
ANDAXI	Andersonia axilliflora (Stschegl.)Druce
ANDCAE	Andersonia caerulea R.Br.
ANDECH	Andersonia echinocephala (Stschegl.)Druce
ANDLEHLE	Andersonia lehmanniana Sond. subsp. lehmanniana
ANDSETAF	Andersonia aff setifolia (SB 129)
ANDSP1	Andersonia sp (SB 652)
ANDSPR	Andersonia sprengelioides R.Br.
ANTGEN	Anthocercis genistoides Miers
ANTVISVI	Anthocercis viscosa R.Br. subsp. viscosa
AOTGEN	Aotus genistoides Turcz.
ARCCAL	Arctotheca calendula (L.)Levyns
ASPAET	Asplenium aethiopicum (Burm.f.)Bech.
ASPFLA	Asplenium flabellifolium Cav.
ASTBAX	Astroloma baxteri DC.
ASTEPA	Astroloma epacridis (DC.)Druce
ASTFAS	Astartea fascicularis (Labill.)DC.
ASTPAL	Astroloma pallidum R.Br.
ASTTEC	Astroloma tectum R.Br.
AVEBAR	Avena barbata Link in Schrad.
AVESAT	Avena sativa L.
BANBAU	Banksia baueri R.Br.
BANBAX	Banksia baxteri R.Br.
BANGARBR	Banksia gardneri A.S.George var. brevidentata A.S.George
BANGRA	Banksia grandis Willd.
BANLEM	Banksia lemanniana Meisn.in A.DC.
BANNUTNU	Banksia nutans R.Br. var. nutans
BANORE	Banksia oreophila A.S.George
BANSOL	Banksia solandri R.Br.
BANSPHSP	Banksia sphaerocarpa R.Br. var. sphaerocarpa
BANVER	Banksia verticillata R.Br.
BEAANI	Beaufortia anisandra Schauer
BEABRA	Beaufortia bracteosa Diels in Diels & E.Pritz.
BEACYR	Beaufortia cyrtodonta (Turcz.)Benth.
BEADEC	Beaufortia decussata R.Br.in W.T.Aiton
BELTRI	Bellardia trixago (L.)All.
BILGRA	Billardiera granulata (Turcz.)E.M.Benn.
BILVAR	Billardiera variifolia DC.
BORALB	Boronia albiflora R.Br.ex Benth.
BORCON	Borya constricta Churchill
BORCRECR	Boronia crenulata Smith var. crenulata
BORCREVI	Boronia crenulata var viminea
BORGRA	Boronia gracilipes F.Muell.
BORLON	Borya longiscapa Churchill
BORNIT	Borya nitida Labill.
BORPUL	Boronia pulchella Turcz.
BORSPA	Boronia spathulata Lindl.
BORSPH	Borya sphaerocephala R.Br.
BOSRUF	Bossiaea rufa R.Br.in W.T.Aiton
BOSWEB	Bossiaea webbii F.Muell.
BRASUB	Brachysema subcordatum Benth.
BRIMAX	Briza maxima L.
BRIMIN	Briza minor L.
BROMAD	Bromus madritensis L.
BURCON	Burchardia congesta Lindl.
BURMUL	Burchardia multiflora Lindl.
CALASP	Calytrix asperula (Schauer)Benth.
CALBRE	Calandrinia brevipedata F.Muell.
CALCRA	Calothamnus crassus (Benth.)Hawkeswood
CALCRAAF	Calothamnus aff crassus
CALCYA	Calectasia cyanea R.Br.
CALFAL	Caladenia falcata (Nicholls)M.A.Clem.& Hopper
CALFLA	Caladenia flava R.Br.
CALFLASY	Caladenia flava subsp sylvestis
CALGRA	Calandrinia granulifera Benth.
CALGRA	Calectasia grandiflora L.Preiss ex Endl.
CALLIN	Calandrinia liniflora Fenzl in Endl.
CALMAC	Calothamnus macrocarpus Hawkeswood
CALMAR	Caladenia marginata Lindl.
CALNAN	Caladenia nana Endl.in Lehm.

CALPRE	Callitris preissii Miq.in Lehm.
CALQUA	Calothamnus quadrifidus R.Br.in Sims
CALTUB	Calothamnus tuberosus Hawkeswood
CALUNI	Calandrinia uniflora F.Muell.
CARDSP	Cardamine sp (SB 512)
CARMOD	Carpobrotus modestus S.T.Blake
CARPYC	Carduus pycnocephalus L.
CARVIR	Carpobrotus virescens (Haw.)Schwantes
CASGLAGL	Cassytha glabella R.Br. forma glabella
CENERY	Centaurium erythraea Rafn
CENSTR	Centrolepis strigosa (R.Br.)Roem.& Schult.
CERGLO	Cerastium glomeratum Thuill.
CHACORCO	Chamaescilla corymbosa (R.Br.)Benth. var. corymbosa
CHEAUS	Cheilanthes austrotenuifolia H.M.Quirk & T.C.Chambers
CIRVUL	Cirsium vulgare (Savi)Ten.
CLEPUB	Clematis pubescens Huegel ex Endl.
COMCAL	Comesperma calymega Labill.
CONCAE	Conospermum caeruleum R.Br.
CONSETSE	Conostylis setigera R.Br. subsp. setigera
CONTER	Conospermum teretifolium R.Br.
CORDIL	Corybas dilatatus (Rupp & Nicholls)Rupp & Nicholls ex Rupp
CORREC	Corybas recurvus D.Jones
COTBIP	Cotula bipinnata Thunb.
CRACOLCO	Crassula colorata (Nees)Ostenf. var. colorata
CRAEXS	Crassula exserta (Reader)Ostenf.
CROANGDE	Crowea angustifolia Smith var. dentata (Benth.)Paul G.Wilson
CRYCONGE	Cryptandra congesta
CRYOVA	Cryptostylis ovata R.Br.
CYASER	Cyanicula caerulea ms
CYASP1	Cyathochaeta sp Mt Ragged (SB 659)
CYPHAL	Cypselocarpus haloragoides (F.Muell.ex Benth.)F.Muell.
CYRHUE	Cyrtostylis huegelii Endl.in Lehm.
DAMERI	Dampiera eriocephala de Vriese
DAMFAS	Dampiera fasciculata R.Br.
DAMHED	Dampiera hederacea R.Br.
DAMJUN	Dampiera juncea Benth.
DAMLIN	Dampiera linearis R.Br.
DAMLOR	Dampiera loranthifolia F.Muell.ex Benth.
DAMPAR	Dampiera parvifolia R.Br.
DAMTEN	Dampiera tenuicaulis E.Pritz.in Diels & E.Pritz.
DANCAE	Danthonia caespitosa Gaudich.
DARCOL	Darwinia collina C.A.Gardner
DARLEJ	Darwinia lejostyla (Turcz.)Domin
DARMAC	Darwinia macrostegia (Turcz.)Benth.
DARSQU	Darwinia squarrosa (Turcz.)Domin
DAUGLO	Daucus glochidiatus (Labill.)Fisch.
DAVEMA	Daviesia emarginata Crisp
DAVGRO	Daviesia grossa
DAVINC	Daviesia incrassata Smith
DAVINF	Daviesia inflata Crisp
DAVOBO	Daviesia obovata Turcz.
DAVPRE	Daviesia preissii Meisn.in Lehm.
DAVSTR	Daviesia striata Turcz.
DEYINA	Deyeuxia inaequalis Vickery
DICREP	Dichondra repens J.R.Forst.& G.Forst.
DILPUN	Dillwynia pungens (J.Mackay ex Sweet)Benth.
DODCER	Dodonaea ceratocarpa Endl.
DODPIN	Dodonaea pinifolia Miq.
DROERY	Drosera erythrogyne N.G.Marchant & Lowrie
DROGLA	Drosera glanduligera Lehm.
DROHUE	Drosera huegelii Endl.
DROHUEDW	Drosera huegelii dwarf form (SB 633)
DROLASAF	Drosera aff lasiantha (SB 682)
DROMAC	Drosera macrantha Endl.
DROMIC	Drosera microphylla Endl.
DROMOD	Drosera modesta Diels
DROPLA	Drosera platystigma Lehm.
DROSTOMO	Drosera stolonifera Endl. subsp. monticola : ILowrie & N.G.Marchant
DRUHASLO	Drummondita hassellii (F.Muell.)Paul G.Wilson var. longifolia Paul G.Wilson
DRYARM	Dryandra armata R.Br.
DRYARMAF	Dryandra armata var nova ms
DRYCON	Dryandra concinna R.Br.
DRYCUN	Dryandra cuneata R.Br.
DRYFOL	Dryandra foliolata R.Br.
DRYFOR	Dryandra formosa R.Br.
DRYLONAR	Dryandra longifolia ss archeos ms
DRYNIV	Dryandra nivea (Labill.)R.Br.
DRYPLU	Dryandra plumosa R.Br.
DRYQUE	Dryandra quercifolia Meisn.in A.DC.
ELYEMA	Elythranthera emarginata (Lindl.)A.S.George
EREPEC	Eremosyne pectinata Endl.
ERHELO	Eriochilus helonomos
ERIDILDI	Eriochilus dilatatus subsp dilatatus ms
ERIDILUN	Eriochilus dilatatus ss undulatus ms
ERISCA	Eriochilus scaber Lindl.
EROCYGCY	Erodium cygnorum Nees subsp. cygnorum
EUCACI	Eucalyptus acies Brooker
EUCCAL	Eucalyptus calophylla Lindl.
EUCDIV	Eucalyptus diversicolor F.Muell.
EUCDOR	Eucalyptus doratoxylon F.Muell.
EUCERE	Eucalyptus erectifolia Brooker & Hopper
EUCMAR	Eucalyptus marginata Donn ex Sm.
EUCMEG	Eucalyptus megacarpa F.Muell.
EUCPRE	Eucalyptus preissiana Schauer in Lehm.
EUCSTA	Eucalyptus staeri (Maiden)Kessell & C.A.Gardner
EUCTET	Eucalyptus tetraptera Turcz.
EUTEPA	Eutaxia epacridoides Meisn.in Lehm.
EUTOBO	Eutaxia obovata (Labill.)C.A.Gardner
EUTVIR	Eutaxia virgata Benth.
EXOSPA	Exocarpos sparteus R.Br.
GAHDEC	Gahnia decomposita (R.Br.)Benth.
GAHSP1	Gahnia sp1Mt Lindesay (xfl)
GASBIL	Gastrolobium bilobum R.Br.
GASBRO	Gastrolobium brownii Meisn.in Lehm.
GASPARAF	Gastrolobium acrocaroli ms (SB 475)
GASPYC	Gastrolobium pycnostachyum Benth.
GLIAUR	Glischrocaryon aureum (Lindl.)Orchard
GNASPH	Gnaphalium sphaericum Willd.
GOMCON	Gompholobium confertum (DC.)Crisp in C.H.Stirt.
GOMKNI	Gompholobium knightianum Lindl.
GOMVIL	Gompholobium villosum (Meisn.)Crisp in C.H.Stirt.
GONBEN	Gonocarpus benthamii Orchard
GONDIF	Gonocarpus diffusus (Diels)Orchard
GONNOD	Gonocarpus nodulosus Nees in Lehm
GONOSP	Gonocarpus nodulosus Nees in Lehm
GONSP1	Gonocarpus sp (SB 642)
GOOCAE	Goodenia caerulea R.Br.
GOOSCA	Goodenia scapigera R.Br.
GRECOCLA	Grevillea coccinea Meisn. subsp. lanata P.Olde & N.Marriott
GRECON	Grevillea concinna R.Br.
GREFAS	Grevillea fasciculata R.Br.
GREFASLI	Grevillea fasiculata var linearis
GREFUS	Grevillea fuscolutea Keighery

GREINF	Grevillea infundibularis A.S.George
GRETRI	Grevillea trifida (R.Br.)Meisn.in Lehm.
HAKAMB	Hakea ambigua Meisn.in Lehm.
HAKBAX	Hakea baxteri R.Br.
HAKCER	Hakea ceratophylla (Sm.)R.Br.
HAKCRA	Hakea crassifolia Meisn.in Lehm.
HAKCUC	Hakea cucullata R.Br.
HAKELL	Hakea elliptica (Sm.)R.Br.
HAKHOO	Hakea hookeriana Meissner
HAKPAN	Hakea pandanicarpa R.Br.
HAKVAR	Hakea varia R.Br.
HAKVER	Hakea verrucosa F.Muell.
HAKVIC	Hakea victoria J.Drumm.
HELMAC	Helichrysum macranthum Benth.
HEMPOD	Hemigenia podalyrina F.Muell.
HEMWES	Hemigenia westringioides Benth.
HIBAMP	Hibbertia amplexicaulis Steud.
HIBARG	Hibbertia argentea Steud.
HIBAURAF	Hibbertia aff aurea (SB 446)
HIBCOM	Hibbertia commutata Steud.
HIBCUN	Hibbertia cunninghamii W.T.Aiton ex Hook.
HIBMUC	Hibbertia mucronata (Turcz.)Benth.
HIBNUT	Hibbertia nutans Benth.
HIBPER	Hibbertia perfoliata Endl.
HIBPIL	Hibbertia pilosa Steud.
HIBPOL	Hibbertia polyclada Diels
HIBPUN	Hibbertia pungens Benth.
HIBSPPO	Hibbertia sp Porongurups ms
HIBSUB	Hibbertia subvaginata (Steud.)F.Muell.
HIBVER	Hibbertia verrucosa (Turcz.)Benth.
HOLLAN	Holcus lanatus L.
HOMFIR	Homalospermum firmum Schauer
HOVTRI	Hovea trisperma Benth.
HYACOT	Hyalosperma cotula (Benth.)Paul G.Wilson
HYBFLO	Hybanthus floribundus (Lindl.)F.Muell.
HYDCAL	Hydrocotyle callicarpa Bunge
HYDCAL	Hydrocotyle callicarpa Bunge
HYDHIR	Hydrocotyle hirta R.Br.ex A.Rich.
HYPGLA	Hypochaeris glabra L.
HYPMYR	Hypocalymma myrtifolium Turcz.
HYPOCCOC	Hypoxis occidentalis Benth. var. occidentalis
HYPPHI	Hypocalymma phillipsii Harv.
ISOATT	Isopogon attenuatus R.Br.
ISOCON	Isolepis congrua Nees in Lehm.
ISOCONAF	Isolepis aff congrua (SB 535)
ISOFOR	Isopogon formosus R.Br.
ISOLAT	Isopogon latifolius R.Br.
ISONOD	Isolepis nodosa (Rottb.)R.Br.
ISOPOL	Isopogon polycephalus R.Br.
ISOSPH	Isopogon sphaerocephalus Lindl.
JACCOM	Jacksonia compressa Turcz.
JACELO	Jacksonia elongata ms
JOHLUP	Johnsonia lupulina R.Br.
JUNBUF	Juncus bufonius L.
JUNCAP	Juncus capitatus Weigel
KENEXI	Kennedia eximia Lindl.
KINAUS	Kingia australis R.Br
KUNERI	Kunzea ericifolia (Sm.)Heynh.
KUNMON	Kunzea montana (Diels)Domin
LABLANBR	Labichea lanceolata Benth. subsp brevifolia (Meissner) J.Ross
LAGHUE	Lagenifera huegelii Benth.
LAMERI	Lambertia ericifolia R.Br.
LAMUNI	Lambertia uniflora R.Br.
LASCOM	Lasiopetalum compactum Paust
LASDIE	Lasiopetalum dielsii E.Pritz.in Diels & E.Pritz.
LASPETAF	Lasiopetalum aff cordifolium
LATTENTE	Latrobea tenella (Meisn.)Benth var tenella
LAXMIN	Laxmannia minor R.Br
LAXSP1	Laxmania sp Mt Lindesay SB.sn
LEPANG	Lepidosperma angustatum R.Br.
LEPAXI	Leptomeria axillaris R.Br.
LEPBRU	Lepidosperma brunonianum Nees in Lehm.
LEPBRUAF	Lepidosperma viscidum R.Br.
LEPDRU	Lepidosperma drummondii Benth.
LEPEFF	Lepidosperma effusum Benth.
LEPERU	Leptospermum erubescens Schauer in Lehm.
LEPGLA	Lepidosperma gladiatum Labill.
LEPHER	Lepyrodia hermaphrodita R.Br.
LEPMEN	Leptoceras menziesii
LEPPUBAF	Lepidosperma aff pubisquameum (SB 658)
LEPRESPL	Lepidosperma resinosum var pleianthemum
LEPSCR	Leptomeria scrobiculata R.Br.
LEPSP2	Lepidosperma aff tenue Thumb Pk (SB 325.1)
LEPSP3	Lepidosperma sp nov. Big Heads A.George 11294
LEPSP4	Lepidosperma sp Stirling Ra (SB 42)
LEPSPG	Lepidosperma sp G (Whaite 4172)
LEPSQU	Lepidosperma squamatum Labill.
LEPTEN	Lepidosperma tenue Benth.
LEPTENAF	Lepidopsperma aff tenue Mt Ragged (SB 651)
LEPUST	Lepidosperma ustulatum Steud.
LEPVIS	Lepidosperma viscidum R.Br.
LEPVISAF	Lepidosperma sp aff viscidum Thumb Pk (SB 681)
LEUAPI	Leucopogon apiculatus R.Br.
LEUASS	Leucopogon assimilis R.Br.
LEUASSAF	Leucopogon aff assimilus (SB 385)
LEUATH	Leucopogon atherolepis Stschegl.
LEUAUS	Leucopogon australis R.Br.
LEUCOR	Leucopogon corynocarpus Sond.
LEUCUN	Leucopogon cuneifolius Stschegl.
LEUFLABR	Leucopogon flavescens var brevifolius
LEUGIB	Leucopogon gibbosus Stschegl.
LEUGLA	Leucopogon glabellus R.Br.
LEUGNA	Leucopogon gnaphalioides Stschegl.
LEULAS	Leucopogon lasiostachyus Stschegl.
LEUMOL	Leucopogon mollis E.Pritz.in Diels & E.Pritz.
LEUOBO	Leucopogon obovatus (Labill.)R.Br.
LEUOXY	Leucopogon oxycedrus Sond.
LEUPAR	Leucopogon parviflorus (Andrews)Lindl.
LEUPRO	Leucopogon propinquus R.Br.
LEUREF	Leucopogon reflexus R.Br.
LEUUNI	Leucopogon unilateralis Stschegl.
LEUVER	Leucopogon verticillatus R.Br.
LEVPUS	Levenhookia pusilla R.Br.
LINLIN	Lindsaea linearis Sw.in Schrad.
LOGNUD	Logania nuda F.Muell.
LOGSER	Logania serpyllifolia R.Br.
LOMHAS	Lomandra hastilis (R.Br.)Ewart
LOMINT	Lomandra integra T.D.Macfarl.
LOMNIG	Lomandra nigricans T.D.Macfarl.
LOMPAU	Lomandra pauciflora (R.Br.)Ewart
LOMPRE	Lomandra preissii (Endl.)Ewart
LOMSER	Lomandra sericea (Endl.)Ewart
LOXFAS	Loxocarya fasciculata (R.Br.)Benth.
LOXFLE	Loxocarya flexuosa (R.Br.)Benth.
LOXPUB	Loxocarya pubescens (R.Br.)Benth.
LUZMER	Luzula meridionalis Nordensk.
LYSCIL	Lysinema ciliatum R.Br.
LYSFIM	Lysinema fimbriatum F.Muell.
LYSOBO	Lysinema obovatum
MELBLA	Melaleuca blaeriifolia Turcz.
MELCIT	Melaleuca citrina Turcz.
MELDIO	Melaleuca diosmifolia Andrews

MELFUL	Melaleuca fulgens R.Br.
MELMIC	Melaleuca microphylla Sm.in Rees
MELPENSU	Melaleuca pentagona Labill. var. subulifolia Schauer
MELSTR	Melaleuca striata Labill.
MELTHY	Melaleuca thymoides Labill.
MESGRA	Mesomelaena graciliceps (C.B.Clarke)K.L.Wilson
MESSTYST	Mesomelaena stygia (R.Br.)Nees subsp. stygia
MESTET	Mesomelaena tetragona (R.Br.)Benth.
MICMEDME	Microtis media ss media
MICSTI	Microlaena stipoides (Labill.)R.Br.
MICSUB	Microcorys subcanescens Benth.
MILTEN	Millotia tenuifolia Cass.
MIRDIL	Mirbelia dilatata R.Br.
MONBRA	Monadenia bracteata (Sw.)T.Durand & Schinz
MONGRA	Monotaxis grandiflora Endl.
MONOLI	Monotoca oligarrhenoides F.Muell.
MONTAM	Monotoca tamariscina F.Muell.
MUEADP	Muehlenbeckia adpressa (Labill.)Meisn.
MUIHAS	Muiriantha hassellii (F.Muell.)C.A.Gardner
MYOTET	Myoporum tetrandrum (Labill.)Domin
NEMCOR	Nemcia coriacea (Sm.)Domin
NEMELL	Nemcia sp Ellen Pk (SB 245)
NEMLEA	Nemcia leakeana (J.Drumm.)Crisp in C.H.Stirt.
NEMMAG	Nemcia sp Magog (SB 55)
NEMPUL	Nemcia pulchella (Turcz.)Crisp in C.H.Stirt.
NEMRUB	Nemcia rubra Crisp in C.H.Stirt.
NEMRUBAF	Nemcia aff rubra (SB 611)
NEMVES	Nemcia vestita Domin
NEUALO	Neurachne alopecuroidea R.Br.
OLAPHY	Olax phyllanthi (Labill.)R.Br.
OLEAXIAF	Olearia aff axillaris Stirling Ra (SB 290)
OLEAXIER	Olearia axillaris var erimicola (SB 394)
OLEPAU	Olearia paucidentata (Steetz)F.Muell.ex Benth.
OPEAPI	Opercularia apiciflora Labill.
OPEHIR	Opercularia hirsuta F.Muell.ex Benth.
OPEHIS	Opercularia hispidula Endl.
OPEHISAF	Opercularia aff hispidula (SB 493)
OPEVOL	Opercularia volubilis R.Br.ex Benth.
OXACOR	Oxalis corniculata L.
PATOCC	Patersonia occidentalis R.Br.
PATUMB	Patersonia umbrosa Endl.
PELAUS	Pelargonium australe Willd.
PERLON	Persoonia longifolia R.Br.
PERSAU	Persoonia saundersiana Kippist ex Meisn.
PERSTR	Persoonia striata R.Br.
PERTRI	Persoonia trinervis Meissner
PETDIV	Petrophile diversifolia R.Br.
PETDIV	Petrophile diversifolia R.Br.
PETFAS	Petrophile fastigiata R.Br.
PETPHY	Petrophile phylicoides R.Br.
PHERUDLI	Phebalium rude Bartl. subsp. lineare (C.A.Gardner)Paul G.Wilson
PHYPAR	Phyllangium paradoxum
PIMANG	Pimelea angustifolia R.Br.
PIMBRE	Pimelea brevifolia R.Br.
PIMFLO	Pimelea floribunda Meissner
PIMHIS	Pimelea hispida R.Br.
PIMIMB	Pimelea imbricata R.Br.
PIMLON	Pimelea longiflora R.Br.
PIMSPE	Pimelea spectabilis Lindl.
PLACOM	Platysace commutata (Turcz.)C.Norman
PLACOM	Platysace compressa (Labill.)C.Norman
PLAEFF	Platysace effusa (Turcz.)C.Norman
PLAFIL	Platysace filiformis (Bunge)C.Norman
PLAGAL	Platytheca galioides Steetz
PLAJUN	Platytheca juniperina Domin
PLANSP	Plantago sp (SB 647)
PLASPS	Platyscae sp Stirling (JM Fox 88/262)
PLERUT	Pleurosorus rutifolius (R.Br.)Fee
POADRU	Poa drummondiana Nees
POAHOM	Poa homomalla Nees in Lehm.
POAPOR	Poa porphyroclados Nees in Lehm.
POMMYR	Pomaderris myrtilloides Fenzl in Endl.
PRASP1	Prasophyllum sp1xfl
PSELUT	Pseudognaphalium luteo-album (L.)Hilliard & B.L.Burtt
PTEESC	Pteridium esculentum (G.Forst.)Cockayne
PTENANAF	Pterostylis aff nana (SB 142)
PTEROE	Pterostylis roensis M.A.Clem.& D.L.Jones
PTEVIT	Pterostylis vittata Lindl.
PULERI	Pultenaea ericifolia Benth.in Lindl.
PULRET	Pultenaea reticulata (Sm.)Benth.
RANCOL	Ranunculus colonorum Endl.
REGVEL	Regelia velutina (Turcz.)C.A.Gardner
RICGLAGL	Ricinocarpos glaucus Endl. var. glaucus
RINOXY	Rinzia oxycoccoides Turcz.
RINSCH	Rinzia schollerifolia (Lehm.)Trudgen
ROMROS	Romulea rosea (L.)Eckl.
RUMACE	Rumex acetosella L.
SANACU	Santalum acuminatum (R.Br.)A.DC.
SCAAUR	Scaevola auriculata Benth.
SCABRO	Scaevola brookeana F.Muell.
SCHBRE	Schoenus brevisetis (R.Br.)Benth.
SCHCAE	Schoenus caespititius W.Fitzg.
SCHCAEAF	Schoenus aff caespititius (SB 324.1)
SCHEFO	Schoenus efoliatus F.Muell.
SCHLAE	Schoenus laevigatus W.Fitzg.
SCHODO	Schoenus odontocarpus F.Muell.
SCHSP2	Schoenus sp. Stirling Ra. Perth 04067878
SENGLO	Senecio glomeratus Desf.ex Poir.in Lam.
SENHIS	Senecio hispidulus A.Rich.
SENPIC	Senecio picridioides (Turcz.)M.E.Lawr.
SILFIL	Siloxerus filifolius (Benth.)Ostenf.
SOLDRU	Sollya drummondii C.Morren
SOLHET	Sollya heterophylla Lindl.
SONOLE	Sonchus oleraceus L.
SPASCI	Spartochloa scirpoidea (Steud.)C.E.Hubb.
SPHALA	Sphaerolobium alatum Benth.
SPHDRA	Sphenotoma dracophylloides Sond.
SPHDRAAF	Sphenotoma aff dracophylloides (SB 54)
SPHDRU	Sphenotoma drummondii (Benth.)F.Muell.
SPHGRA	Sphaerolobium grandiflorum (R.Br.)Benth.
SPHPAR	Sphenotoma parviflorum F.Muell.
SPHSCA	Sphaerolobium scabriusculum Meisn.in Lehm.
SPHSQU	Sphenotoma squarrosum (R.Br.)G.Don
SPHVIM	Sphaerolobium vimineum Sm.in K.D.Koenig & Sims
STEMED	Stellaria media (L.)Vill.
STIHEM	Stipa hemipogon Benth.
STIMOL	Stipa mollis R.Br.
STIPYC	Stipa pycnostachya Benth.

STITENTE	Stirlingia tenuifolia (R.Br.)Steud. var. tenuifolia
STYADN	Stylidium adnatum R.Br.
STYALB	Stylidium albomontis Carlquist
STYAMO	Stylidium amoenum R.Br.
STYART	Stylidium articulatum R.Br.
STYBRE	Stylidium breviscapum R.Br.
STYCORPR	Stylidium corymbosum R.Br. var. proliferum Benth.
STYCRA	Stylidium crassifolium R.Br.
STYGLA	Stypandra glauca R.Br.
STYHAI	Styphelia hainesii F.Muell.
STYHIR	Stylidium hirsutum R.Br.
STYKEI	Stylidium keigheryi Lowrie & Carlquist
STYLUTCL	Stylidium luteum R.Br. subsp. clavatum Carlquist
STYPILMI	Stylidium piliferum R.Br. subsp. minor (Mildbr.)Carlquist
STYSCA	Stylidium scandens R.Br.
STYSCH	Stylidium schoenoides DC.
STYSP1	Stylidium sp Stirling Ra (SB 115)
STYSP2	Stylidium sp2 Bluff Knoll x fl
STYSP3	Stylidium sp nova spathulatum complex (SB 683)
STYSPIMO	Stylidium spinulosum R.Br. subsp. montanum Carlquist
STYTEN	Styphelia tenuiflora Lindl.
STYVER	Stylidium verticillatum F.Muell.
TETCAP	Tetraria capillaris (F.Muell.)J.M.Black
TETLAE	Tetrarrhena laevis R.Br.
TETOCT	Tetraria octandra (Nees)Kuek.
TETSET	Tetratheca setigera Endl.
THEAZU	Thelymitra azurea R.S.Rogers
THEAZU	Thelymitra azurea R.S.Rogers
THEFLE	Thelymitra flexuosa Endl.
THEMAC	Thelymitra macrophylla Lindl.
THEMACAF	Thelymitra aff macrophylla (SB 572)
THEPAU	Thelymitra pauciflora R.Br.
THESP1	Thelymitra sp (SB 163)

THESPISP	Thelymitra spiralis (Lindl.)F.Muell. var spiralis Nicholls
THOFOL	Thomasia foliosa Gay
THOSOLAF	Thomasia sp Toolbrunup (SB 254
THRSAX	Thryptomene saxicola (A.Cunn. ex Hook.)Schauer in Lehm
THYDIC	Thysanotus dichotomus (Labill.)R.Br.
THYMUL	Thysanotus multiflorus R.Br.
THYPAT	Thysanotus patersonii R.Br.
TRAANI	Trachymene anisocarpa (Turcz.)B.L.Burtt
TRACOECO	Trachymene coerulea Graham var coerulea
TRAORN	Trachymene ornata (Endl.)Druce
TRAPIL	Trachymene pilosa Sm. in Rees
TREDIF	Tremandra diffusa R.Br ex DC
TRESTE	Tremandra stelligera R.Br. ex DC
TRINEENE	Tricostularia neesii Lehm. var. neesii
TRYFLOTR	Trymalium floribundum subsp. trifidum Rye
URSANT	Ursinia anthemoides (L.)Poir. in Lam.
UTRMEN	Utricularia menziesii R.Br.
UTRMUL	Utricularia multifida R.Br.
VELFOL	Velleia foliosa (Benth.)K.Krause in Engl.
VERPLE	Veronica plebeia R.Br
VERPLU	Verticordia plumosa (Desf.)Druce
VILCAL	Villarsia calthifolia F.Muell.
VULBRO	Vulpia bromoides (L.)Gray
VULMYU	Vulpia myuros (L.)C.C.Gmel.
XANPLA	Xanthorrhoea platyphylla D.J.Bedford
XANPRE	Xanthorrhoea preissii Endl.
XANPUS	Xanthosia pusilla Bunge
XANROTHY	Xanthosia rotundifolia DC. var hypoleuca Diels
XANROTRO	Xanthosia rotundifolia DC. var rotundifolia
XANSPF	Xanthosia sp Fitzgerald (RD Royce 9266)

APPENDIX 8:

COMMUNITY TYPES DERIVED FROM 11 GROUP CLASSIFICATION

TYPICAL TAXA: OCCUR WITH A FREQUENCY OF >60%

COMMON TAXA: OCCUR WITH A FREQUENCY OF >30%

STRUCTURAL UNITS: ACCORDING TO MUIR (1977)

Appendix 8. Community Types Derived From 11 group classification

Community Type 1a: **Mt Lindesay Shrub-mallee heath / low woodland**

Typical Species

Trees / Mallees	Shrubs	Herbs
Eucalyptus marginata (shrub-mallee)	*Banksia grandis*	*Mesomelaena gracilipes*
	Hakia varia	*Tetraria capillaris*
	Agonis parviceps	*Lepidosperma squamatum*
	Beaufortia decussata	*Drosera erythrogyne*
	Sphenotoma aff. *dracophylloides*	*Stylidium scandens*
	Persoonia longifolia	*Amphipogon amphipogonoides*
	Sphenotoma parviflorum	

Common Species:

E.calophylla	*Acacia browniana*	*Lomandra nigricans*
E. megacarpa	*Pimmelea hispidula*	*Johnsonia lupulina*
	Hibbertia subvaginata	*Mesomelaena tetragona*
	Dryandra nivea	
	Adenanthos obovatus	
	Eutaxia epacridoides	
	Hibbertia pilosa	
	Dampiera linearis	

No. Quadrats: 3

Mean species richness: 45.6

Geology:

Structural Units:
low woodland B: 231
open shrub-mallee / dwarf scrub C: 207
dense shrub mallee-heath B: 208

DB impact: 0,1,2

Soils:
Clayey sand / gravelly sand

Community Type: 1b Western Stirlings Mallee-heath and shrublands

Typical Species:

Trees / Mallee	Shrubs	Herbs
Eucalyptus staeri	*Dryandra foliata*	*Tetraria capillaris*
	Petrophile divaricata	*Anarthria prolifera*
	Aotus genistoides	*Actinotus glomeratus*
	Xanthosia rotundifolia var. *hypoleuca*	*Stylidium verticillatum*
	Beaufortia anisandra	

Common Species

	Dryandra armata var nova	
	Xanthorrhoea platyphylla	
	Allocasuarina humilis	
	Isopogon formosus	
	Dampiera linearis	
	Boronia albiflora	*Lomandra sericea*
	Melaleuca thymoides	*Loxocarya flexuosa*
	Isopogon latifolius	*Lepidopmerma* sp. G
	Hakia varia	
	Nemcia coriacea	
	Agonis hypericifolia	
	Latrobea tenella	
	Lambertia ericifolia	

No. of quadrats: 5

Mean species richness: 44

Geology:
quartzite

Structural units:
dense heath B: 218
thicket 204 206
shrub mallee-heath B 205, 233

DB impact: 0

Soil:
sandy loam

Appendix 8. Community Types Derived From 11 group classification

Community Type: 1c Central-Eastern Stirling Range Mallee-Woodland-Shrublands

Typical Species:

Trees / Mallee	Shrubs	Herbs
Eucalyptus megacarpa	*Hakia varia* *Kunzea montana* *Agonis parviceps* *Calathamnus crassus* *Nemcia leakeana* *Xanthosia rotundifolia* var *rotundifolia* *Sphenotoma* aff. *dracophylloides* *Beaufortia anisandra*	*Anarthria prolifera* *Tetraria capillaris* *Lepidosperma* sp.

Common species

Trees / Mallee	Shrubs	Herbs
Eucalyptus marginata (mallee) *E. calophylla*	*Leucopogon parviflorus* *Hypocalyma myrtifolium* *Veillea foliosa* *Astartea fascicularis* *Banksia oreophila* *Banksia solandri* *Andersonia axilliflora* *Andersonia echinocephala* *Hypocalyma phillipsii* *Nemcia crenulata* *Leucopogon unilateralis* *Isopogon latifolius* *Adenanthos filifolius* *Dryandra formosa* *Gonocarpus benthamii*	*Drosera huegelii* dwarf form *Loxocarya flexuosa* *Lepidosperma tenue* *Lomandra nigricans* *Stylidium scandens*

No. of quadrats: 12

Mean species richness:28.8

Geology:
quartzite

Structural units:
heath B: 213, 212,214
dense thicket:210, 211
low woodland A: 209
dense mallee-thicket: 217
mallee - heath B: 229, 232
dwarf scrub D: 230, 234
Dense tall sedge: 238

DB impact: 0,1,2

Soil:
loam
sandy clay loam

Appendix 8. Community Types Derived From 11 group classification

Community Type 2a: **Porongurup Range karri forest - woodland - thicket**

Typical Species:

Trees / Mallees	Shrubs	Herbs
	Hibbertia sp. Porongurups	*Tetrarrhena laevis*
	Thryptomene saxicola	*Poa porphyroclados*
	Melaleuca blauerifolia	*Oxalis corniculata*
	Myoporum tetrandum	*Tetraria capillaris*
	Leucopogon obovatum	*Veronica plebeia*
		Pteridium esculentum
		Hydrocotyle hirta
		Lepidosperma angustatum
		Senecio hispidula

No. of quadrats: 3	**Mean species richness: 26**	**geology:** granite
Structural units woodland: 215 karri forest: 226 dense thicket: 216	**DB impact: 0**	**Soil:** loam, sandy loam

Community Type 2b : Toolbrunup Woodland -Thicket

Typical Species:

Trees / Mallees	Shrubs	Herbs
E. calophylla	*Acacia veronica*	*Tetrarrhena laevis*
	Thomasia sp.Toolbrunup	*Poa porphyroclados*
	Sphenotoma drummondii	*Corybas recurvus*
	Trymalium floribundum	*Tetraria capillaris*
	Hakia varia	*Lomandra pauciflora*
	Leucopogon parviflorus	*Drosera stolonifera* ssp. *monticola*
	Sollya drummondii	

No. of quadrats: 2	**Mean species richness: 26**	**geology:** quartzite
Structural units open low woodland A: 227 open low woodland A over thicket: 228	**DB impact: 0?**	**Soil:** sandy clay loam

Appendix 8. Community Types Derived From 11 group classification

Community Type: 3 Mt Manypeaks E. megacarpa mallee and heath

Typical Species:

Trees / Malles	Shrubs	Herbs
	Hakea elliptica	*Lepidosperma gladiatum*
	Leucopogon australis	*Opercularia hispidula*
	Ricinocarpus glaucus	
	Agonis marginata	
	Xanthosia rotundifolia var. *rotundifolia*	
Common		
Eucalyptus megacarpa	*Acacia myrtifolia*	*Lepidosperma angustatum*
	Acacia drummondii	
	Nemcia coriacea	

No. of quadrats: 3

Mean species richness: 19.7

Geology:
granite

Structural units:
dense mallee-thicket: 201
heath A: 201
heath B: 219

DB impact: 0

Soil:
sandy loam

Community Type 4; Thumb Peak heath / mallee heath

Typical Species:

Trees / Mallee	Shrubs	Herbs
Eucalyptus acies	*Hakea hookeriana*	*Lepidosperma* aff. *tenue*
	Dryandra quercifolia	*Actinotus glomeratus*
	Grevillea fistulosa	*Anarthria prolifera*
	Jacksonia compressa	*Lepidosperma* aff. *viscidum*
	Davesia emarginata	*Schoenus caespititus*
	Adenanthos labilliardieri	
	Melaleuca striata	
	Petrophile divaricata	
	Beaufortia anisandra	
	Agonis linearifolia var. *conspicua*	
	Boronia spathulata	
	Allocasuarina humilis	
	Boronia albiflora	
	Dryandra armata var *nova*	
	Dampiera loranthifolia	

No. of quadrats: 3

Mean species richness: 48.3

Geology:
quartzite

Structural units:
dense shrub mallee-heath B: 220
very open mallee / heath B: 221
heath B : 237

DB impact: 0

Soil:
sandy loam

Appendix 8. Community Types Derived From 11 group classification

Community Type 5: **Mt Ragged mallee / scrub**

Typical Species:

Trees / Mallees	Shrubs	Herbs
Eucalyptus doratoxylon	*Dryandra longiofolia* ssp. *archeos*	*Lepidosperma ustulatum*
	Scaevola brookeana	*Lepidoperma* aff. *tenue*
	Leucopogon apiculatus	*Schoenus brevisetis*
	Melaleuca pentagona ssp. *subulifolia*	
	Dampiera parvifolia	
	Monotoca oligarrhenoides	
	Acacia myrtifolia	
	Petrophile fastigiata	
	Pimelia brevifolia	

No. of quadrats: 2

Mean species richness: 35.5

geology:
quartzite

Structural units:
shrub mallee / dwarf scrub C: 222
open- mallee /dwarf scrub C: 221

DB impact: 0

soil:
loamy sand

Community Type: 6 **Peak Charles and Peak Eleanora shrublands**

Typical Species:

Trees / Mallees	Shrubs	Herbs
	Calathamnus quadrifidus	*Stypandra glauca*
	Labichea lanceolata ssp. *brevifolia*	*Trachymene ornata*
	Melaleuca fulgens	*Opercularia aff hispidula*
	Leucopogon cuneifoius	*Thysonotus dichotomous*
	Dampiera tenuicaulis	*Spartacloa scirpoides*
Common		
	Olearia aff.C250 *axillaris*	*Lepidosperma drummondii*
	Astroloma epacridis	
	Acacia lasiocalyx	
	Allocasuarina campestris	

No. of quadrats: 4

Mean species richness: 23

geology:
granite

Structural units:
dense thicket: 224
dwarf scrub C: 225
low scrub B: 235
thicket: 236

DB impact: 0

soil:
loamy sand

Appendix 8. Community Types Derived From 11 group classification

Community Type 7a lithic (granite) scrub and herbs

Typical Species:

Trees / Mallees	Shrubs	Herbs
		Stypandra glauca *Cheilanthes austrotenuifolia* **E339Hypochoeris glabra* *Pterostylis* aff. *nana* *Pelargonium australe*

Common

Trees / Mallees	Shrubs	Herbs
	Agonis linearifolia var conspicua	*Asplenium flabellifolium* *Platysace compressa* *Cryptostylis ovata* *Asplenium aethiopicum*

No. of quadrats: 4

geology:
granite

Structural units:
very open herbs
dwarf scrub D

DB impact: 0,1

soil:
loamy sand

Community Type: 7b Lithic (quartzite) Scrub / Herbs

Typical Species:

Trees / Mallees	Shrubs	Herbs
	Sphenotoma drummondii *Velliea foliosa* *Kunzea montana* *Calathamnus crassus* *Actinotus rhomboideus*	*Asplenium flabellifoium* *Danthonia caespitosa* *Platysace compressa* **Hypochoeris glabra*

Common

Trees / Mallees	Shrubs	Herbs
	Leucopogon gnaphaloides *Helichrysum macranthum* *Hakea varia*	*Caladrinia liniflora* *Senecio glomeratus* *Opercularia volubis* *Stylidium* sp.Stirling Ra *Isolepis* aff. *congrua* **Aira praecox*

No. of quadrats: 6

geology:
quartzite

Structural units:
low scrub B
dwarf scrub D

DB impact: 0,1,2

soil:
loam, sandy loam

APPENDIX 9.

INVERTEBRATES IDENTIFIED TO ORDER LEVEL LITTER INVERTEBRATE SURVEY

Sampling periods: **March 1995**
August / September 1995
April / May 1996
June 1996

Sites included in systematic pitfall survey:

Toolbrunup Q227, 228
Bluff Knoll Q213, 214, 230
Magog Q232, 209
Mondurup Q217, 218
Porongurup Q215, 226
Mt Lindesay Q207, 208

3 sampling periods: March 1995 (1996), August/September 1995, June 1996

Additional sites (1 sampling period April / May 1996)
Thumb Peak Invert 1& 2
Mt Ragged Inverts 1, Q222
Ellen Peak Q211.1, Invert 1

Manypeaks Q201, 202 (March 1995 / April 1996)
Bluff Knoll 214 (control grid March 1996)

APPENDIX 9. Invertebrate abundances by Order, systematic pitfall survey **March** 1995 (* = sites sampled March 1996)

	Toolbrunup 227	Toolbrunup 228	Porongurup 226	Porongurup 215	Bluff Knoll 213	Bluff Knoll 214	Bluff Knoll 230*	Mondurup 217	Mondurup 218	Mt Lindesay 208*	Mt Lindesay 231*	Magog 232*	Magog 209*	Total
ANNELIDA														
Haplotaxida											0			
Arhynchobdellae											4			4
CHELICERATA														
Acarina	22	3	8	43	31	10	2	5	27	24	23	75	10	283
Araneae	33	28	73	141	89	52	35	30	50	38	30	30	21	650
Opilionida	2	2	113	27	9	27	104	12	8	1		2	1	308
Scorpionida				17	1			2		1				21
CRUSTACEA														
Amphipoda	101	54	759	27	1			97		12	2		95	1148
Isopoda	73	91	7	22				36		1	1	1	2	234
MOLLUSCA														
Class Gastropoda														
Sigmurethra	3		13	1	1									18
UNIRAMIA														
Class Chilopoda														
Lithobiida					1	1								2
Class Diplopoda:														
Julida			2	3										5
Spirobolida			1	1										2
Spirostreptida					1		1			2	1			5
Polyzonida														
Subclass Hexapoda														
Collembola	40	9	94	135	22	84	105	340	113	110	80	140	105	1377
Ephemeroptera					1									1
Blattodea	2	1					4	8		1	1	2	1	20
Isoptera									1					1
Dermaptera	8	11	8	13	71	40	7	9	10		2	2	8	189
Orthoptera			6	27	3	42	15		1	4	34			132
Psocoptera				1										1
Phithiraptera	1													1
Hemiptera	3	4	6	63	9		25	1	17	17	3	29	5	182
Thysanoptera														
Coleoptera	10	7	9	23	73	22	74	18	23	33	11		2	305
Siphonoptera														
Diptera	115	134	103	416	132	21	180	31	82	120	130	130	270	1864
Lepidoptera	2	4		1	1	1	4	3	1	2				19
Hymenoptera	28	14	37	485	174	96	141	113	760	300	61	63	90	2362
Total orders	15	13	15	18	17	11	13	14	12	15	14	10	12	

APPENDIX 9. Invertebrate abundances by Order, systematic pitfall survey **August / September** 1995.
* = sites added to survey Aug 1995

	Toolbrunup 227	Toolbrunup 228	Porongurup 226	Porongurup 215	Bluff Knoll 213	Bluff Knoll 214	Bluff Knoll 230*	Mondurup 217	Mondurup 218	Mt Lindesay 208*	Mt Lindesay 231*	Magog 232*	Magog 209*	Total
ANNELIDA														
Haplotaxida										1	1			2
CHELICERATA														
Acarina	10	16	10	65	1	1	2	1	10	11	5	6	4	142
Araneae	36	29	27	45	2	11	2	17	14	79	30	15	34	341
Opilionida		2	47	14	9	2	109		5		1	1	1	191
CRUSTACEA														
Amphipoda	11	7	134	12				8		5	11	2	27	217
Isopoda	3	1	6	8						1	1	1	2	23
MOLLUSCA														
Class Gastropoda														
Sigmurethra	3	2	7	2								1	3	18
UNIRAMIA														
Class Chilopoda														
Scolopendridae			1											1
Class Diplopoda:														
Julida														0
Spirobolida														0
Spirostreptida														
Polyzonida			1		1					7	1			9
														1
Subclass Hexapoda														
Collembola	125	148	85	254	119	135	255	103	594	876	88	159	113	3054
Blattodea				1			1	5		2	1	1		11
Isoptera								1		1				2
Dermaptera				1		1		1	5	6	1	2		17
Orthoptera			15	2	4	5	28		1	47	14			116
Hemiptera	1	1	1	6		1	2	9	17	5	1	2	5	51
Thysanoptera												1		1
Coleoptera	8	7	10	14	50	7	54	4	17	29	8	18	33	259
Siphonoptera											1			1
Diptera	256	229	152	308	290	20	5	160	163	61	42	115	181	1982
Lepidoptera				2	1			1	1	2		3	2	12
Hymenoptera	40	7	9	48	14	4	14	17	67	1526	52	44	23	1865
Total orders	10	11	14	15	10	10	10	12	11	15	15	15	11	

APPENDIX 9. Invertebrate abundances by order, systematic pitfall survey June 1996.

	Toolbr. 227	Toolbr. 228	Porongurup 226	Porongurup 215	Bluff Knoll 213	Bluff Knoll 214	Bluff Knoll 230	Mondurup 217	Mondurup 218	Mt Lindesay 208	Mt Lindesay 231	Magog 232	Magog 209	Total
Haplotaxida														
Arhynchobdellae														
Acarina	1	3	16	11	6	10	9	33	12	8	5	8	2	122
Araneae	13	15	39	60	26	42	8	27	58	38	38	31	22	417
Opilionida	2		57	12	40	27	220	9	15	7	4	4	1	398
Pseudoscorpionida						1								1
Scorpionida														0
Amphipoda	11	10	250	30	10	21	3	12		75	10	8	119	559
Isopoda	1	2	7	3		3		2	1	4		1	25	49
Class Gastropoda														
Sigmurethra			6	3				2			1			12
PHYLUM UNIRAMIA														
Cryptopidae							1	1						2
Lithobiida					1	3								4
Julida									1					1
Sphaerotheriida			2										2	4
Spirobolida		1							1					2
Spirostreptida	1				1	1				6	1			10
Polyzonida				1										1
Subclass Hexapoda														
Collembola	65	60	290	120	480	180	140	110	250	170	145	220	80	2310
Ephemeroptera														
Blattodea		1						5	2	2	6			16
Isoptera														
Dermaptera	1			2	3			2	4	1	6	3		31
Orthoptera			5	8	11	8	50		2	18	12	4		118
Psocoptera								3	4					7
Phithiraptera														
Hemiptera	8	4		1	4	2	3	3	3	4		2	3	37
Thysanoptera														
Coleoptera	17	2	5	11	19	29	8	1	14	56	72	20	25	279
Siphonoptera														
Diptera	45	45	100	66	300	60	108	195	100	70	43	120	145	1397
Lepidoptera		1		2			1							4
Hymenoptera	1	6	7	337	15	9	32	63	644	464	53	138	30	1799
Total orders	**12**	**12**	**12**	**16**	**13**	**15**	**12**	**15**	**15**	**14**	**13**	**12**	**11**	

Invertebrates by order
Additional sites surveyed April / May 1996

	Thumb Pk Invert 1	**Thumb pk Invert 2**	**Mt Ragged Invert 1**	**Mt Ragged 222**	**Manypeaks 201**	**Manypeaks 202**	**Ellen Pk 211.1**	**Ellen Pk Invert 1**
ANNELIDA								
Haplotaxida							1	
CHELICERATA								
Acarina	5	12	2	18	64	3	3	5
Araneae	39	29	34	31	26	3	18	16
Opilionida	14	1	2	5	8	15	8	
Pseudoscorpionida							9	
Scorpionida	3	3						
CRUSTACEA								
Amphipoda					9	35	15	
Isopoda	4		2	1	8	9	2	1
Class Gastropoda								
Sigmurethra		1			2			
UNIRAMIA								
Class Chilopoda								
Lithobiida							1	
Class Diplopoda:								
Sphaerotheriida			1			1		1
Spirobolida			1					
Spirostreptida				1	4	25		
Polydesmida						6		
Subclass Hexapoda								
Collembola	6	11	1	11	15	145	2	25
Blattodea	1	34			2	6	3	1
Isoptera		2						
Dermaptera	5	6		1		2		
Orthoptera	7		4	56	1	6	3	
Psocoptera	1	1						4
Hemiptera	1						8	
Coleoptera	18	7	2	19	31	15	34	1
Diptera	2	12	19	14	29	8	18	2
Lepidoptera		1		1				
Hymenoptera	6	4	5	8	19	73	7	11
Total orders	14	14	11	12	13	14	15	1

APPENDIX 10. ANT SPECIES AND ABUNDANCE DATA FROM MOUNTAIN SURVEY

Appendix 10a: Ant species recorded from all sites, systematic pitfall survey sites shown in bold.

Appendix 10b:

- Ant species and abundances, systematic pitfall survey March 1995 & additional sites surveyed March 1996
- Ant species and abundances, systematic pitfall survey August / September 1995
- Ant species and abundances, systematic pitfall survey June 1996
- Ant species and abundances, extra sites not included in systematic survey

APPENDIX 10a. Ant species recorded in litter invertebrate survey.

(Systematic survey sites indicated by **bold** type)

	Tool2 27	Tool 228	Porong 226	Porong 215	Bluff Knoll 213	Bluff Knoll 214	Bluff Knoll 230	Mond 217	Mond 218	Mt Lind. 231	Mt Lind. 208	Magog 209	Magog 232	Manypeaks 201	Manypeaks 202	Mt Ragged 222	Mt Ragged Invert 1	Thumb Peak invert 1	Thumb Peak Invert 2	Ellen Peak 211.1	Ellen Peak 1
DOLICHODERINAE																					
Dolichoderus sp.1						#	#				#										
Iridomyrmex sp conifer group				#				#	#	#	#		#	#	#						#
Iridomyrmex 'vicina'					#	#			#	#			#		#		#	#	#		
Doleromyrma 'darwinianus'				#			#	#	#		#				#			#			#
Ochetellus 'glaber'									#		#		#								
Papyrius sp 1										#											
Papyrius sp 2																					#
Tapinoma sp.1				#																	
FORMICINAE																					
Camponotus sp.1					#	#		#	#	#				#		#	#		#		#
Camponotus sp.2			#				#			#			#								
Camponotus sp.3				#					#		#		#						#		#
Camponotus sp.4						#															
Camponotus sp.5									#				#								
Camponotus sp.6 nigriceps group																#	#				
Camponotus sp.7					#		#														
Camponotus sp.8															#			#			
Camponotus sp.9											#										
Melophorus sp.1.				#	#	#			#				#								
Melophorus sp.2					#																
Melophorus sp.3				#																	
Plagiolepis sp.1				#																	
Plagiolepis sp.2															#						
Polyrhachis patiens										#											
Prolasius sp.1		#		#		#	#	#		#	#	#	#	#		#	#	#		#	#
Prolasius sp.2						#	#	#	#	#	#	#	#	#		#					
Prolasius sp.3				#																	
Notoncus sp.1				#			#		#	#	#	#									
Notoncus sp.2				#	#						#				#						
Myrmechorhynchus sp.1											#										
Total Species	0	0	2	16	9	12	9	10	16	11	14	3	14	7	12	7	6	5	4	1	8

APPENDIX 10a. Ant species recorded in litter invertebrate survey.

(Systematic survey sites indicated by **bold** type)

	Tool2 27	Tool 228	Porong 226	Porong 215	Bluff Knoll 213	Bluff Knoll 214	Bluff Knoll 230	Mond 217	Mond 218	Mt Lind. 231	Mt Lind. 208	Magog 209	Magog 232	Manypeaks 201	Manypeaks 202	Mt Ragged 222	Mt Ragged Invert 1	Thumb Peak invert 1	Thumb Peak Invert 2	Ellen Peak 211.1	Ellen Peak 1
FORMICIDAE																					
PONERINAE																					
Platythyrea sp. 1				#							#										
Amblyopone sp.1				#																	
Amblyopone sp.2			#																		
Amblyopone sp3															#						
Rhytidoponera inornata					#	#	#	#	#				#			#	#				
Rhytidoponera sp.1											#				#						
Rhytidoponera sp2					#																
Brachyponera sp 1															#	#					
Trachymesopus sp1																#					
MYRMECIINAE																					
Myrmecia sp.1						#				#			#	#				#	#		
Myrmecia sp.2				#				#	#				#								
Myrmecia sp.3						#															
Myrmecia sp. A39urens group																	#				
MYRMICINAE																					
Alderzia sp.1						#															
Crematogaster sp.1							#	#	#		#		#		#						#
Meranoplus sp.1						#			#	#											
Monomorium leae				#					#				#	#	#						
Orectognathus sp. 1					#																
Pheidole sp.1				#				#	#						#						
Strumigenys sp.1								#													
Tetramorium sp 1														#							
Monomorium sp.1																					#

Appendix 10b. Ant species and abundance, systematic pitfall survey March 1995.

* = additional sites surveyed March 1996

FORMICIDAE	Tool 227	Tool 228	Poron 226	Poron 215	B Kno 213	B Kno 214	B Kno 230*	Mond 217	Mond. 218	Lind.208*	Lind 231*	Mag 209*	Mag 232*	total
PONERINAE														
Platythyrea sp.1				9						1				10
Amblyopone sp.1				1										1
Amblyopone sp.2			1											
Rhytidoponera inornata					33	14	8	1	5				13	74
Rhytidoponera sp.2					1									1
MYRMECIINAE														
Myrmecia sp.1						1					1		1	3
Myrmecia sp.2								2	1				3	6
Myrmecia sp.3						2								2
MYRMICINAE														
Adlerzia sp.1						1								1
Crematogaster sp.1								5	17	2				24
Meranoplus sp.1						9			4					13
Monomorium leae									32					32
Pheidole sp.1				7					4					11
DOLICHODERINAE														
Dolichoderus sp.1						1	2			2				5
Iridomyrmex sp conifer grp				351				69	486	199	18		16	1139
Iridomyrmex 'vicina'					1	37			50		1		7	96
Doleromyrma 'darwineanus'				1				4	20	4				28
Ochetellus 'glaber'									3	1				4
Papyrius sp 1											4			4
Tapinoma sp.1				1										1
FORMICINAE														
Camponotus sp.1					2	2		5	4					13
Camponotus sp.2			5				2				1			8
Camponotus sp.3									8					8
Camponotus sp.4						2								2
Camponotus sp.5									3					3
Camponotus sp.7					5									5
Melophorus sp.1.				3	5	1			26				5	40
Melophorus sp.2					1									1
Melophorus sp.3				1										1
Plagiolepis sp.1				1										1
Polyrhachis patiens											1			1
Prolasius sp.1				4			1			2	21	2	1	31
Prolasius sp.2						2	1		12	8		6	1	30
Total ant no.	0	0	6	379	48	72	14	86	675	219	47	8	48	
Species no.	0	0	2	10	7	11	5	6	15	8	7	2	8	

APPENDIX 10b. Ant species and abundance, systematic pitfall survey **Aug/Sept** 1995

	Toolbrunup 227	Toobrunup 228	Porongurup 226	Porongurup 215	Bluff Knoll 213	Bluff Knoll 214	Bluff Knoll 230	Mondurup 217	Mondurup 218	Mt Lindesay 208	Mt Lindesay 231	Magog 209	Magog 232	Total
FORMICIDAE														
PONERINAE														
Platythyrea sp.1				3										3
Amblyopone sp.2			1											1
Rhytidoponera inornata							4		1				4	9
Rhytidoponera sp.1										1				1
MYRMECIINAE														
Myrmecia sp.1											11		1	12
Myrmecia sp.2				1										1
MYRMICINAE														
Crematogaster sp.1							2	1	6	4			4	17
Meranoplus sp.1											3			3
Monomorium leae				1									1	2
Strumigenys sp.1								1						1
DOLICHODERINAE														
Iridomyrmex sp conifer grp				259				9	25	1572	1		1	1867
Doleromyrma 'darwinianus'				11			1	3	9	13				37
Ochetellus 'glaber'									4				3	7
FORMICINAE														
Camponotus sp.1									1		1			2
Camponotus sp.2			2										1	3
Camponotus sp.3										9				9
Camponotus sp.5													2	2
Camponotus sp.7					1									1
Camponotus sp.9										2				2
Plagiolepis sp.1				4										4
Prolasius sp.1							2			41	19	4	1	67
Prolasius sp.2								1	3	91	4	12	2	113
Prolasius sp.3				11										11
Notoncus sp.1				1			1		1	53	2	12		70
Myrmechorhynchus sp.1										4				4
Total no.	0	0	3	291	1	0	1	15	50	1790	41	28	29	
Species no.	0	0	2	8	1	0	5	5	8	10	7	3	10	

APPENDIX 10b. Ant species and abundance, systematic pitfall survey June 1996

	Toolbrunup 227	Toolbrunup 228	Porongurup 226	Porongurup 215	Bluff Knoll 213	Bluff Knoll 214	Bluff Knoll 230	Mondurup 217	Mondurup 218	Mt Lindesay 208	Mt Lindesay 231	Magog 209	Magog 232	Total
FORMICIDAE														
PONERINAE														
Platythyrea sp.1				4										4
Amblyopone sp.2			1											1
Rhytidoponera inornata					2	2	5						1	10
MYRMECIINAE														
Myrmecia sp.1						3					2			5
MYRMICINAE														
Crematogaster sp.1							3	3	28				14	48
Pheidole sp.1				1				1						2
Orectognathus sp.1					1									1
DOLICHODERINAE														
Iridomyrmex sp conifer grp				290				41	590	310	5		93	1329
Iridomyrmex 'vicinus'						1								1
Doleromyrma 'darwinianus'				8				4	13	19				44
Ochetellus 'glaber'									1					1
FORMICINAE														
Camponotus sp.1					1			1						2
Camponotus sp.2											10			10
Camponotus sp.3				2					3	4			7	16
Camponotus sp.7							1							1
Prolasius sp.1		4		4		2		1		25	29	22	20	107
Prolasius sp.2							11		4	92			1	108
Notoncus sp.2				4	1					3				8
Myrmechorhynchus sp.1										1				
Total no.	0	4	1	313	5	7	20	51	639	453	46	22	136	
Species no.	0	1	1	7	4	4	4	6	6	7	4	1	6	

Appendix 10b. Ant species and abundances, additional pifall grids: Manypeaks, Ellen Pk, Thumb Pk Mt Ragged

	Manypeaks 201 (March 1995)	Manypeaks 202 (March 1995)	Bluff Knoll 214 (March 1996)	Thumb 1(April 1996)	Thumb 2 (April 1996)	Ragged 222 (April 1996)	Ragged 1 (April 1996)	Manypeaks 201(April 1996)	Manypeaks 202 (April 1996)	Ellen Pk 211.1 (May 1996)	Ellen Pk 1 (May 1996)
FORMICIDAE											
PONERINAE											
Amblyopone sp 3									1		
Rhytidoponera inornata			1			6	19				
Rhytidoponera sp.1		2									
Rhytidoponera sp.2											
Trachymesopus sp.1						2					
Brachyponera sp.1						1			2		
MYRMECIINAE											
Myrmecia sp.1			1	2	4			1			
Myrmecia sp. urens group							1				
MYRMICINAE											
Crematogaster sp.1		7							3		12
Monomorium leae	2	7									
Pheidole sp.1		29									
Tetramorium sp.1								1			3
DOLICHODERINAE											
Dolichoderus sp.1			1								
Iridomyrmex sp conifer grp	134	1743						26	680		79
Iridomyrmex 'vicina'		4	1	2	1		14				
Doleromyrma 'darwinianus'		8		2					3		5
Papyrius sp.2											1
FORMICINAE											
Camponotus sp.1					2	2	3	1			3
Camponotus sp.3					1						2
Camponotus sp.6 nigriceps grp						10	3				
Camponotus sp.8		1		1							
Notoncus sp.2									3		
Plagiolepis sp.2		3									
Prolasius sp.1	20			12		9	6	1	2	2	1
Prolasius sp.2						39					
Species no.	3	9	5	5	4	7	6	5	7	1	8

APPENDIX 11 TWO-TABLES FOR ANT AND SPIDER COMMUNITIES SHOWING PRESENCE / ABSENCE OF SPECIES

APPENDIX 11A

- TWO WAY TABLE SHOWING PRESENCE / ABSENCE OF ANT SPECIES BY COMMUNITY TYPE FOR 3 GROUP CLASSIFICATION

APPENDIX 11B

- TWO WAY TABLE SHOWING PRESENCE / ABSENCE OF SPIDER SPECIES BY COMMUNITY TYPE FOR 4 GROUP CLASSIFICATION

Appendix 11a. Two-way table showing ant species by community type

```
Species                       Community
Code
                            1      2     3

                            TM|PMMMBLBLB|P
                            oa|oooalilil|o
                            og|rnngununu|r
                            22|222222222|2
                            20|111330131|2
                            89|578208413|6
                              |         |
                              |         |
                              |         |
Platythyrea sp.1              |*    *   |
Notoncus sp.2                 |*    *  *|
Rhytidoponera spl             |     *   |
Camponotus 9                  |     *   |
Myrmechorhynchus spl          |     *   |
                            --+---------+-
Amblyopone 2                  |         |*
Camponotus 2                  |   **  * |*
Papyrius sp.1                 |       * |
Polyrhachis patiens           |       * |
                            --+---------+-
Rhytidoponera inornata        | **** * *|
Melophorus 1                  |* **  * *|
Myrmecia 1                    |   *  ** |
Meranoplus spl                |  *   ** |
Iridomyrmex vicina            |  **  ***|
Camponotus 1                  | **   ***|
Myrmecia 2                    |****     |
Monomorium leae               |* **     |
Pheidole sp                   |***      |
Iridomyrmex conifer grp       |**** * * |
Ochetellus glaber             |  ** *   |
Camponotus 3                  |* ** *   |
Camponotus 5                  |  **     |
Crematogaster sp              | *****   |
Doleromyrma darwinanus        |*** **   |
Prolasius 1                 **|** ***** |
Proslasius 2                 *| ******* |
Notoncus sp 1                *|* * ** * |
Dolichoderus sp.1             |    ***  |
Strumigenys spl               | *       |
                            --+---------+-
Myrmecia 3                    |      *  |
Adlerzia sp                   |      *  |
Camponotus 4                  |      *  |
                            --+---------+-
Rhytidoponera 2               |        *|
Orectognathus spl             |        *|
Melophorus 2                  |        *|
Camponotus 7                  |    *   *|
                            --+---------+-
Amblyopone 1                  |*        |
Tapinoma sp                   |*        |
Melophorus 3                  |*        |
Plagiolepis 1                 |*        |
Prolasius 3                   |*        |
```

Appendix 11b. Two-way table showing spider species by community type

Species Code	Community Type 1			2				3			4		
	T	T	M	P	P	L	L	M	M	M	B	B	B
	o	o	a	o	o	i	i	o	o	a	l	l	l
	o	o	g	r	r	n	n	n	n	g	u	u	u
	2	2	2	2	2	2	2	2	2	2	2	2	2
	2	2	0	2	1	3	0	1	1	3	1	1	3
	7	8	9	6	5	1	8	7	8	2	3	4	0
Eucyrtops sp2											*	*	
Ctenidae sp4											*	*	
Stiphidiidae sp2											*	*	
Amaurobiidae sp5											*		
Gnaphosidae G4											*		
Linphyiidae sp1											*		
Unident gB											*		
Cycloctenidae sp2				*	*						*	*	
Linphyiidae sp3					*						*		
Stiphidiidae sp1			*								*		
Habronestes sp2			*								*	*	*
Chenistonia tepperi							*		*	*		*	*
Segestiidae sp1									*	*	*	*	
Ambicodamus marae		*			*				*			*	
Tasmanoonops mainae		*	*		*	*		*	*	*		*	
Lycidas gr1			*					*	*	*		*	
Corinnidae G11					*			*		*			
Habronestes sp5				*	*			*	*	*			
Desidae sp1									*		*		*
Textricella sp1				*			*		*		*		*
Lycosidae sp3							*				*		*
Neostorena sp							*				*	*	*
Hahniidae sp3						*	*	*	*	*	*		
Lycosidae sp1					*	*	*	*			*	*	*
Lycoscidae sp5				*	*	*	*	*	*	*		*	*
Sidymella sp	*				*	*	*				*		
Chenestonia sp1	*	*	*	*	*			*					
Ctenidae sp2	*	*	*	*	*	*	*	*		*	*		
Linphyiidae sp4	*		*	*	*	*	*	*				*	
Ctenidae sp1	*	*			*		*	*					
Lycosidae sp4	*	*	*				*						
Clubiona sp1								*					*
Cycloctenidae sp1													*
Gnaphosidae G5													*
Linphyiidae sp8													*
Linphyiidae sp2					*							*	*
Habronestes sp3												*	*
Lycosidae sp1				*	*					*		*	*
Neohomogona sp1		*											
Gnaphosidae G2		*											

Appendix 11b. Two-way table showing spider species by community type

Tuala sp1	*			
Badumna sp	*			
Stiphidiidae sp4	*			
---	---	---	---	---
Stanwellia s1				*
Ctenidae sp3				*
Linphyiidae sp6				*
Lycosidae sp2				*
Maratus pavonis?				*
Stephanopis sp4				*
Toxops sp				*
Hahniidae sp4	*		*	**
Unident gA			*	*
---	---	---	---	---
Stanwellia sp2		**		
Amaurobiidae sp1		**		
Amaurobiidae sp9		*		
Desidae sp2		*		
Euryopsis sp		*		
Stephanopsis sp2		*		
---	---	---	---	---
Teyl sp2		**		
Hahniidae sp2		*		
Australomimetus sp		*		
Miturgidae sp2		*		
Ctenidae sp5		**		
Habronestes sp6		**		
---	---	---	---	---
Amaurobiidae sp7		*		
Hahniidae sp1		*		
Hahniidae sp5		*		
Micropholcomma sp2		*		
Salticidae gA		*		
Habronestes sp7		*		
---	---	---	---	---
Moggridgea sp1			*	
Amaurobiidae sp8			*	
Micropholcomma sp1			*	
Forsterina sp1			*	
Theriidae G2			*	
Theriidae G4			*	
---	---	---	---	---
Clubiona sp2	*		*	
Gnaphosidae G3	*		*	
Gnaphosidae G1	*			
Stiphiidae sp3	*			
Metinae sp1	*			
Segestriidae sp4	*		*	
---	---	---	---	---
Neohomogona sp2			**	
Supunna picta			**	
Baimi montana		*	**	
Amaurobiidae sp3			*	
Amaurobiidae sp6			*	
Segestriidae sp2			*	

Appendix 11b. Two-way table showing spider species by community type

Corasoides sp		*
Theriidae G1		*
Habronestes sp1		*
Teyl sp1	*	
Amaurobiidae sp2	*	
Gnaposiidae G6	*	
Textricella sp2	*	
Plurident A	*	
Metinae sp2	*	
Theriidae G3	*	
Habronestes sp8	*	

APPENDIX 12.

ARACHNID SPECIES (SPIDERS, HARVEST SPIDERS, SCORPIONS AND PSEUDOSCORPIONS) RECORDED IN MOUNTAIN SURVEY

SYSTEMATIC SURVEY SITES SHOWN IN BOLD

#O = OPPORTUNISTIC COLLECTION

APPENDIX 12. ARACHNID SPECIES (SPIDERS, HARVEST SPIDERS, SCORPIONS PSEUDOSCORPIONS) RECORDED IN MOUNTAIN SURVEY. Systematic survey sites shown in **bold**, #0 = opportunistic collection.

ARANEAE	**Tool 227**	**Tool 228**	**Poron 226**	**Poron 215**	**Bluff Knoll 213**	**Bluff Knoll 214**	**Bluff Knoll 230**	**Mond 217**	**Mond 218**	**Mt Lind. 231**	**Mt Lind. 208**	**Magog 209**	**Magog 232**	Manypeaks 201	Manypeaks 202	Mt Ragged 222	Mt Ragged Invert 1	Thumb Peak invert 1	Thumb Peak Invert 2	Ellen Peak 211.1	Ellen Peak 1
MYGALOMORPHAE																					
Idiopidae																					
Eucyrtops sp. 1																					
Eucyrtops sp. 2					#	#															#
Eucyrtops sp. 3																					
Eucyrtops sp. indet																		#			
Neohomogona sp. 1		#											#		#						
Neohomogona ?stirlingi								#	#												
Neohomogona sp. 3																					
Migidae														#	#						
Moggridgea sp. 1																					
Nemesiidae													#								
Aname sp. 1																					
Aname sp. 2																#					
Chenistonia tepperi						#	#									#					
Chenistonia sp. 1	#	#	#	#					#		#		#					#	#		
Chenistonia sp. 3								#				#			#						
Stanwellia sp. 1						#											#				
Stanwellia sp. 2			#	#																#	
Teyl sp. 1																					
Teyl sp. 2											#										
ARANEOMORPHAE										#	#			#	#		#				
Amaurobiidae																					
Amaurobiidae sp. 1			#	#																	
Amaurobiidae sp. 2											#										
Amaurobiidae sp. 3									#												
Amaurobiidae sp. 4																					
Amaurobiidae sp. 5					#										#						
Amaurobiidae sp. 6									#												#
Amaurobiidae sp. 7				#																	
Amaurobiidae sp. 8																					
Amaurobiidae sp. 9			#										#								
Amaurobiidae indet							#														
Araneidae																#	#				

APPENDIX 12. ARACHNID SPECIES (SPIDERS, HARVEST SPIDERS, SCORPIONS PSEUDOSCORPIONS) RECORDED IN MOUNTAIN SURVEY.
Systematic survey sites shown in **bold**, #0 = opportunistic collection.

	Tool 227	Tool 228	Poron 226	Poron 215	Bluff Knoll 213	Bluff Knoll 214	Bluff Knoll 230	Mond 217	Mond 218	Mt Lind. 231	Mt Lind. 208	Magog 209	Magog 232	Manypeaks 201	Manypeaks 202	Mt Ragged 222	Mt Ragged Invert 1	Thumb Peak invert 1	Thumb Peak Invert 2	Ellen Peak 211.1	Ellen Peak 1
Argiope protensa																#					
Cyclosa sp.																#O					
Eriophora biapicata																#O					
Eriophora sp.?						#O															
Eriophora pustulosa																#O					
Archeidae																					
Austrarchaea sp.																				#	
Clubionidae																					
Clubiona sp. 1							#	#													
Clubiona sp. 2												#	#								
Corinnidae																					
Corinnidae Genus1 sp1				#				#					#								
Supunna sp.1 nr *picta*								#	#											#	
Ctenidae																					
Ctenidae sp. 1	#	#		#				#			#										
Ctenidae sp. 2	#	#	#	#	#			#		#	#	#	#								#
Ctenidae sp. 3						#															
Ctenidae sp. 4					#	#														#	
Ctenidae sp. 5				#						#				#							
Ctenidae sp. 6																	#				
Ctenidae indet			#												#						
Cycloctenidae																					
Cycloctenidae sp. 1							#														
Cycloctenidae sp. 2			#	#	#	#									#						
Desidae																					
Badumna sp.	#																				
Desidae sp. 1					#		#		#						#						
Desidae sp. 2			#																		
Gallieniellidae																					
Gallieniellidae Gen1 sp1																	#	#	#		
Gnaphosidae																					
Gnaphosidae Gen1 sp1												#									
Gnaphosidae Gen2 sp1		#																			
Gnaphosidae Gen3 sp1												#	#								
Gnaphosidae Gen4 sp1					#																

APPENDIX 12. ARACHNID SPECIES (SPIDERS, HARVEST SPIDERS, SCORPIONS PSEUDOSCORPIONS) RECORDED IN MOUNTAIN SURVEY. Systematic survey sites shown in **bold**, #0 = opportunistic collection.

	Tool 227	**Tool 228**	**Poron 226**	**Poron 215**	**Bluff Knoll 213**	**Bluff Knoll 214**	**Bluff Knoll 230**	**Mond 217**	**Mond 218**	**Mt Lind. 231**	**Mt Lind. 208**	**Magog 209**	**Magog 232**	Manypeaks 201	Manypeaks 202	Mt Ragged 222	Mt Ragged Invert 1	Thumb Peak invert 1	Thumb Peak Invert 2	Ellen Peak 211.1	Ellen Peak 1
Gnaphosidae Gen4 sp2																			#O		
Gnaphosidae Gen5 sp1							#														
Gnaphosidae Gen6 sp1											#										
Hahniidae																					
Hahniidae sp. 1				#																	
Hahniidae sp. 2										#				#							
Hahniidae sp. 3					#			#	#	#	#		#								
Hahniidae sp. 4	#				#	#		#												#	
Hahniidae sp. 5				#																	
Linphyiidae																					
Linyphiidae sp. 1					#																
Linyphiidae sp. 2				#		#	#										#				
Linyphiidae sp. 3				#	#																
Linyphiidae sp. 4	#		#	#		#		#		#	#	#		#							
Linyphiidae sp. 5																			#		
Linyphiidae sp. 6						#															
Linyphiidae sp. 7																				#	
Linyphiidae sp. 8							#														
Linyphiidae indet																					
Lycosidae																					
Lycosidae sp. 1				#	#	#	#	#		#	#										
Lycosidae sp. 2						#															
Lycosidae sp. 3					#		#				#										
Lycosidae sp. 4	#	#		#O							#	#								#	
Lycosidae sp. 5			#	#		#	#	#	#	#	#		#								
Lycosidae sp. 6																#					
Lycosidae indet															#			#	#		
Micropholcommatidae																					
Micropholcomma sp. 1													#								
Micropholcomma sp. 2				#																	
Micropholcomma sp. 3														#							
Textricella sp. 1			#		#		#		#		#										
Textricella sp. 2											#										
Mimetidae																					
Australomimetus sp.										#											

APPENDIX 12. ARACHNID SPECIES (SPIDERS, HARVEST SPIDERS, SCORPIONS PSEUDOSCORPIONS) RECORDED IN MOUNTAIN SURVEY.
Systematic survey sites shown in **bold**, #0 = opportunistic collection.

	Tool 227	Tool 228	Poron 226	Poron 215	**Bluff Knoll 213**	**Bluff Knoll 214**	**Bluff Knoll 230**	**Mond 217**	**Mond 218**	**Mt Lind. 231**	**Mt Lind. 208**	**Magog 209**	**Magog 232**	Manypeaks 201	Manypeaks 202	Mt Ragged 222	Mt Ragged Invert 1	Thumb Peak invert 1	Thumb Peak Invert 2	Ellen Peak 211.1	Ellen Peak 1
Miturgidae																					
Miturgidae sp. 1																		#			
Miturgidae sp. 2										#											
Nicodamidae																					
Ambicodamus marae		#		#		#			#											#	
Oonopidae																					
Orchestina sp.				#O																	
Orsolobidae																					
Tasmanoonops mainae		#		#		#		#	#	#		#	#	#		#					
Pisauridae																					
Pisauridae sp. 1				#O																	
Prodidomidae																					
Molycriinae sp. 1															#						
Salticidae																					
Lycidas sp. 1			#	#		#	#						#								
Lycidas sp group sp 1						#		#	#			#	#								
'Lycidas' michaelseni																#					#
Tuala sp. 1		#																			
Ocrisiona sp. 1					#O																
Maratus pavonis												#O									
Maratus mungaich																				#	
Maratus pavonis?						#															
Maratus sp. nov.																#					
Margaromma sp.																					#
Opisthoncus sp.																		#O			
Tara sp.														#							
Salticidae genus A sp 1				#																	
Plurident genus A											#										
Unident genus A						#		#													
Unident genus B					#																
Segestriidae																					
Segestriidae sp. 1					#	#			#				#								
Segestriidae sp. 2									#												
Segestriidae sp. 3																					#
Segestriidae sp. 4								#				#									

APPENDIX 12. ARACHNID SPECIES (SPIDERS, HARVEST SPIDERS, SCORPIONS PSEUDOSCORPIONS) RECORDED IN MOUNTAIN SURVEY.
Systematic survey sites shown in **bold**, #0 = opportunistic collection.

	Tool 227	Tool 228	Poron 226	Poron 215	**Bluff Knoll 213**	**Bluff Knoll 214**	**Bluff Knoll 230**	**Mond 217**	**Mond 218**	**Mt Lind. 231**	**Mt Lind. 208**	**Magog 209**	**Magog 232**	Manypeaks 201	Manypeaks 202	Mt Ragged 222	Mt Ragged Invert 1	Thumb Peak invert 1	Thumb Peak Invert 2	Ellen Peak 211.1	Ellen Peak 1
Stiphidiidae																					
Corasoides sp.									#												
Forsterina sp. 1													#								
Forsterina sp. 2																#	#				
Baiami montana				#O				#	#		#			#	#						
Baiami sp.	#															#		#			
Stiphidiidae sp. 1					#							#		#	#					#	
Stiphidiidae sp. 2					#	#															
Stiphidiidae sp. 3												#									
Stiphidiidae sp. 4	#																				
Stiphidiidae Unidentified											#										
Tetragnathidae																					
Nephila edulis																	#				
Metinae sp. 1												#									
Metinae sp. 2											#										
Theridiidae																					
Euryopis sp.			#																		
Theriidae Genus1 sp 1									#												
Theriidae Genus 2 sp. 1													#								
Theriidae Genus 3 sp. 1											#										
Theriidae Genus 4 sp. 1													#								
Thomasidae																					
Diaea sp.													#O								
Steatoda sp.														#		#					
Sidymella sp.	#			#	#					#	#					#		#	#	#	
Stephanopis sp. 1																					#
Stephanopis sp. 2			#																		
Stephanopis sp. 3															#						
Stephanopis sp. 4						#															
Toxopidae																					
Laestrygones sp.																#	#				
Toxops sp.						#														#	
Zodariidae																					
Habronestes sp. 1									#						#						

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Systematic survey sites shown in **bold**, #0 = opportunistic collection.

	Tool 227	Tool 228	Poron 226	Poron 215	**Bluff Knoll 213**	**Bluff Knoll 214**	**Bluff Knoll 230**	**Mond 217**	**Mond 218**	**Mt Lind. 231**	**Mt Lind. 208**	**Magog 209**	**Magog 232**	Manypeaks 201	Manypeaks 202	Mt Ragged 222	Mt Ragged Invert 1	Thumb Peak invert 1	Thumb Peak Invert 2	Ellen Peak 211.1	Ellen Peak 1
Habronestes sp. 2					#	#	#					#									
Habronestes sp. 3						#	#														#
Habronestes sp. 4															#						
Habronestes sp. 5			#	#				#	#				#								
Habronestes sp. 6				#						#											
Habronestes sp. 7				#																	
Habronestes sp. 8											#				#						
Neostorena sp.					#	#	#				#			#				#			
Nostera sp.																					
Zodariidae indet																#					
OPILIONIDA																					
Caddidae																					
Hesperopilio mainae					#	#			#		#		#		#					#	
Megalopsalididae																					
Megalopsalis sp.					#	#	#					#			#					#	
Spinicrus sp.	#		#	#	#	#	#	#	#	#	#		#	#	#			#	#	#	
Neopilionidae																					
Ballarra sp.																#					
Triaenonychidae																					
Nunciella sp.	#	#	#	#	#	#	#	#	#			#		#	#		#				
PSEUDOSCORPIONIDA																					
Chthoniidae																					
Pseudotyrannochthonius sp.						#														#	
SCORPIONIDA																					
Bothriuridae																					
Cercophonius sulcatus				#	#			#													
Buthidae																					
Lychas marmoreus								#													
Scorpionidae																					
Urodacus novaehollandiae																		#	#		

APPENDIX 13

DIEBACK SUSCEPTIBILITY RATING OF SELECTED PLANT SPECIES FROM MOUNTAIN SURVEY

DIEBACK RATING: 1-12

	Disease Susceptibility [1]			
Evidence [2]	Resistant	Low	Variable	High
Inferred	3	4	7	10
Limited	2	5	8	11
Good	1	6	9	12

[1] Susceptibility:
Resistant = no deaths observed, no secondary symptoms apparent
Low susceptability = generally < 20% killed at any location, and/or other secondary symptoms observed
Variable susceptability = 20-80% killed varying with location
High susceptability = generally > 80% killed

[2]Evidence: Inferred: based on trends observed in members of the same genera,
Limited: based on one observation / sampling
Good: based on several observations

DIEBACK AUTHORITY: B = S.Barrett
Gr = M. Grant
W = R.T.Wills
WJ = G. Wardell-Johnson

E = Endemism (see Appendix 5)

P = Priority & Rare Taxa (see Appendix 6)

APPENDIX 13

TAXON	E	P	DB Rating	Authority
Adiantaceae				
Cheilanthes austrotenuifolia			3	W
Anthericaceae				
Agrostocrinum scabrum			3	WJ
Johnsonia lupulina			1	WJ
Apiaceae				
Xanthosia rotundifolia	eS	P3	2	B
Platysace compressa			2	B
Platyscae sp. Stirling (JM Fox 88/262)	eS	P2	2	B
Xanthosia rotundifolia			1	W
Xanthosia rotundifolia var. hypoleuca	eS		1	B
Actinotus rhomboideus	eS	P2	5	B
Asteraceae				
Helichrysum macranthum			2	B
Olearia aff. axillaris Stirling Ra (SB 290)	eS		2	B
Casuarinaceae				
Allocasuarina trichodon			2	B
Allocasuarina humilis			1	W
Allocasuarina decussata			2	B
Allocasuarina fraseriana			11	WJ
Colchicaceae				
Burchardia multiflora			1	WJ
Burchardia congesta			2	WJ
Cyperaceae				
Mesomelaena graciliceps			1	B
Lepidosperma gladiatum			3	W
Lepidosperma squamatum			2	B
Lepidosperma tenue			1	B
Lepidosperma viscidum			1	W
Lepidosperma effusum			3	WJ
Mesomelaena tetragona			1	W
Schoenus efoliatus			2	B
Tetraria capillaris			1	B
Isolepis aff. congrua (SB 535)	eS		2	B
Mesomelaena stygia			1	W
Lepidosperma brunonianum			3	B
Lepidosperma sp. Stirling Ra (SB 42)	eS		1	B
Lepidosperma angustatum			1	W
Dasypogonaceae				
Lomandra pauciflora			2	W
Lomandra nigricans			3	W
Kingia australis			1	W
Dasypogon bromeliifolius			5	W
Dennstaedtiaceae				
Pteridium esculentum			2	W
Dilleniaceae				
Hibbertia commutata			5	W
Droseraceae				
Drosera stolonifera ssp. monticola	eS		2	B
Drosera huegelii dwarf form			2	B
Epacridaceae				
Andersonia lehmanniana			10	B
Andersonia sprengelioides			11	B
Leucopogon propinquus			3	W
Leucopogon unilateralis			5	B
Leucopogon parviflorus			5	B
Andersonia echinocephala	eS/B	P3	12	B
Andersonia caerulea			11	W
Leucopogon lasiostachyus	eS*	P2	5	W
Leucopogon atherolepis			11	B
Leucopogon gnaphalioides	eS		12	B
Leucopogon australis			6	B
Leucopogon gibbosus			12	W
Lysinema ciliatum			12	W
Sphenotoma squarrosum			12	W
Sphenotoma parviflorum		P3	10	B
Leucopogon lasiophyllus	eS*		7	W
Monotoca oligarrhenoides			11	B
Sphenotoma capitatum			10	B
Sphenotoma dracophylloides			11	W

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Sphenotoma drummondii	eS M*	DRF	12	B
Andersonia axilliflora	eS	DRF	12	B
Andersonia sp. Mt Lindesay	eL		11	Gr
Andersonia aff. setifolia (SB 129)	eL		11	B
Sphenotoma aff. dracophylloides (SB 54)	eS/L		12	B
Goodeniaceae				
Velleia foliosa	eS	P3	1	B
Dampiera fasciculata			2	B
Dampiera linearis			1	W/B
Goodenia caerulea			2	W
Goodenia scapigera			2	W
Haemodoraceae				
Conostylis setigera			1	W
Iridaceae				
Patersonia occidentalis			2	W
Patersonia umbrosa			2	B
Lauraceae				
Cassytha glabella			1	B
Lindsaeaceae				
Lindsaea linearis			1	WJ
Loganiaceae				
Logania serpyllifolia			2	WJ
Mimosaceae				
Acacia veronica	eS	P3	2	B
Acacia myrtifolia			8	W
Acacia drummondii			2	B
Myrtaceae				
Agonis spathulata			5	W
Agonis parviceps			6	W
Eucalyptus staeri			6	W
Astartea fascicularis			1	B
Calothamnus affinis	eS	P3	4	B
Beaufortia anisandra			6	B
Beaufortia decussata			6	W
Calothamnus crassus	eS	P2	6	B
Darwinia collina	eS	DRF	6	B
Darwinia lejostyla	eS	P4	1	W
Eucalyptus talyuberlup	eS*		3	B
Eucalyptus tetraptera			1	W
Agonis hypericifolia			9	W
Eucalyptus marginata			6	W
Hypocalymma phillipsii	eS	P3	2	B
Kunzea montana	eS		6	B
Melaleuca microphylla			3	W
Melaleuca thymoides			9	W
Hypocalymma myrtifolium	eS		2	W/B
Eucalyptus preissiana			1	W
Eucalyptus megacarpa			1	W/B
Homalospermum firmum			2	B
Eucalyptus erectifolia	eS	P4	2	B
Eucalyptus doratoxylon			2	B
Eucalyptus diversicolor			1	G
Agonis juniperina			1	W
Darwinia squarrosa	eS	DRF	6	B
Agonis parviceps x linearifolia (SB 326)			2	B
Eucalyptus calophylla			1	W
Agonis aff marginata (SB 150)			5	B
Agonis linearifolia var. linearifolia			4	W
Olacaceae				
Olax phyllanthi			1	W
Orchidaceae				
Monadenia bracteata			2	B
Caladenia flava			3	W
Cryptostylis ovata			1	W
Elythranthera brunonis			3	W
Pterostylis aff. nana (SB 142)			2	B
Pterostylis vittata			3	WJ
Thelymitra pauciflora			3	WJ
Papilionaceae				
Aotus genistoides			8	B
Pultenaea reticulata			12	WJ
Hovea chorizemifolia			2	WJ

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Nemcia sp. Magog (SB 55)	eS		4	B
Gastrolobium bilobum			3	W
Nemcia aff. rubra (SB 611)	eS		8	B
Nemcia pulchella	eS		9	B
Nemcia leakeana	eS		4	B
Bossiaea webbii			1	W
Nemcia vestita	eS		4	B
Nemcia rubra	eS		8	B
Nemcia sp. Ellen Pk (SB 245)	eS		4	B
Gompholobium confertum			7	WJ
Bossiaea rufa			2	W
Pittosporaceae				
Sollya drummondii		P2	2	B
Poaceae				
Agrostis aemula		3	W	
Tetrarrhena laevis		3	W	
Amphipogon laguroides		2	B	
Briza maxima			3	W
Poa porphyroclados		2	B	
Proteaceae				
Banksia sphaerocarpa			9	W
Banksia gardneri		9	W	
Grevillea fuscolutea	eL	P2	4	B
Banksia gardneri		8	W	
Dryandra montana	eS	DRF	12	B
Grevillea coccinea	eB	P3	4	B
Banksia nutans			10	Gr
Lambertia ericifolia	eS*		10	B
Dryandra armata			11	Gr
Banksia quercifolia			12	WJ
Banksia solandri	eS	P4	12	B
Banksia verticillata		DRF	12	W
Banksia violacea			12	W
Conospermum caeruleum			8	Gr
Conospermum dorrienii	eS		8	Gr
Banksia oreophila	eS	B	12	B
Dryandra baxteri			12	B
Dryandra concinna	eS	P4	11	B
Dryandra foliolata		P4	11	B
Dryandra formosa			8	B
Dryandra nivea			9	W
Dryandra plumosa			11	Gr
Dryandra quercifolia			11	Gr
Adenanthos obovatus			11	W
Persoonia micranthera	eS	P1	12	B
Adenanthos cuneatus			5	WJ
Adenanthos ellipticus	eB	DRF	12	Gr
Adenanthos filifolius	eS		11	W
Adenanthos labillardierei	eB*	P4	11	W
Banksia lemanniana		10	Gr	
Adenanthos oreophilus	eB	R*	12	W
Banksia baueri			11	Gr
Banksia baxteri			12	W
Banksia brownii		DRF	12	B
Banksia coccinea			12	Gr
Banksia grandis			12	W
Dryandra armata var. nova ms			11	Gr
Lambertia inermis			12	W
Isopogon buxifolius			12	W
Isopogon formosus			11	Gr
Isopogon latifolius	eS		11	B
Isopogon sphaerocephalus			9	W
Lambertia fairallii	eS	DRF	12	Gr
Isopogon baxteri	eS/M*		5	Gr
Lambertia uniflora			11	W
Persoonia longifolia			11	W
Petrophile carduacea	eS		10	B
Petrophile divaricata			12	W
Petrophile diversifolia			12	W
Synaphea polymorpha			8	W
Grevillea fasciculata			8	B
Hakea elliptica			8	Gr
Grevillea infundibularis	eB	DRF	4	B

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Hakea ambigua	eS*		9	W
Hakea baxteri			9	W
Hakea ceratophylla			5	W
Hakea crassifolia			8	Gr
Hakea cucullata			9	W
Grevillea fistulosa	eB	P2	4	B
Hakea hookeriana	eB	P2	7	B
Hakea varia			5	W
Hakea victoria			6	W
Isopogon attenuatus			5	B
Restionaceae				
Anarthria prolifera			1	W/B
Loxocarya flexuosa			2	B
Loxocarya fasciculata			8	WJ
Rutaceae				
Boronia crenulata			1	WJ
Boronia spathulata			1	W/B
Boronia crenulata var. viminea			2	B
Sterculiaceae				
Thomasia sp. Toolbrunup (SB 284)	eS		2	B
Stylidiaceae				
Stylidium sp. Stirling Ra (SB 115)	eS		2	B
Stylidium keigheryi	eS	P2	2	B
Stylidium imbricatum			2	B
Stylidium spinulosum ssp. montanum	eS		2	B
Stylidium verticillatum	eS	P3	2	W
Stylidium scandens			1	B
Thymelaeaceae				
Pimelea hispida			2	W
Tremandraceae				
Tetratheca setigera			12	W
Xanthorrhoeaceae				
Xanthorrhoea platyphylla			12	W
Xanthorrhoea preissii			12	W
Xyridaceae				
Xyris sp. Bluff Knoll	eS	DRF	2	B

APPENDIX 14 FIRE RESPONES OF SELECTED PLANT SPECIES FROM MOUNTAIN SURVEY

FIRE RESPONSE = FIRE RESPONSE CATEGORY 1-10

Fire Response	Category
Mature plants die following 100% leaf-scorch (Category 8 if no further data available):	8
*propagules present after fire in the form of canopy stored seed	1
*propagules present after fire in the form of soil stored seed	2
*no propagules remain on site after fire	3
Mature plants survive 100% canopy scorch (Category 9 if no further data available):	9
*resprout from root suckers or rhizomes	4
*resprout from basal stem buds eg. lignotubers	5
*resprout from epicormic shouts	6
*resprout from unharmed usually terminal buds	7
*Resprout underground corm or bulb	11
Ferns & Allies	
*reproduces by rhizomes or spores	10

FIRE RESPONSE AUTHORITY:

B = S.BARRETT

K = G.Keighery (unpub)

Mc = L. McCaw (unpub)

WJ = G.Wardell-Johnson (unpub)

RC = Robinson & Coates (1995)

N= K.Newbey (unpub)

G = George (1984)

BELL = Bell *et al.*, (1995)

E = **ENDEMIC** (see Appendix 5)

P = **PRIORITY OR RARE TAXA** (see Appendix 6)

APPENDIX 14	E	P	Fire Response & Authority	
Adiantaceae				
Adiantum aethiopicum			10	B
Anthericaceae				
Thysanotus dichotomus			5	B
Chamaescilla corymbosa			11	WJ
Agrostocrinum scabrum			5	WJ
Johnsonia lupulina			5	WJ
Apiaceae				
Xanthosia collina	eS	P3	8	K
Actinotus rhomboideus	eS	P2	2	B
Xanthosia pusilla		2	B	
Platysace compressa			5	WJ
Xanthosia rotundifolia var. rotudifolia			5	B
Trachymene ornata			2	B
Xanthosia rotundifolia var. hypoleuca	eS	P3	5	B
Trachymene pilosa			2	B
Trachymene anisocarpa		P2	2	B
Asteraceae				
Olearia paucidentata			2	Bell
Olearia aff. axillaris Stirling Ra (SB 290)	eS		2	B
Cotula bipinnata *			8	B
Senecio glomeratus			8	B
Senecio hispidulus			8	B
Senecio ramosissimus			8	WJ
Sonchus oleraceus *			8	B
Hyalosperma cotula			8	B
Millotia tenuifolia			8	B
Helichrysum macranthum			8	B
Ursinia anthemoides *			8	B
Caesalpiniaceae				
Labichea lanceolata			2	B
Caryophyllaceae				
Cerastium glomeratum*			8	B
Stellaria media*			8	B
Casuarinaceae				
Allocasuarina humilis			5	B
Allocasuarina fraseriana			6	B
Allocasuarina decussata			6	B
Colchicaceae				
Burchardia multiflora			11	WJ
Burchardia congesta			11	WJ
Cupressaceae				
Callitris preissii			1	B
Cyperaceae				
Lepidosperma angustatum			5	WJ
Lepidosperma gladiatum			5	WJ
Lepidosperma effusum			5	WJ
Mesomelaena stygia			5	Mc
Lepidosperma sp. Stirling Ra (SB 42)	eS		9	B/K
Mesomelaena tetragona			5	WJ
Lepidosperma tenue			5	WJ
Tetraria octandra			9	B
Tetraria capillaris			9	B
Dasypogonaceae				
Lomandra hastilis			2	Mc
Lomandra nigricans			5	WJ
Calectasia cyanea			2	MC
Kingia australis			7	WJ
Dasypogon bromeliifolius			7	WJ
Dennstaedtiaceae				
Pteridium esculentum			4	WJ
Dilleniaceae				
Hibbertia commutata			5	WJ
Hibbertia furfuracea			5	WJ
Hibbertia verrucosa			8	B
Hibbertia glomerata			2	B
Hibbertia microphylla			5	B
Hibbertia mucronata			8	B
Hibbertia nutans			8	B
Hibbertia pilosa			2	B
Hibbertia serrata			5	WJ
Hibbertia sp. Porongurups ms	eP	DRF	2	K
Hibbertia subvaginata			8	B

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Hibbertia argentea		P3	2	B
Hibbertia amplexicaulis			9	WJ/B
Droseraceae				
Drosera erythrogyne			8	WJ
Epacridaceae				
Andersonia caerulea			2	WJ/B
Lysinema ciliatum			2	Mc
Lysinema fimbriatum			2	B
Astroloma tectum			9	B/WJ
Astroloma pallidum			9	WJ
Monotoca oligarrhenoides			2	B
Andersonia sprengelioides			2	WJ
Andersonia echinocephala	eS/B	P3	2	B
Andersonia aff. setifolia (SB 129)	eL		5	B
Andersonia axilliflora	eS	DRF	2	B/K
Monotoca tamariscina			2	B
Sphenotoma aff. dracophylloides (SB 54)	eS/L		2	B
Sphenotoma capitatum			2	B
Sphenotoma dracophylloides			2	B
Sphenotoma drummondii	eS/M*	DRF	2	K/B
Sphenotoma parviflorum		P3	2	B
Sphenotoma squarrosum			2	WJ
Leucopogon sp. Thumb Pk (SB 323.1)	eB		2	B
Leucopogon propinquus			5	WJ
Leucopogon lasiostachyus	eS*	P2	2	K
Leucopogon mollis			2	B
Leucopogon obovatus			5	WJ/B
Leucopogon verticillatus			5	WJ
Leucopogon gnaphalioides	eS		2	B
Leucopogon parviflorus			5	B
Leucopogon glabellus			2	B
Leucopogon gibbosus			2	Mc/B
Leucopogon lasiophyllus	eS*		2	K
Leucopogon flavescens var. brevifolius			2	B
Leucopogon cuneifolius			2	B
Leucopogon australis			5	WJ
Leucopogon atherolepis			5	B
Leucopogon assimilis			2	B
Leucopogon apiculatus		P3	2	B
Leucopogon aff. assimilus (SB 385)			2	B
Leucopogon tenuis			2	B
Leucopogon unilateralis			2	B
Euphorbiaceae				
Ricinocarpos glaucus			2	WJ
Phyllanthus calycinus			5	B
Goodeniaceae				
Dampiera juncea			2	Mc
Velleia foliosa	eS	P3	2	B/K
Goodenia decursiva		2	B	
Dampiera fasciculata			5	B
Dampiera tenuicaulis			5	B
Dampiera linearis			4	WJ
Dampiera loranthifolia			5	B
Scaevola brookeana	eR	P2	9	B
Dampiera parvifolia			5	B
Haemodoraceae				
Conostylis setigera			5	WJ
Haloragaceae				
Gonocarpus rudis	eS	P2	8	K
Glischrocaryon aureum			9	B
Iridaceae				
Patersonia occidentalis			5	WJ
Patersonia umbrosa			5	WJ
Lamiaceae				
Hemigenia podalyrina			2	B
Lamiaceae				
Lindsaea linearis			10	WJ
Loganiaceae				
Logania serpyllifolia			5	WJ
Menyanthaceae				
Villarsia calthifolia	eP	DRF	8	K
Villarsia marchantii	eP	P4	8	K

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Mimosaceae					
Acacia alata			2	B	
Acacia browniana			2	B	
Acacia congesta			2	B	
Acacia crassiuscula			2	B	
Acacia divergens			2	WJ	
Acacia drummondii			2	B	
Acacia drummondii ssp. elegans (Porongorup variant)	eP	P2	2	B	
Acacia heteroclita	eP	P2	2	K	
Acacia myrtifolia		2	B		
Acacia veronica	eS	P3	2	B	
Myoporaceae					
Myoporum tetrandrum			8	WJ	
Myrtaceae					
Calothamnus quadrifidus			5	Bell/B	
Kunzea montana	eS		2	B/K	
Calothamnus crassus	eS	P2	9	K/B	
Kunzea ericifolia			5	Bell	
Beaufortia decussata			5	B	
Melaleuca blaeriifolia			1	B	
Melaleuca diosmifolia		P3	9	RC	
Melaleuca fulgens			5	B	
Hypocalymma phillipsii	eS	P3	5	K	
Hypocalymma myrtifolium	eS		5	B/K	
Homalospermum firmum		5	B		
Darwinia collina	eS	DRF	8	K/B	
Darwinia lejostyla	eS	P4	8	K/B	
Darwinia macrostegia	eS	DRF	8	K	
Darwinia sp. Mt Ragged	eR		8	B	
Darwinia squarrosa	eS	DRF	8	B	
Darwinia vestita			2	Mc	
Agonis obtusissima			8	B	
Agonis aff. floribunda (SB 490)				5	B
Agonis aff. marginata (SB 150)				1	B
Agonis hypericifolia			5	WJ/B	
Agonis juniperina			1	WJ	
Agonis linearifolia var. conspicua			5	B	
Agonis linearifolia var. linearifolia			5	B	
Agonis marginata			5	WJ	
Melaleuca microphylla			6	WJ	
Agonis parviceps			5	B	
Agonis parviceps x linearifolia (SB 326)			5	B	
Agonis spathulata			5	Mc	
Astartea fascicularis			8	WJ/B	
Melaleuca thymoides			5	B	
Melaleuca striata			9	N/B	
Melaleuca pentagona			5	B	
Beaufortia anisandra			1	B	
Eucalyptus calophylla			6	B	
Eucalyptus acies		P3	9	B	
Eucalyptus doratoxylon			9	B	
Eucalyptus erectifolia	eS	P4	9	K	
Eucalyptus marginata			6	B	
Eucalyptus megacarpa			6	B	
Eucalyptus preissiana			9	B	
Eucalyptus tetraptera			9	B	
Eucalyptus talyuberlup	eS*		9	B	
Eucalyptus staeri			9	B	
Olacaceae					
Olax phyllanthi			8	WJ	
Orchidaceae					
Cyrtostylis huegelii			11	WJ	
Cryptostylis ovata			11	WJ	
Caladenia flava			11	WJ	
Pterostylis aff. nana (SB 142)			11	WJ	
Pterostylis vittata			11	WJ	
Elythranthera brunonis			11	WJ	
Thelymitra pauciflora			11	WJ	
Papilionaceae					
Nemcia rubra	eS		2	K	
Gompholobium venustum			2	Mc	
Gastrolobium bilobum			2	WJ	

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Pultenaea reticulata			2	WJ
Eutaxia epacridoides			2	B
Nemcia aff. rubra (SB 611)	eS		2	K
Nemcia coriacea			2	B
Nemcia crenulata	eS		2	K
Nemcia leakeana	eS		5	B
Nemcia pulchella	eS		2	K
Bossiaea webbii			2	B
Nemcia vestita	eS		2	K
Aotus genistoides			2	B
Latrobea tenella			5	B
Gompholobium knightianum			2	B
Gompholobium confertum			2	B
Gastrolobium brownii		P3	2	B
Mirbelia dilatata			2	Bell
Bossiaea rufa			5	WJ/B
Brachysema subcordatum	eP	P4	2	K
Eutaxia obovata			2	WJ/B
Daviesia preissii			5	WJ
Daviesia grossa			5	B
Daviesia incrassata			5	WJ/B
Hovea chorizemifolia			5	WJ
Daviesia inflata			5	Mc
Hovea trisperma			2	WJ
Daviesia obovata	eS/B*	P2	5	B
Gompholobium villosum			2	B
Sphaerolobium vimineum			5	Bell/B
Jacksonia compressa	eB	P4	2	B
Sphaerolobium alatum			2	B
Hardenbergia comptoniana			5	WJ
Phormiaceae				
Stypandra glauca			5	WJ
Pittosporaceae				
Billardiera bicolor			2	Mc
Billardiera granulata	eP/M	P4	8	K
Billardiera variifolia			5	WJ
Poaceae				
Avena barbata *			8	B
Tetrarrhena laevis			4	WJ
Aira praecox*			8	B
Amphipogon amphipogonoides			5	WJ
Briza maxima*			8	WJ
Poa porphyroclados			8	WJ
Danthonia caespitosa			5	WJ
Primulaceae				
Anagallis arvensis *			8	B
Proteaceae				
Adenanthos oreophilus	eB	R*	8	B
Dryandra montana	eS	DRF	1	B
Dryandra longifolia ssp. archeos ms	eR		1	B
Dryandra formosa			1	B
Dryandra nivea			5	B
Dryandra foliolata		P4	1	B
Dryandra cuneata			1	Mc/B
Dryandra concinna	eS	P4	1	B
Dryandra baxteri			1	B
Dryandra quercifolia			1	B
Persoonia longifolia			5	WJ
Persoonia micranthera	eS	P1	8	K
Stirlingia tenuifolia			8	B
Adenanthos cuneatus			5	WJ
Adenanthos ellipticus	eB	DRF	8	B
Adenanthos filifolius	eS		8	B
Adenanthos obovatus			9	B
Petrophile carduacea	eS		8	K
Dryandra plumosa			1	B
Adenanthos labillardierei	eB*	P4	8	B
Petrophile divaricata			1	B
Petrophile diversifolia			1	WJ/B
Grevillea trifida			8	Mc
Isopogon polycephalus			5	B
Grevillea concinna			8	B
Grevillea coccinea	eB	P3	8	B

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Isopogon attenuatus			5	B
Isopogon buxifolius			5	B
Isopogon formosus			1	WJ
Isopogon latifolius	eS		1	B
Grevillea fasciculata			2	B
Isopogon sphaerocephalus			5	WJ
Conospermum dorrienii	eS		2	Mc/K
Conospermum caeruleum			2	Mc
Lambertia ericifolia	eS*		1	B
Lambertia fairallii	eS	DRF	8	K
Lambertia inermis			1	Mc
Lambertia uniflora			1	B
Hakea trifurcata			1	Mc/B
Hakea baxteri			1	B
Hakea ceratophylla			5	WJ
Hakea cucullata			1	B
Hakea elliptica			1	B
Hakea hookeriana	eB	P2	1	B
Grevillea fistulosa	eB	P2	2	N/B
Hakea varia			5	B
Hakea verrucosa			1	B
Hakea victoria			1	B
Grevillea pauciflora			2	B
Grevillea muelleri			2	Mc
Grevillea fuscolutea	eL	P2	2	B
Hakea ambigua	eS*		1	B
Banksia gardneri			5	B
Banksia violacea			1	G
Dryandra armata			5	WJ
Banksia sphaerocarpa			5	B
Banksia solandri	eS	P4	1	B
Banksia quercifolia			1	WJ
Banksia oreophila	eS/B		1	B
Banksia lemanniana			1	G
Banksia grandis			6	B
Banksia verticillata		DRF	1	R
Banksia baueri			1	G
Banksia coccinea			1	B
Banksia brownii		DRF	1	B
Banksia baxteri			1	G
Ranunculaceae				
Clematis pubescens			5	WJ/B
Restionaceae				
Loxocarya flexuosa			4	WJ/B
Loxocarya fasciculata			4	WJ
Anarthria prolifera			9	WJ/B
Rhamnaceae				
Cryptandra congesta	eL	P2	5	B
Trymalium floribundum subsp. trifidum			2	B
Spyridium montanum	eS	P2	8	K
Rubiaceae				
Opercularia vaginata			2	Mc
Opercularia hispidula			5	WJ
Opercularia volubilis			5	WJ
Rutaceae				
Drummondita hassellii	ePC	DRF	2	B
Muiriantha hassellii	eS/M	P2	8	B
Boronia spathulata			5	WJ/B
Boronia crenulata var. viminea			2	B
Crowea angustifolia			2	B
Boronia gracilipes			2	B
Boronia pulchella			2	WJ
Santalaceae				
Leptomeria scrobiculata			9	B
Santalum spicatum			8	B
Leptomeria axillaris			9	B
Santalum acuminatum			8	B
Exocarpos sparteus			8	B
Sapindaceae				
Dodonaea ceratocarpa			5	WJ
Dodonaea pinifolia			5	B
Scrophulariaceae				
Parentucellia viscosa			9	WJ

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Solanaceae				
Anthocercis viscosa			8	B
Anthocercis genistoides			8	B
Solanum nigrum *			3	WJ
Sterculiaceae				
Lasiopetalum dielsii	eS	P2	2	B
Lasiopetalum compactum			2	B
Thomasia sp. Toolbrunup (SB 284)	eS		9	B
Thomasia discolor		P3	2	RC
Lasiopetalum aff. cordifolium	eL*		2	B
Stylidiaceae				
Stylidium imbricatum			2	WJ
Levenhookia pusilla			8	WJ
Stylidium piliferum			2	WJ
Stylidium adnatum			2	WJ
Stylidium sp. Stirling Ra (SB 115)	eS		2	K
Stylidium verticillatum	eS	P3	2	WJ/K
Stylidium spinulosum	eS		2	K
Stylidium repens			9	WJ
Stylidium keigheryi	eS	P2	2	K
Stylidium schoenoides			2	WJ
Stylidium scandens			2	WJ
Stylidium rhynchocarpum			2	WJ
Thymelaeaceae				
Pimelea brevifolia			5	B
Pimelea sylvestris			2	WJ
Pimelea hispida			2	WJ
Pimelea spectabilis			2	B
Pimelea suaveolens			2	Bell
Tremandraceae				
Tremandra stelligera			8	B
Platytheca galioides			8	B
Platytheca juniperina	eS/L/B		8	B
Tetratheca setigera			8	WJ
Xanthorrhoeaceae				
Xanthorrhoea platyphylla			7	B
Xanthorrhoea preissii			7	WJ
Xyridaceae				
Xyris sp. Bluff Knoll	eS	DRF	2	RC

APPENDIX 15. RATES OF REGENERATION OF VEGETATION 5 YEARS POST- FIRE FOR MOUNTAIN SURVEY SITES BURNT IN 1991

APPENDIX 15. RATES OF REGENERATION OF VEGETATION 5 YEARS POST-FIRE

QUADRAT	VEGETATION HEIGHT (CM) MEASURED AT 1M INTERVALS FROM NW TO SW CORNER														AVERAGE HT (CM)	PCC* %	ROCK %
Bluff Knoll 230	9	12	6	17	9	13	15	8	7	5	11	23	13	13	11.5	40	10
Bluff Knoll 229	117	122	67	107	173	158	183	180	177	70	232	188	135	53	140.1	80	20
Bluff Knoll 214	55	136	114	145	116	83	94	80	127	114	208	183	85	80	115.7	75	<2
Bluff Knoll 238	90	30	60	28	60	48	45	75	80	68	35	73	45	60	56.9	80	<2
Mt Lindesay 207	108	95	29	89	108	64	28	1	22	28	53	18	74	34	53.6	50	20
Mt Lindesay 208	70	47	90	70	18	40	80	60	41	44	110	90	80	56	64	80	10
Mt Lindesay 231	63	42	46	70	99	18	92	117	94	18	72	38	8	33	57.9	70	20
Ellen Pk 234	5	90	100	110	18	30	10	12	10	13	56	98	114	112	55.6	60	<2
Mt Ragged 222	65	36	156	203	115	56	80	66	36	100	64	51	0	66	78.1	60	20
Mt Ragged 223	88	16	47	18	0	22	54	38	19	31	21	0	25	0	27.1	40	20

* = percentage canopy cover

APPENDIX 16.

DEFINITIONS OF STATUS OF THREAT TO ECOLOGICAL COMMUNITIES

Category 1
Presumed Totally Destroyed
An ecological community which has been searched for but for which no representative occurrences have been located. The community has been found to be totally destroyed or so extensively modified throughout its range that no occurrence of it is likely to recover its species composition and / or structure in the foreseeable future.

Category 2
Critically Endangered
An ecological community which has been subject to a major contraction in area and / or which was originally of limited distribution and is facing severe modification or destruction
throughout its range in the immediate future, or is already severely degraded throughout its range but capable of being substantially restored or rehabilitated.

Category 3
Endangered
An ecological community which has been subject to a major contraction in area and / or which was originally of limited distribution and is in danger of significant modification throughout its range or severe modification or destruction over most of its range in the near future.

Category 4
Vulnerable
An ecological community which is declining and / or has declined in distribution and whose ultimate security has not yet been assured and / or a community which is still widespread but is believed likely to move into a category of higher threat in the near future if threatening processes continue or begin operating throughout its range.

Category 5
Data Deficient
An ecological community for which there is inadequate data to assign it to one of the above categories and / or which is not yet evaluated with respect to the status of threat.
(Usually an ecological community with poorly known distribution or biology that is suspected to belong to any of the above categories. These ecological communities have a high priority for survey and / or research.

Category 6
Lower Risk
A community which has been evaluated and available information suggests that it does not qualify for one of the above categories of threat.