DRYANDRA STATE FOREST

SPRING 1990

A Comparison of the Vertebrate Fauna

of Selected Mallet Plantations and

Natural Vegetation Communities

Prepared for : Conservation & Land Management

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SUMMARY

A vertebrate fauna survey of Dryandra State Forest took place between October 16 and October 25 with the primary objective of assessing the conservation status of Mallet plantations. Areas of Mallet, Wandoo woodland, Marri woodland and lateritic heath were compared. Equal effort was applied to each systematic sampling site and the soil and vegetation associations of each location were described using the methods devised for the Wheatbelt by Muir (1977). Opportunistic data was also collected.

A total of 66 species of bird were observed. This included one gazetted species, the White-tailed Black-Cockatoo *Calyptorhynchus latirostris* and one introduced species, the Laughing Kookaburra *Dacelo novaeguineae*.

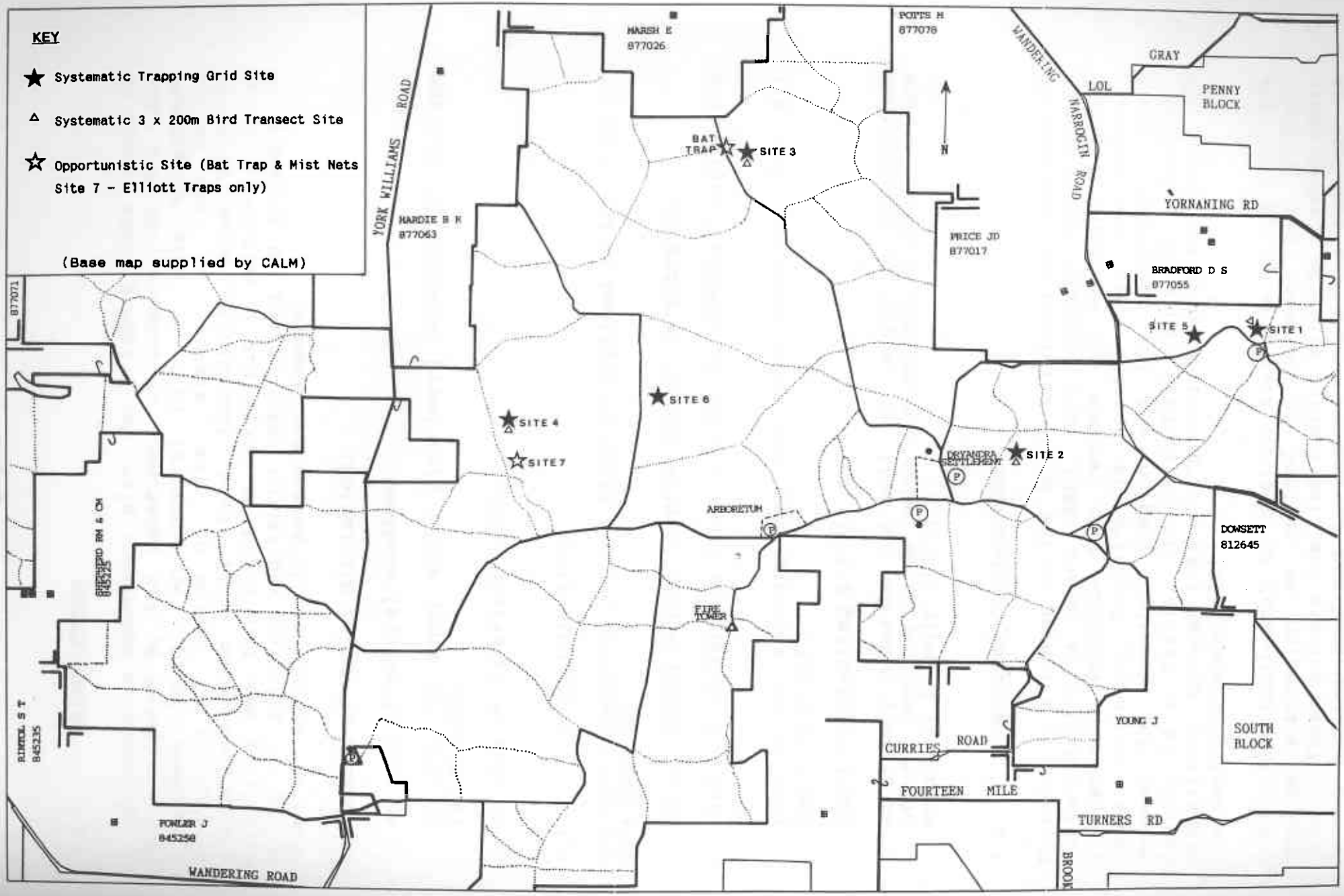
Fourteen native and two introduced mammals were recorded. Two of these are gazetted species, namely the Numbat *Myrmecobius fasciatus* and Brush-tailed Bettong *Bettongia penicillata*. Of the species recorded during this survey, the Honey-possum *Tarsipes rostratus* and the Yellow-footed Antechinus *Antechinus flavipes* are both of interest. The last published records of these species prior to this study were in 1978 and 1965 respectively.

Three amphibians and 18 reptiles were captured. No gazetted species were located although one rare species of snake, the Carpet Python *Morelia spilota imbricata*, is known from Dryandra State Forest.

Systematic data from all sites and all vertebrate groups were compared to assess the relative conservation status of Mallet plantations and it was concluded that:

- there are major differences in vertebrate species richness and abundance between individual Mallet plantations;
- the age of the plantation, the amount of regrowth and the inclusion of habitat elements such as natural vegetation isolates or rocky outcrops have a strong influence on vertebrate species richness and abundance;
- in terms of vertebrate species richness and abundance, Mallet plantations compare favourably with natural vegetation associations depending on the level of representation of the above habitat isolates;
- work by other researchers in natural Mallet has shown that while these associations are generally similar to less productive habitats such as Powderbark Wandoo *Eucalyptus accedens*, they are marginally richer than plantations; and,
- based on other studies, seasonal comparisons may show a greater degree of Mallet plantation usage than was assessed in this single season survey.

FIGURE 1 Map of Dryandra State Forest showing vertebrate fauna sites sampled in October 1990.



1.0 INTRODUCTION

A comprehensive management plan for Dryandra State Forest is being prepared by the Department of Conservation and Land Management (CALM). An integral part of this management process is a review of the status of the Mallet plantations which occur there. Accordingly, Ninox Wildlife Consulting was contracted to carry out a vertebrate fauna survey of selected vegetation associations in Dryandra in order to systematically assess and compare:

- an area of Mallet plantation;
- an area of natural woodland;
- an area of sandy soils with Marri woodland or Kwongan vegetation;
- an area of lateritic heath.

1.1 Study Objectives

The main objectives of this study as outlined in the scope of work were to:

- direct survey effort towards smaller vertebrates;
- list all vertebrate fauna trapped or observed during the survey;
- provide an accurate map and grid reference for all sampling sites;
- quantify sampling effort; and,
- accurately describe the soil and vegetation associations of the sampling sites using the methods devised for the Wheatbelt by Muir (1977).

1.2 Regional Zoogeography

Dryandra is situated in the South-west Botanical Province of Western Australia (Beard 1980). More recently, Beard (1990) divided this Province into regions and according to this latest division, Dryandra is located near the boundary between the Wheatbelt Region and the South-west Forest Region. As a result, its vertebrate fauna is predictably transitional between that of the more mesic Jarrah forest and the semi-arid Wheatbelt.

Birds: the South-west of Western Australia is part of the Bassian sub-region as defined by Serventy and Whittell (1976). These authors describe Bassian birds as predominately forest species confined to country where the rainfall is

higher than 500mm per annum. Figure 4 in Serventy and Whittell depicts the boundary of the majority of Bassian species near the eastern margin of the forest block.

The location of Dryandra places it in the Bassian sub-region. The only comprehensive, published list of birds for Dryandra is that of Job (1969) who described 75 species, the majority of which are typically wide-ranging forest birds. Job's list also included examples of Wheatbelt semi-arid species such as the Mallee-fowl, *Leipoa ocellata*, Chestnut Quail-thrush, *Cinclosoma castanotum*, White-browed Babbler, *Pomatostomus superciliosus*, and the Blue-breasted Fairy-wren, *Malurus pulcherrimus*. Job's list can be compared with that of Sedgwick (1962) for the Williams district, a location situated in similar woodlands south-west of Dryandra. Nearly all the species recorded by Sedgwick were recorded by Job at Dryandra.

This current study added another 12 species to Job's list. These were mainly migratory or nomadic birds, nocturnal species or blossom nomads such as honeyeaters. The combined, published total of birds from the Dryandra forest is thus 87 species.

Mammals: several Dryandra mammals are endemic to the South-west Botanical Province. In many cases they extend well beyond the transitional zone between the Wheatbelt Region and the South-west Forest Region outlined above but have a wider distribution defined by a line from Shark Bay to Israelite Bay. Examples of these are the Western Brush Wallaby *Macropus irma* and the Honey-possum *Tarsipes rostratus*, both of which were recorded during this study. Others are restricted to the deeper south-west and adjacent Wheatbelt of Western Australia either because of their specialised habitat requirements or because their geographic range has contracted since European settlement. Typical examples of these recorded at Dryandra are the Numbat *Myrmecobius fasciatus* and the Brush-tailed Bettong *Bettongia penicillata*.

Amphibians and Reptiles: Chapman and Dell (1985) discussed the zoogeography and distribution of Wheatbelt amphibians and reptiles and presented distribution maps for all species. These maps included the Dryandra area and showed that most species were wide-ranging. Chapman and Dell also concluded that the majority of wide-spread species were usually found on heavier soils and only deep sand specialists tended to be geographically isolated. Because the soils at Dryandra are primarily heavy, and consist of weathered granites and lateritic duricrust the herpetofauna generally reflects that of the Wheatbelt, although a strong South-west Forest Region influence is apparent.

2.0 METHODS

The vertebrate fauna survey took place between October 16 and October 25, 1990. A reconnaissance of the study area was conducted on the first day in association with R. Clifton (CALM Pingelly) and sampling sites were chosen at this time. Brief descriptions of each location are shown below. Detailed vegetation community descriptions with Muir (1977) codes are given in Appendix 1.

Table 1 Vegetation associations sampled at Dryandra State Forest, in October 1990. Expanded vegetation descriptions are given in Appendix 1.

Site 1

(AMG Grid Reference: 6 374 800N 501 250E).

Brown Mallet, *Eucalyptus astringens* plantation.

Site 2

(AMG Grid Reference: 6 373 100N 498 000E).

Mixed Mallet species, *Eucalyptus astringens, E. gardneri* plantation.

Site 3

(AMG Grid Reference: 6 377 150N 494 400E

Wandoo, *Eucalyptus wandoo* woodland .

Site 4

(AMG Grid Reference: 6 373 250N 491 100E).

Powderbark Wandoo, *Eucalyptus accedens* woodland.

Site 5

(AMG Grid Reference: 6 374 800N 500 650E).

Tall heath on lateritic sand.

Site 6

(AMG Grid Reference: 6 374 350N 493 250E).

Marri, *Eucalyptus calophylla* woodland on deep white sand.

Site 7

(AMG Grid Reference: 6 372 750N 491 150E).

Sheoak, *Allocasuarina huegeliana* forest on granite.

* Bat trap site - *Eucalyptus rudis* stream zone.

(AMG Grid Reference: 6 377 200N 494 200E).

Survey effort is tabulated below and the location of sampling areas is shown in Figure 1. In the following description of sampling methods there are two categories of data collection: Census Sampling and Inventory Sampling.

Census sampling: refers to data which was systematically gathered over a fixed time period in an area of known size and of a discrete vegetation type. The resulting information has been used as a standardised base for site comparisons within the study area in order to assess faunal affinities or dissimilarities. This type of sampling also allows for objective seasonal comparisons of sites. Providing the same methods are adhered to, future monitoring can be carried out by any suitably experienced field personnel.

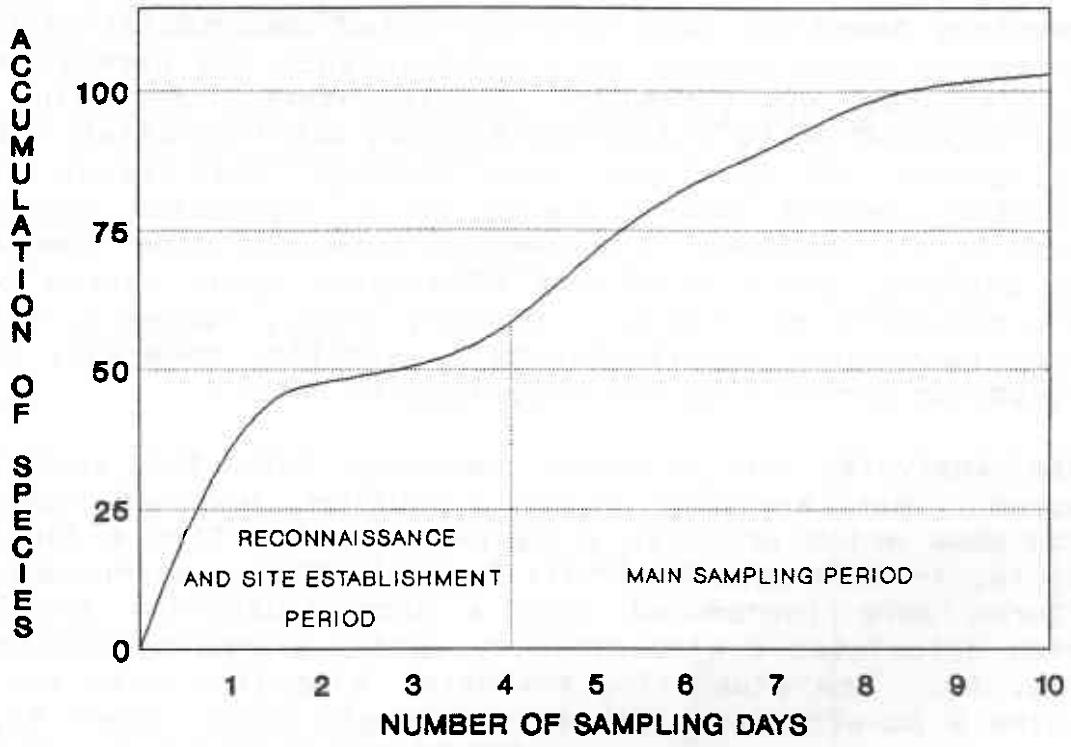
Inventory sampling: includes all opportunistically gathered, non-systematic data such as that recorded during the reconnaissance, transect/trapline establishment or while team members were traversing the study area.

Table 2 Systematic and inventory sampling effort within selected vegetation associations at Dryandra State Forest, October 1990.

SITE NUMBER	1	2	3	4	5	6	7
SYSTEMATIC SAMPLING							
Bird Transects (metres)	600	600	600	600	-	-	-
No. of pit trap/nights	30	30	30	30	30	30	-
No. of Elliott trap/nights	60	60	60	60	60	60	-
No. of cage trap/nights	10	10	10	10	10	10	-
Head torching (hrs)	3	3	3	3	3	3	-
Hand foraging (hrs)	6	6	6	6	6	6	-
INVENTORY SAMPLING							
No. of Elliott trap/nights	-	-	-	-	-	-	125
Head torching (hrs)	-	-	-	-	-	-	3
Hand foraging (hrs)	-	-	-	-	-	-	3
Bat trap/nights	-	-	7	-	-	-	-
Mist nets (metres)	-	-	120	-	-	-	-
Spotlight run	x	x	x	x	x	x	x
Other	As Described						

Figure 2 has been prepared from both inventory and systematic data. It gives an indication of seasonal survey efficiency in that a well-surveyed location would show little or no accumulation of species after an adequate period of time. The Dryandra study had reached this point by the last day. However, the results of this survey were gathered in a single season and it is therefore self-evident that not all species have been recorded. Although the conservation status of Mallet plantations has been determined in this report, some caution should be used in applying this information to final management decisions on the future of Mallet plantations. Their usage by fauna could differ substantially from season to season.

FIGURE 2 Graph showing sampling efficiency of the October 1990 Dryandra State Forest survey.



2.1 Birds

Systematic Sampling: three 200 metre transects were established in each of the Mallet plantations and in both natural Wandoo woodland associations, totalling 1200 metres in Mallet, 600 metres in Wandoo *Eucalyptus wandoo* and 600 metres in Powderbark Wandoo *Eucalyptus accedens*.

All transects were sampled daily between 0600hrs and 1100hrs for five consecutive days. Two observers were rotated between transect sets and sampling times were staggered to minimise

variations in observer bias, weather and peak activity periods of birds. Observers slowly moved along each transect and recorded all birds by sight or sound within five 10 metre distance categories either side of the transect centreline. Accessory information such as breeding activity, feeding behaviour and plant species utilised was logged on to field data sheets for eventual transfer to a computer database.

The resulting data have been used to determine the individual bird species densities within each sampling site. This sampling technique is known as the strip-transect method and variations on it are fully described in Emlen (1971) and Harden *et al.* (1986). Censusing methods such as these are designed to estimate the density per unit area of the "effective area" of observation which varies between bird species and from habitat to habitat. These variations are a result of differing bird sizes, behaviour and the effect of vegetation structure on line of sight.

Inventory Sampling: data were collected opportunistically at systematic sites during the reconnaissance and establishment of traplines and transects. Supplementary information was also gathered while travelling between sampling sites and in the course of spotlight runs through the forest. Each inventory record was allocated to a vegetation community where it corresponded to a sampling site. All other habitats, for example, the Flooded Gum *Eucalyptus rudis* stream zone, were placed in an inventory category ("OP", Tables 3, 4 & 5) which represents opportunistically sampled, generally small vegetation communities not described in detail.

Data Analysis: raw distance category data for each bird record was analysed using a custom designed computer programme which produces a maximum density figure for each species in each site (Appendix 2a & b). These maximum density figures were introduced into a data clustering programme which calculated a site affinity, group-averaging dendrogram (Fig. 5). The clustering analysis algorithm used was the Cosine θ Co-efficient (Imbrie and Purdie 1962) where θ_{ip} is the angle between any two samples X_j and X_p about the origin. Cosine θ is a measure of the degree to which samples resemble one another in composition or other attributes. When θ is 90°, cos θ = 0, and the samples have nothing in common; when θ is 0°, cos θ = 1, and the samples are identical in composition. The formula for the Cosine Theta Co-efficient is given below:

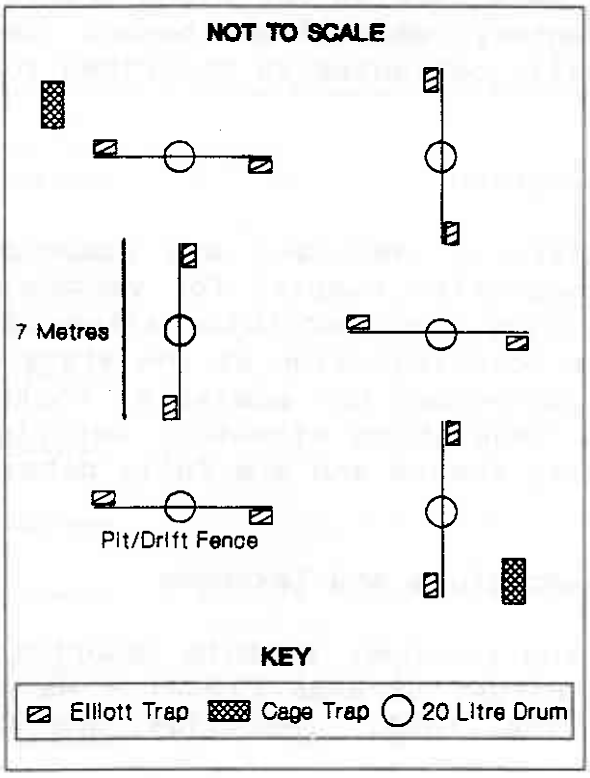
$$\text{Cosine } \Theta_{ip} = \frac{\Sigma_j X_{ji} X_{jp}}{\sqrt{(\Sigma_j X_{ji}^2)(\Sigma_j X_{jp}^2)}}$$

2.2 Mammals, Amphibians and Reptiles

Systematic Sampling: terrestrial vertebrate traplines were located in all of the vegetation associations listed in Section 2.0 and detailed in Appendix 1. Figure 3 shows the format of pit traps/drift fences suggested by CALM. In addition, two Elliott box traps were positioned at either end of individual drift fences and two wire cage traps were located close to diagonally opposite pit traps. Each trapline was permanently marked with one star picket at the first pit trap and another on the road verge nearest the site. At the conclusion of sampling, drift fences were rolled and placed in their corresponding pit traps which were securely capped, covered with soil and left in position for future sampling.

Traplines were left in position for five nights, cleared each morning and all captured animals identified, temporarily marked and released. Accessory information such as breeding, age and sex was logged on to field data sheets for subsequent transfer to a computer database.

FIGURE 3 Terrestrial vertebrate trapline format used during the Dryandra survey.



In addition to trapping, a minimum of six personnel hours was spent in each sampling site during which intensive, diurnal hand-foraging for vertebrates was conducted. Techniques included identification of active animals, raking spoil

heaps, abandoned ant nests and deep leaf litter, turning over rocks and logs, stripping bark from dead trees, investigating burrow systems and recording tracks or scats. An appraisal of vertebrate micro-habitat quality and critical resources was also conducted. This latter aspect included an assessment of the number of tree-hollows, the frequency of logs on the ground, leaf litter depth and distribution, the capacity of the soil to support burrows and the density of flowering shrubs. All seven sites were sampled nocturnally by head torch for a minimum of three personnel hours.

Inventory Sampling: an additional Elliott trapline was located in *Allocasuarina huegeliana* woodland on granite in an attempt to capture the Red-tailed Wambenger *Phascogale calura*. This line consisted of 25 Elliott traps, 13 of which were positioned on the ground and 12 tied to trunks and branches of trees.

Bats were sampled using a collapsible bat trap which was left in position for seven nights and checked each morning. The site chosen for the bat trap was a dam located on a stream zone in close proximity to Wandoo Site 3. One hundred and twenty metres of mist net (3 x 40 metre nets) were also set for one night at the same site. These nets were monitored for approximately three hours from dusk. Two extended spotlight sampling runs were carried out along tracks during the survey and all inventory data from beyond sampling sites was opportunistically collected as described for birds.

2.3 Vegetation

Dr E.M. Mattiske of Mattiske and Associates described the vegetation communities sampled for vertebrate fauna. One day was spent visiting and describing sites. Unidentified plants were taken for identification at the State Herbarium and soil samples were collected for analysis. Photographs were taken of each site. Vegetation structure descriptions were logged on to field data sheets and are fully detailed in Appendix 1.

2.4 Nomenclature and Taxonomy

Nomenclature and taxonomy in this report follows: Blakers *et al.* (1984) - Birds; Strahan (1983) - Mammals; Storr *et al.* (1981, 1983, 1986, 1990) - Reptiles; and Tyler *et al.* (1984) - Amphibians.

3.0 RESULTS AND DISCUSSION

3.1 Birds

A total of 66 species of bird, comprising 23 non-passerines and 43 passerines were recorded during the study period. This included one species gazetted under Schedule 2 of the Wildlife Conservation Act 1950, Carnaby's Black-Cockatoo *Calyptorhynchus latirostris* and one introduced species, the Laughing Kookaburra *Dacelo novaeguineae*.

Fifty species of bird were recorded during systematic sampling of Sites 1 to 4 and these results have been used in all analyses. Of those species recorded during inventory work, only one species, the Bush Thick-knee *Burhinus magnirostris*, was not recorded in vegetation similar to a sampling site. This bird was recorded calling at night in the vicinity of Dryandra village.

TABLE 3 List of bird species recorded during systematic and inventory sampling at Dryandra State Forest between October 16 and 25, 1990.

OP = Minor vegetation communities (opportunistic)
X = Inventory sampling

SAMPLING SITE	1	2	3	4	5	6	7	OP
ANATIDAE								
Anas superciliosa, Pacific Black Duck	-	-	2	-	-	-	-	X
ACCIPITRIDAE								
Lophoictinia isura, Square-tailed Kite	-	-	-	-	-	X	-	X
Accipiter cirrhocephalus, Collared Sparrowhawk	-	-	X	-	-	X	-	-
Aquila audax, Wedge-tailed Eagle	-	-	X	1	-	X	-	X
MEGAPODIIDAE								
Leipoa ocellata, Malleefowl	-	-	X	-	-	-	-	-
PHASIANIDAE								
Coturnix varia, Painted Button-quail	-	-	2	-	-	-	-	-
BURHINIDAE								
Burhinus magnirostris, Bush Thick-knee	-	-	-	-	-	-	-	X
COLUMBIDAE								
Phaps chalcoptera, Common Bronzewing	3	1	3	1	-	X	-	-
CACATUIDAE								
Calyptorhynchus latirostris, White-tailed Black-Cockatoo	1	-	5	-	-	-	-	-
LORIIDAE								
Glossopsitta porphyrocephala, Purple-crowned Lorikeet	-	-	2	-	-	-	-	X
PLATYCERCIDAE								
Purpureicephalus spurius, Red-capped Parrot	-	-	22	-	-	-	-	-
Platycercus icterotis, Western Rosella	2	-	6	-	-	-	-	-
Barnardius zonarius, Port Lincoln Ringneck	13	-	30	11	X	X	-	X
Neophema elegans, Elegant Parrot	-	-	2	-	X	-	-	-

SAMPLING SITE	1	2	3	4	5	6	7	OP
CUCULIDAE								
Cuculus pyrrhophanus, Fan-tailed Cuckoo	-	-	13	-	-	-	-	X
Chrysococcyx basalis, Horsfield's Bronze-Cuckoo	3	X	5	-	-	X	-	X
C. lucidus, Shining Bronze-Cuckoo	X	-	3	1	-	X	-	X
STRIGIDAE								
Ninox novaeseelandiae, Southern Boobook	-	-	1	1	-	-	-	X
PODARGIDAE								
Podargus strigoides, Tawny Frogmouth	-	1	-	-	-	X	-	-
AEGOTHELIDAE								
Aegotheles cristatus, Australian Owlet-nightjar	-	-	1	X	-	-	-	X
ALCEDINIDAE								
Dacelo novaeguineae, Laughing Kookaburra	1	X	-	-	-	-	-	X
Halcyon sancta, Sacred Kingfisher	-	-	3	-	-	-	-	-
MEROPIDAE								
Merops ornatus, Rainbow Bee-eater	-	X	21	-	-	X	-	X
HIRUNDINIDAE								
Cecropis nigricans, Tree Martin	-	-	1	-	-	-	-	X
CAMPEPHAGIDAE								
Coracina novaehollandiae, Black-faced Cuckoo-shrike	3	1	9	4	-	X	X	X
Lalage sueurii, White-winged Triller	-	-	X	-	-	-	-	-
MUSCICAPIDAE								
Petroica multicolor, Scarlet Robin	-	-	-	-	-	-	X	-
P. goodenovii, Red-capped Robin	X	-	-	-	-	X	-	X
Eopsaltria griseogularis, Western Yellow Robin	3	-	X	5	-	-	-	-
Pachycephala pectoralis, Golden Whistler	6	2	-	8	-	X	X	-
P. rufiventris, Rufous Whistler	10	2	2	1	-	X	-	X
Colluricincla harmonica, Grey Shrike-thrush	2	-	23	6	-	X	-	X
Oreoica gutturalis, Crested Bellbird	-	-	X	-	-	-	-	-
Myiagra inquieta, Restless Flycatcher	-	-	18	-	-	-	-	X
Rhipidura fuliginosa, Grey Fantail	-	-	-	-	-	X	-	X
R. leucophrys, Willie Wagtail	X	-	4	-	-	-	-	-
TIMALIIDAE								
Pomatostomus superciliosus, White-browed Babbler	-	-	5	-	-	-	-	-
MALURIDAE								
Malurus splendens, Splendid Fairy-wren	-	-	-	-	X	-	-	-
M. pulcherrimus, Blue-breasted Fairy-wren	X	-	12	-	X	X	-	-
ACANTHIZIDAE								
Sericornis frontalis, White-browed Scrubwren	1	3	5	-	X	X	-	X
Smicrornis brevirostris, Weebill	6	16	-	6	X	-	-	X
Gerygone fusca, Western Gerygone	2	1	-	3	-	X	X	X
Acanthiza apicalis, Inland Thornbill	-	1	-	1	-	X	X	-
A. chrysorrhoa, Yellow-rumped Thornbill	3	6	-	-	-	-	X	X
NEOSITTIDAE								
Daphoenositta chrysoptera, Varied Sittella	-	-	3	X	-	X	-	-
CLIMACTERIDAE								
Climacteris rufa, Rufous Treecreeper	10	3	18	1	-	-	-	X
MELIPHAGIDAE								
Anthochaera carunculata, Red Wattlebird	1	1	-	-	-	-	-	X
A. chrysoptera, Little Wattlebird	5	-	-	-	X	-	-	-
Lichenostomus virescens, Singing Honeyeater	X	-	-	-	-	-	-	X
L. leucotis, White-eared Honeyeater	-	-	X	-	-	-	-	-

SAMPLING SITE	1	2	3	4	5	6	7	OP
L. ornatus, Yellow-plumed Honeyeater	1	-	63	7	-	X	-	-
Melithreptus brevirostris, Brown-headed Honeyeater	3	13	-	-	X	X	-	-
M. lunatus, White-naped Honeyeater	21	6	-	7	-	X	-	X
Lichmera indistincta, Brown Honeyeater	10	1	6	4	X	X	X	X
Phylidonyris nigra, White-cheeked Honeyeater	1	-	-	-	X	X	-	-
P. melanops, Tawny-crowned Honeyeater	-	-	-	-	X	-	-	-
Acanthorhynchus superciliosus, Western Spinebill	3	2	1	-	X	-	X	-
DICAEIDAE								
Dicaeum hirundinaceum, Mistletoebird	-	-	X	-	-	-	-	-
PARDALOTIDAE								
Pardalotus striatus, Striated Pardalote	44	33	11	79	X	X	-	X
ZOSTEROPIDAE								
Zosterops lateralis, Silvereye	-	-	-	-	X	X	X	-
ARTAMIDAE								
Artamus personatus, Masked Woodswallow	-	-	4	4	-	X	-	-
A. cinereus, Black-faced Woodswallow	-	-	X	-	-	-	-	-
A. cyanopterus, Dusky Woodswallow	-	-	29	-	-	-	-	X
CRACTICIDAE								
Gymnorhina tibicen, Australian Magpie	X	-	X	-	-	X	-	X
Strepera versicolor, Grey Currawong	5	1	2	1	-	-	-	X
CORVIDAE								
Corvus coronoides, Australian Raven	7	1	1	X	-	X	-	X
NUMBER OF SPECIES	33	22	45	23	14	30	9	34
NUMBER OF SPECIES (SYSTEMATIC)	27	19	35	20	-	-	-	-
NUMBER OF INDIVIDUALS "	170	95	338	152	-	-	-	-

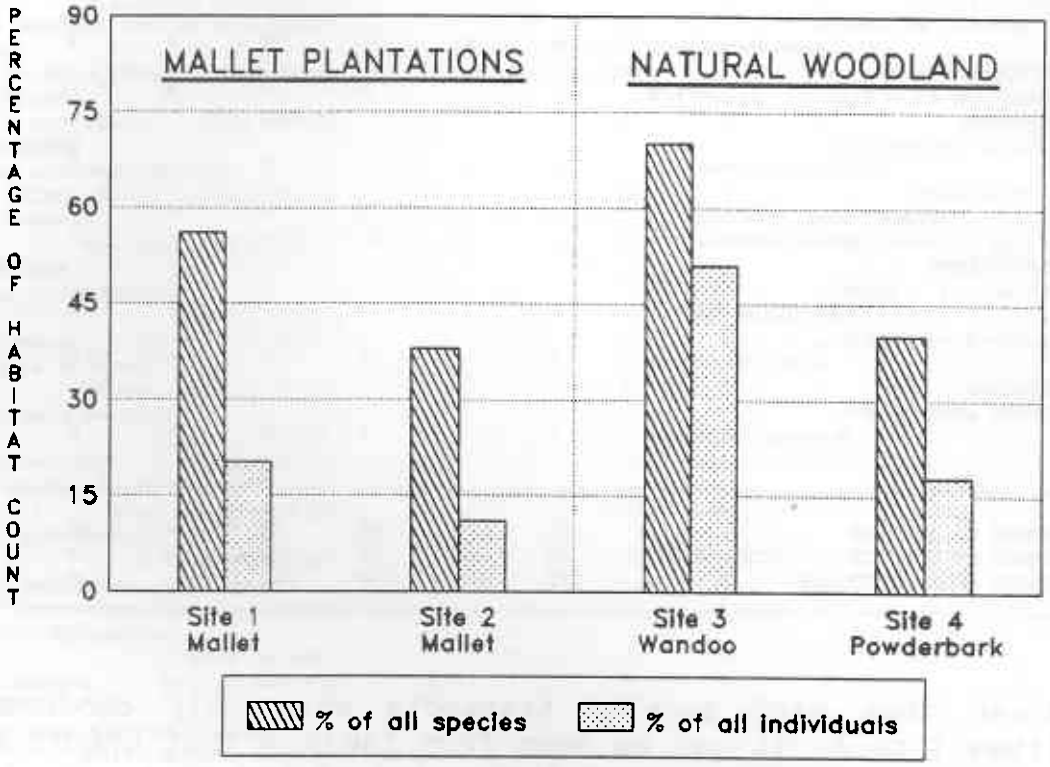
Given that bird density transects were only conducted at Sites 1 to 4, it can be seen from Table 3 that opportunistic recording can give a good indication of the richness of small areas of habitat. Site 6, Marri woodland on deep white sand, had a total of 30 bird species compared to Site 5, lateritic heath, with 14 species. The Sheoak on granite (Site 7) had nine species.

Of those sites that were sampled systematically for birds, the Wandoo woodland (Site 3) was the richest with 35 species (Appendix 2b). A further 10 species were added to this association during opportunistic recording (Table 3). The mixed Mallet plantation (Site 2) was the poorest with 19 species with an additional three species recorded opportunistically.

Figure 4 presents bird species richness and abundance for each site expressed as a percentage of the total number species and total number of individuals recorded in all sites during systematic sampling. It can be seen that Wandoo *Eucalyptus wandoo* Site 3 was the most productive in both its

percentage of species and percentage of individuals (70% and 51%) with Mallet Site 1 being the next most productive with 56% and 20% respectively. Mallet Site 2 and Wandoo *Eucalyptus accedens* Site 4 were very similar.

FIGURE 4 Histogram showing bird species richness and abundance in two Mallet and two forest sites sampled at Dryandra State Forest in October 1990. (Data expressed as a percentage of total species and abundance records shown in Table 3).



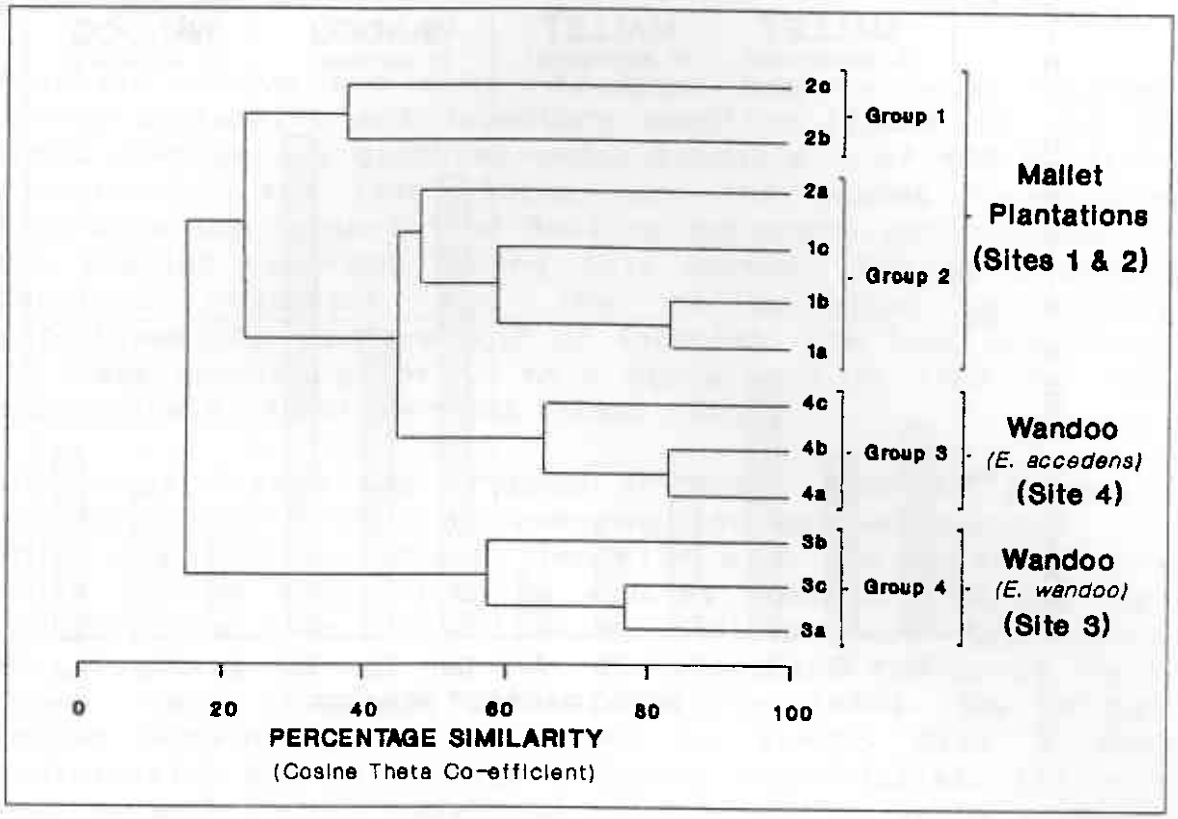
3.1.1 Community Groupings

Referring to the clustering analysis dendrogram in Figure 5 which is based on individual bird species densities for 12 transects (Appendix 2a, 2b), it can be seen that four main bird community groupings are apparent.

Group 1: consists of the Mallet Site 2, transects 2c and 2b, closest to the settlement. These two bird transects group together because of their depauperate nature. Both had the lowest bird densities per hectare of all transects sampled (Fig. 6, Appendix 2a) and, similarly, were lowest in bird species richness (Fig. 4). Whether their unusually low productivity reflects proximity to the settlement, the relatively younger age of this plantation compared to the Mallet Site 1 representative, or results from some feature such as low invertebrate populations, cannot be clearly

established after a single survey such as this. It may well be that productivity is much higher at other times of the year.

FIGURE 5 Dendrogram showing habitat relationships based on individual bird species densities per hectare for each of twelve 200 metre transects sampled at Dryandra State Forest in October 1990.

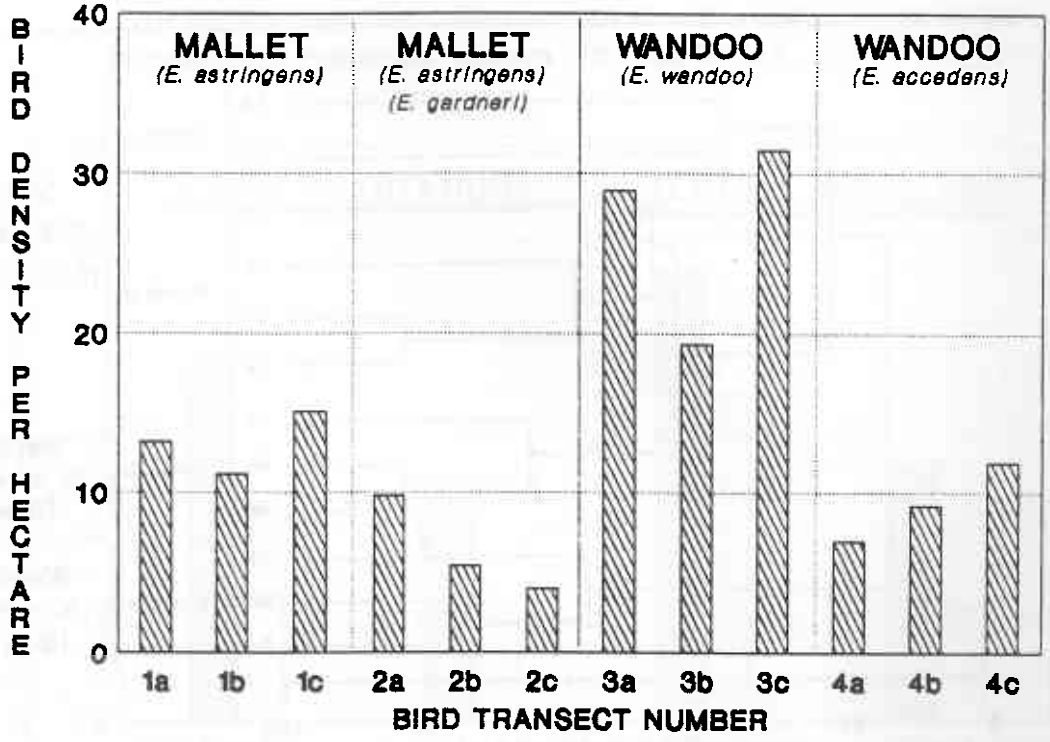


Group 2: supports the remaining Mallet Site 2 transect (2a) of the 2a-c group. Transect 2a which represents the sampling point most distant from the settlement and closest to a heath patch, was the most productive of these three bird transects (Fig. 6) and loosely links with the Mallet Site 1 transects 1a-c (Fig. 5). These latter bird transects had surprisingly high bird densities and were rich in species considering that they are Mallet plantation representatives. Taken as a group, bird transects 1a-c had the second highest species richness and bird density per hectare of all habitats systematically sampled (Figs. 4 and 6).

The main influencing feature is almost certainly the greater maturity of the Site 1 plantation compared to the settlement example, and the presence of a relatively large number of regrowth original *Eucalyptus* species. This appears to be advantaging a wider range of bird species and larger numbers

of individuals (Fig. 4). In addition, all Site 1 transects were close to heath and there could be a flow-on from this association as speculated for Site 2, transect 2a.

FIGURE 6 Total bird density per hectare for each of twelve 200 metre transects sampled at Dryandra State Forest in October 1990.



Group 3: is composed of the Powderbark Wandoo *Eucalyptus accedens* transects which are most similar to the Site 2 Mallet plantation. It is interesting that this area of native forest was poorer in bird species (Fig. 4) and had a lower bird density per hectare (Fig. 6) than the Mallet Site 1 series of transects. The Powderbark Wandoo series is in fact intermediate between the two groups of Mallet transects in terms of its bird productivity, and has a much closer affinity with both of these than it does with the Wandoo *Eucalyptus wandoo* association (Fig. 5). This low productivity is probably related to the relative lack of an understorey in this type of country, although other factors such as low invertebrate populations and perhaps seasonality, may also be contributing.

Group 4: consists of the Site 3 Wandoo *Eucalyptus wandoo* transects which form a series having very little affinity with any other sites (Fig. 5). This community's large number of bird species and high density of birds per hectare is graphically shown in Figures 4 and 6.

In summary, the two Mallet bird communities differed substantially from one another with the Site 2 settlement plantation being the poorest area for birds and the Site 1 plantation representing the second most productive habitat sampled. Powderbark Wandoo *Eucalyptus accedens* was intermediate between the two plantations while Wandoo *Eucalyptus wandoo* woodland supported by far the richest bird community and had very little in common with all other sites.

3.2 Mammals

Fourteen native and two introduced mammals were recorded during systematic and inventory sampling (Table 4). Two of these species are gazetted under Schedule 1 of the Wildlife Conservation Act 1950. These were the Numbat *Myrmecobius fasciatus* and Brush-tailed Bettong *Bettongia penicillata*. Of the species recorded during this survey, the Honey-possum *Tarsipes rostratus* and the Yellow-footed Antechinus *Antechinus flavipes* are both of interest. The last recordings of these species prior to this study were in 1978 and 1965 respectively (Kitchener and Vicker 1981).

The Honey Possum was trapped in Heath Site 5, a small, isolated association with emergent low mallee (Appendix 1). This is a complex, dense community with six strata levels which include many flowering species such as *Dryandra* spp. and *Calothamnus* sp., which are known to be target food plants for the Honey Possum in this north-eastern region of their known range (Ninox Wildlife Consulting 1990). The Yellow-footed Antechinus was recorded in Wandoo Site 3 (two individuals) and Marri Site 6 (three individuals). All were females with highly developed pouches but no young present. This small marsupial is more usually associated with swamps and stream zones within the main forest block and along the south-west coast. It is presumed to be extinct in the central Wheatbelt (Kitchener *et al.* 1980) with the last recording being in 1843. The Dryandra population is now at the extreme eastern edge of its current distribution. During earlier work for CALM by the authors in five small nature reserves near Kojonup on the fringe of the Wheatbelt, no Yellow-footed Antechinuses were trapped (Ninox Wildlife Consulting 1985). Part of this survey was carried out in Reserve #2243, which included the upper reaches of the Tone River, a typical stream zone habitat for this species.

The Western Pygmy-possum *Cercartetus concinnus* is also of interest, and while generally common throughout much of its range, is only occasionally trapped. It was recorded in both Mallet sites and Marri Site 6.

Bats were sampled in a Flooded Gum *Eucalyptus rudis* creekline adjacent to Wandoo Site 3. Pools of water and a small dam

concentrated them in this area. Five species of bat were captured including Gould's Long-eared Bat *Nyctophilus gouldi*, a species not previously recorded in the Dryandra area.

Two species of introduced mammal were recorded, a single Rabbit observed in Mallet Site 1 and another in the paddock near Dryandra village. A Fox scat was found on a track adjacent to the Heath Site 5.

Kitchener and Vicker (1981) show that a further 12 native and three introduced mammal species originally occurred, or may still be present in Dryandra State Forest. Appendix 3 lists these species.

TABLE 4 List of mammal species recorded during systematic and inventory sampling at Dryandra State Forest between October 16 and 25, 1990.

OP = Minor vegetation communities (opportunistic)
X = Inventory sampling

SAMPLING SITE	1	2	3	4	5	6	7	OP
TACHYGLOSSIDAE								
Tachyglossus aculeatus, Short-beaked Echidna	X	X	-	1	-	-	-	X
DASYURIDAE								
Antechinus flavipes, Yellow-footed Antechinus	-	-	2	-	-	3	-	-
MYRMECOBIIDAE								
Myrmecobius fasciatus, Numbat	-	X	5	-	-	-	-	-
PHALANGERIDAE								
Trichosurus vulpecula, Common Brushtail Possum	-	-	-	-	-	1	-	X
BURRAMYIDAE								
Cercartetus concinnus, Western Pygmy-possum	1	3	-	-	-	1	-	-
TARSIPEDIDAE								
Tarsipes rostratus, Honey-possum	-	-	-	-	4	-	-	-
POTOROIDAE								
Bettongia penicillata, Brush-tailed Bettong	3	-	7	4	2	8	X	X
MACROPODIDAE								
Macropus irma, Western Brush Wallaby	-	-	X	-	-	-	-	X
M. fuliginosus, Western Grey Kangaroo	-	4	1	2	-	3	-	X
VESPERTILIONIDAE								
Nyctophilus gouldi, Gould's Long-eared Bat	-	-	-	-	-	-	-	X
N. geoffroyi, Lesser Long-eared Bat	-	-	-	-	-	-	-	X
Chalinolobus gouldii, Gould's Wattled Bat	-	-	-	-	-	-	-	X
C. morio, Chocolate Wattled Bat	-	-	-	-	-	-	-	X
Eptesicus regulus, King River Eptesicus	-	-	-	-	-	-	-	X
LEPORIDAE								
Oryctolagus cuniculus, Rabbit	X	-	-	-	-	-	-	X
CANIDAE								
Vulpes vulpes, Fox	-	-	-	-	X	-	-	-
NUMBER OF SPECIES	4	4	5	3	3	5	1	11
NUMBER OF SPECIES (SYSTEMATIC)	2	2	4	3	2	5	-	-
NUMBER OF INDIVIDUALS "	4	7	15	7	6	16	-	-

3.2.1 Community Groupings

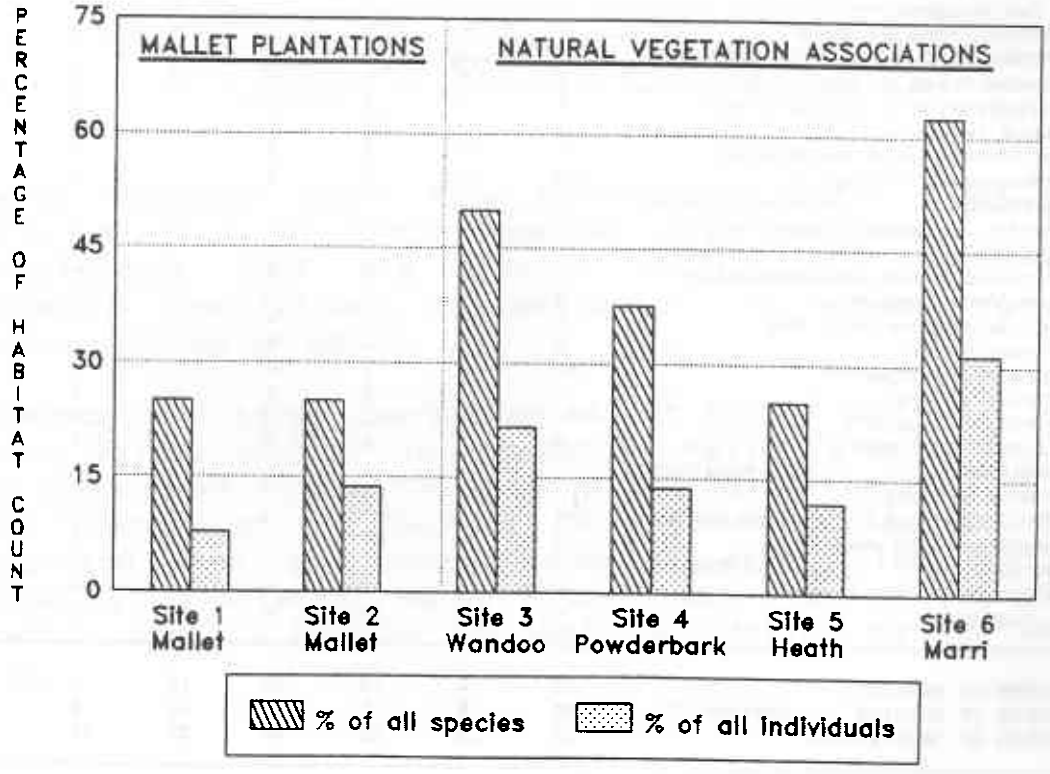
The richest systematic sample sites for native mammals were Marri Site 6 with five species and Wandoo Site 3 with four species. These sites had 16 and 11 individuals respectively. The two Mallet plantations (Sites 1 and 2) each had two native mammal species, with four and seven individuals respectively (Table 4).

Figure 7 is based on systematic results and expresses the number of species and individuals in each site as a percentage of the total number of species and individuals recorded throughout all sites.

Species Richness: both Mallet sites had a low species richness and grouped with Heath Site 5 although the species in the latter differed from those of Mallet (Table 4). Powderbark Site 4 had a moderately higher species richness than these three sites while Marri Site 6 and Wandoo Site 3 were the richest sites at Dryandra.

Abundance: a similar pattern was evident for the number of individuals recorded, although Mallet Site 2 was equal second highest along with Wandoo Site 3. As with its species richness, Marri Site 6 was the most productive association.

FIGURE 7 Histogram showing mammal species richness and abundance in two Mallet and two forest sites sampled at Dryandra State Forest in October 1990. (Data expressed as a percentage of total species and abundance records shown in Table 4).



3.3 Amphibians and Reptiles

Three amphibians and 18 reptiles were recorded during this survey (Table 5). No gazetted species were captured although one rare species of snake, the Carpet Python *Morelia spilota imbricata*, is known from Dryandra State Forest.

Several amphibians and reptiles were recorded at both the eastern and western limits of their known range during this and other studies (Table 5, Appendix 4). Eastern examples are: the legless lizards *Aprasia pulchella* and *A. repens*, the skinks *Ctenotus labillardieri* and *Leiolopisma trilineatum* and the snakes *Ramphotyphlops pinguis* and *Notechis scutatus occidentalis*. Western examples are represented by the Dragon lizard *Moloch horridus* and the skink *Eremiascincus richardsonii*. This underscores the point made in Section 1.2 that the reserve's herpetofauna generally reflects its position on the transition zone between the Wheatbelt and the South-west Forest Region. A further five species of amphibian and 29 species of reptile are known from the Dryandra area. These are listed in Appendix 4.

TABLE 5 List of amphibian and reptile species recorded during systematic and inventory sampling at Dryandra State Forest between October 16 and 25, 1990.

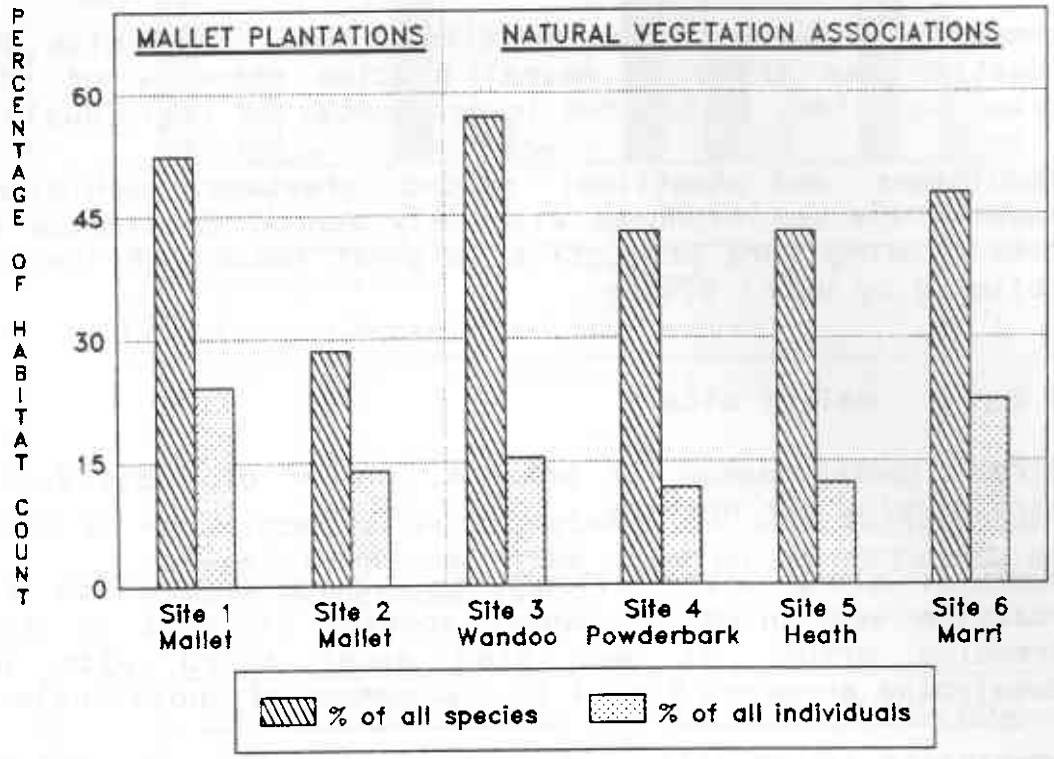
OP = Minor vegetation communities (opportunistic)
X = Inventory sampling

SAMPLING SITE	1	2	3	4	5	6	7	OP
LEPTODACTYLIDAE Frogs								
Heleioporus albopunctatus	-	-	1	-	-	9	-	-
H. barycragus	1	-	-	-	1	1	-	-
Limnodynastes dorsalis	-	-	-	-	-	3	-	-
GEKKONIDAE Geckos								
Crenadactylus o. ocellatus	2	17	1	-	2	1	-	-
Diplodactylus g. granariensis	1	-	3	1	-	-	-	-
Oedura reticulata	1	-	3	5	-	-	X	X
Phyllodactylus m. marmoratus	-	-	X	1	-	-	-	-
Underwoodisaurus milii	18	0	1	3	-	-	X	X
PYGOPODIDAE Legless Lizards								
Pygopus l. lepidopodus	-	-	-	-	2	-	-	-
SCINCIDAE Skinks								
Cryptoblepharus plagiocephalus		2	X	6	2	-	3	XX
Ctenotus schomburgkii	X	-	-	-	-	-	-	-
Egernia multiscutata bos	-	-	-	-	2	-	-	-
E. napoleonis	2	-	-	1	-	-	-	-
Lerista distinguenda	10	3	2	6	1	6	X	-
Menetia greyii	-	2	2	1	-	2	-	-
Morethia obscura	5	2	3	2	4	13	-	-
Tiliqua r. rugosa	1	1	5	X	6	1	X	X
VARANIDAE Monitors								
Varanus gouldii	-	1	1	-	-	1	X	X
TYPHLOPIDAE Blind Snakes								
Ramphotyphlops australis	2	-	1	-	3	-	-	-
ELAPIDAE Elapid Snakes								
Rhinoplocephalus gouldii	-	-	-	-	2	-	-	-
R. nigriceps	-	1	-	-	-	-	-	-
NUMBER OF SPECIES	11	8	13	10	10	9	6	5
NUMBER OF SPECIES (SYSTEMATIC)	10	8	11	9	10	9	-	-
NUMBER OF INDIVIDUALS "	43	29	23	26	25	37	-	-

3.3.1 Community Groupings

As with other faunal groups, Figure 8 is based on systematic results and expresses the number of species and individuals in each site as a percentage of the total number of species and individuals recorded throughout all sites.

FIGURE 8 Histogram showing amphibian and reptile species richness and abundance in two Mallet and two forest sites sampled at Dryandra State Forest in October 1990. (Data expressed as a percentage of total species and abundance records shown in Table 5).



Species Richness: apart from Mallet Site 2 all sites were fairly similar in their species richness. Site 2 had approximately half the species richness of all other vegetation associations. In particular, it lacked frogs and several species of gecko.

Abundance: all sites apart from Mallet Site 1 and Marri Site 6 were fairly similar in abundance. Mallet site 1 was the most productive vegetation association mainly because of the large numbers of the Barking Gecko *Underwoodisaurus milii* associated with a breakaway complex within its confines (Table 5). Similarly, Marri Site 6 was rich in the skink *Morethia obscura* because of their attraction to its sandy soils.

5.0 CONCLUSIONS

General conclusions on the conservation status of vertebrates at Dryandra State Forest are given in the preamble to each vertebrate group. The following section therefore deals entirely with comparisons between Mallet and natural vegetation associations, the primary objective of this study.

5.1 Mallet Site 1

Birds: second highest number of bird species, number of individuals and density per hectare of all four bird sampling locations. Second only to Wandoo *Eucalyptus wandoo* Site 3.

Mammals: along with Mallet Site 2 and Heath site 5 this location was third in mammal species richness of all six trapping grids. It had the lowest number of individuals.

Amphibians and Reptiles: second greatest amphibian and reptile species richness with only Wandoo *Eucalyptus wandoo* Site 3 being more productive; highest number of individuals followed by Marri Site 6.

5.2 Mallet Site 2

Birds: lowest number of species, number of individuals and bird density per hectare.

Mammals: along with Mallet Site 1 and Heath site 5 this location was third in mammal species richness of all six trapping grids. It was also equal third with Wandoo *Eucalyptus accedens* Site 4 in its number of individuals.

Amphibians and Reptiles: lowest species richness and second lowest number of individuals.

The following diagrams summarise the above information. However, since bird transect sampling was required in only two other natural woodland associations, Heath Site 5 and Marri Site 6 are not included. Systematic grid trapping alone was conducted in these associations with their mammal, amphibian and reptile data previously summarised in Figures 7 and 8. An Indication of their bird species richness can be obtained from the results of inventory sampling in Table 3 which shows that Marri Site 6 in particular had the potential to be rich in bird species.

Figures 9 and 10 show that Mallet Site 1 was second highest in total species richness and abundance, while Mallet Site 2 was the least productive site in both these categories.

FIGURE 9 Vertebrate species richness in two Mallet and two natural woodland sites sampled at Dryandra State Forest in October 1990.

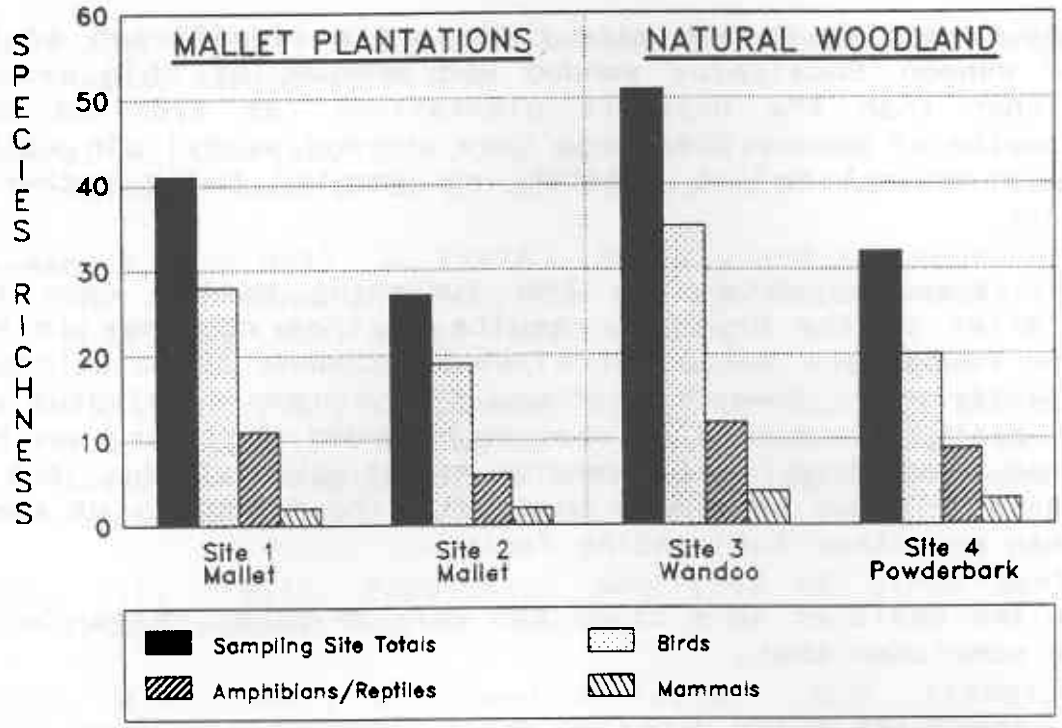
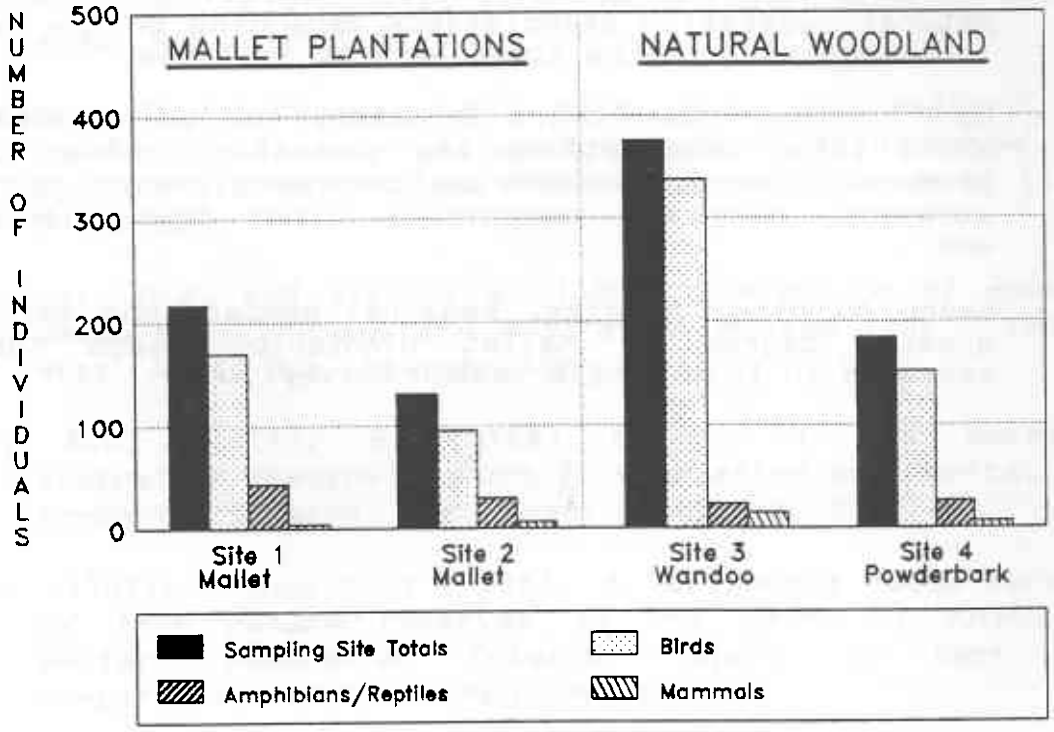


FIGURE 10 Abundance of vertebrates in two Mallet and two natural woodland sites sampled at Dryandra State Forest in October 1990.



Natural Mallet associations have been sampled by Dell *et. al* (1979) at Yornaning 25 kilometres east of Dryandra and by G. Friend (pers. comm.) at Tutanning some 30 kilometres north-east.

The Yornaning Mallet site contained a significant admixture of Wandoo *Eucalyptus wandoo* and because of this, was much richer than the Dryandra plantations (as typified by the results of Wandoo Site 3 in this current study). In addition, this natural Mallet habitat was sampled twice rather than once.

Pit trapping data from the Tutanning Mallet were fairly similar to the Dryandra results in that captures in Mallet and Powderbark Wandoo *Eucalyptus accedens* associations were significantly lower than those from Wandoo *Eucalyptus wandoo* or heath. The number of species recorded, however, was higher than that from the Dryandra Mallet plantations, but once again this may have more to do with the frequency of sampling than any other influencing factor.

On the basis of this study and work by other researchers, it is concluded that:

- there are major differences in vertebrate species richness and abundance between individual Mallet plantations;
- the age of the plantation, the amount of regrowth and the inclusion of habitat elements such as natural vegetation isolates or rocky outcrops have a strong influence on vertebrate species richness and abundance;
- in terms of vertebrate species richness and abundance, the Dryandra Mallet plantations compare favourably with natural vegetation associations depending on the level of representation of the above habitat isolates;
- work by other researchers in natural Mallet has shown that while these associations are generally similar to less productive habitats such as Powderbark Wandoo *Eucalyptus accedens*, they are marginally richer than plantations; and,
- based on other studies, seasonal comparisons may show a greater degree of Mallet plantation usage than was assessed in this single season survey.

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APPENDIX 1 Muir (1977) descriptions of vegetation and soils of the vertebrate systematic sampling sites at Dryandra State Forest, October 1990.

SITE 1

General Description: Forest of *Eucalyptus astringens* with occasional regrowth sapling of *Eucalyptus accedens*.

Muir Description: Forest *over* Open Low Woodland B *over* Open Dwarf Scrub C *over* Open Dwarf Scrub D *over* Very Open Herbs.

Muir Code: e_2Mc.e_3LBr.xSCr.xSDr.xJr/SLG

e_2 = Eucalyptus astringens
e_3 = Eucalyptus accedens
x = mixed species

Stratum 1. *Eucalyptus astringens*. Stratum 18-24m tall, 30-70% canopy cover at sample point. Average foliage density 35%.

Stratum 2. *Eucalyptus accedens* regrowth saplings and *Santalum acuminatum*. Stratum 1-6m tall, 2% canopy cover at sample point. Average foliage density 1%.

Stratum 3. *Gastrolobium microcarpum* shrubs. Stratum 0.5-1m tall, 2-10% canopy cover at sample point. Average foliage density 2%.

Stratum 4. *Astroloma pallidum*, *Daviesia rhombifolia*, *Astroloma ?glaucescens* and *Hibbertia enervia* shrubs. Stratum 0-0.5m tall, 2-10% canopy cover at sample point. Average foliage density 4%.

Stratum 5. Mixed herbaceous and Poaceae species, including species of *Stipa*. Stratum less than 30cm tall, 2-10% canopy cover at sample point. Average foliage density 1%.

Comments: No evidence of fire in recent years. Weeds and introduced grasses absent. Stand is 20 years plus old. Significant degree of past logging.

Litter: 2-3cm deep leaf litter. Mixed size of logs present, including large logs.

Soils: Pale-caramel pink sandy-loams with large range of gravels (SLG), size 1mm to 12cm in diameter.
Maunsell Soil Colour Chart = 7.5YR 6/4

Topography: Mid-slopes and minor breakaways, 5-10° slope.

SITE 2

General Description: Forest of *Eucalyptus astringens* - *Eucalyptus gardneri* with occasional pockets of *Eucalyptus accedens*, *Eucalyptus wandoo* and *Eucalyptus falcata*.

Muir Description: Forest *over* Open Low Woodland B *over* Open Dwarf Scrub C *over* Open Dwarf Scrub D *over* Very Open Herbs.

Muir Code: e_2Mc.e_3LBr.xSCr.xSDr.xJr/SLG

e_2 = Eucalyptus astringens
e_3 = Eucalyptus accedens
x = mixed species

Stratum 1. *Eucalyptus astringens* - *Eucalyptus gardneri*. Stratum 18-24m tall, 30-70% canopy cover at sample point. Average foliage density 40%.

Stratum 2. *Eucalyptus accedens* - *Eucalyptus wandoo* - *Eucalyptus falcata*. Stratum 1-8m tall, 2% - 10% canopy cover at sample point. Average foliage density 2%.

Stratum 3. *Gastrolobium microcarpum* and *Acacia pulchella* shrubs. Stratum 0.5-1m tall, 2-10% canopy cover at sample point. Average foliage density 2%.

Stratum 4. *Astroloma pallidum*, *Bossiaea eriocarpa*, *Hakea prostrata*, *Hibbertia enervia* and *Hibbertia commutata* shrubs. Stratum 0-0.5m tall, 2-10% canopy cover at sample point. Average foliage density 3%.

Stratum 5. Mixed herbaceous and Poaceae species. Stratum less than 30cm tall, 2-10% canopy cover at sample point. Average foliage density 1%.

Comments: No evidence of fire in recent years. Weeds and introduced grasses absent. Stand is 20 years plus old.

Litter: 3-5cm deep leaf litter. Mixed size of logs present, including large logs.

Soils: Pale-caramel pink sandy-loams with large range of gravels, size 1mm to 1cm in diameter.
Maunsell Soil Colour Chart = 7.5YR 7/4

Topography: Valley slopes, 3-5° slope.

SITE 3

General Description: Woodland of *Eucalyptus wandoo.*

Muir Description: Woodland *over* Open Low Woodland B *over* Open Low Scrub B *over* Open Dwarf Scrub C *over* Open Dwarf Scrub D *over* Open Herbs *over* Open Mat Plants.

Muir Code: e_5Mi.aLBr.xSBr.xSCr.xSDr.xJi.xPi/CLG

e_5 = Eucalyptus wandoo
a = Allocasuarina huegeliana
x = mixed species

Stratum 1. *Eucalyptus wandoo.* Stratum 10-22m tall, 10-30% canopy cover at sample point. Average foliage density 25%.

Stratum 2. *Allocasuarina huegeliana.* Stratum 3-5m tall, <2% canopy cover at sample point. Average foliage density 1%.

Stratum 3. *Hypocalymma angustifolium* and *Hakea trifurcata* shrubs. Stratum 1-1.5m tall, 2-10% canopy cover at sample point. Average foliage density 2.5%.

Stratum 4. *Hakea lissocarpha* and *Gastrolobium microcarpum* shrubs. Stratum 0.5-1m tall, 2-10% canopy cover at sample point. Average foliage density 4%.

Stratum 5. *Hibbertia commutata, Dryandra fraseri* and *Astroloma pallidum* shrubs. Stratum 0-0.5m tall, 2-10% canopy cover at sample point. Average foliage density 3%.

Stratum 6. Mixed species, *Orthrosanthus laxus, Loxocarya aspera, Dianella revoluta, Stipa* sp., *Tetratheca virgata* and *Xanthosia huegelii.* Stratum less than 30cm tall, 2-10% canopy cover at sample point. Average foliage density 1%.

Stratum 7. Mixed mat species, *Borya sphaerocephala, Neurachne alopecuroidea* and *Conostylis setigera.* Stratum 2cm tall, 10-30% canopy cover at sample point. Average foliage density 12%.

Comments: No evidence of fire in recent years. Weeds and introduced grasses absent. Stand is 20 years plus old.

Litter: <1cm leaf litter. Mixed size of logs present, including large logs.

Soils: Orange-brown clay-loam with large range of gravels, size 0.5-3cm in diameter.
Maunsell Soil Colour Chart = 7.5YR 7/4

Topography: Lower slopes, 3-5° slope.

SITE 4

General Description: Forest of *Eucalyptus accedens - Eucalyptus gardneri* with occasional pockets of *Eucalyptus accedens*, *Eucalyptus wandoo* and *Eucalyptus falcata.*

Muir Description: Forest *over* Open Low Woodland B *over* Open Dwarf Scrub C *over* Open Dwarf Scrub D *over* Very Open Herbs.

Muir Code: e_2Mc.e_3LBr.xSCr.xSDr.xJr/SLG

e_2 = Eucalyptus astringens
e_3 = Eucalyptus accedens
x = mixed species

Stratum 1. *Eucalyptus astringens - Eucalyptus gardneri.* Stratum 18-24m tall, 30-70% canopy cover at sample point. Average foliage density 40%.

Stratum 2. *Eucalyptus accedens - Eucalyptus wandoo - Eucalyptus falcata.* Stratum 1-8m tall, 2% - 10% canopy cover at sample point. Average foliage density 2%.

Stratum 3. *Gastrolobium microcarpum* and *Acacia pulchella* shrubs. Stratum 0.5-1m tall, 2-10% canopy cover at sample point. Average foliage density 2%.

Stratum 4. *Astroloma pallidum*, *Bossiaea eriocarpa*, *Hakea prostrata*, *Hibbertia enervia* and *Hibbertia commutata* shrubs. Stratum 0-0.5m tall, 2-10% canopy cover at sample point. Average foliage density 3%.

Stratum 5. Mixed herbaceous and Poaceae species. Stratum less than 30cm tall, 2-10% canopy cover at sample point. Average foliage density 1%.

Comments: No evidence of fire in recent years. Weeds and introduced grasses absent. Stand is 20 years plus old.

Litter: 3-5cm deep leaf litter. Mixed size of logs present, including large logs.

Soils: Pale-caramel pink sandy-loams with large range of gravels, size 1mm to 1cm in diameter.
Maunsell Soil Colour Chart = 7.5YR 7/4

Topography: Valley slopes, 3-5° slope.

SITE 5

General Description: Mixed closed heath with occasional emergent low mallee trees of *Eucalyptus drummondii*.

Muir Description: Open Low Woodland B *over* Thicket *over* Heath B *over* Open Dwarf Scrub D *over* Very Open Mat Plants *over* Open Low Sedges.

Muir Code: e_1LBr.xSc.xSBc.xSDr.cPr.cVLi/SG

e_1 = Eucalyptus drummondii
x = mixed Proteaceae and Myrtaceae species
c = Cyperaceae spp.

Stratum 1. Eucalyptus drummondii mallee with occasional stands of *Santalum acuminatum*. Stratum 3-6m tall, 2-10% canopy cover at sample point. Average foliage density 3%.

Stratum 2. *Dryandra stuposa*, *Petrophile ericifolium*, *Adenanthos cygnorum*, *Isopogon dubius*, and *Lambertia ilicifolia* shrubs. Stratum greater than 2 metres tall, 30-70% canopy cover at sample point. Average foliage density 40%.

Stratum 3. *Pericalymma ellipticum*, *Hakea ruscifolia*, *Grevillea tenuiflora*, *Petrophile heterophylla*, *Allocasuarina humilis*, *Grevillea pritzelii*, *Calothamnus* sp. (5-10), *Dryandra* aff. *nivea*, *Dryandra* aff. *cirsioides*, *Jacksonia floribunda*, *Burtonia scabra*, *Banksia sphaerocarpa* shrubs and *Xanthorrhoea preissii*. Stratum 1.0-1.5m tall, 30-70% canopy cover at sample point. Average foliage cover 45%.

Stratum 4. *Synaphea petiolaris*, *Leucopogon polymorphus*, *Astroloma pallidum* and *Hibbertia spp.* shrubs. Stratum 0-0.5m tall, 2-10% canopy cover at sample point. Average foliage cover 3%.

Stratum 5. Mixed Cyperaceae and Haemodoraceae species mat plants. stratum 0-10cm tall, 2-10% canopy cover at sample point. Average foliage cover 3%.

Stratum 6. Mixed Cyperaceae and Restionaceae species sedges. stratum 0-20cm tall, 10-30% canopy cover at sample point. Average foliage cover 15%.

Comments: No evidence of fire in recent years. Weeds and introduced grasses absent. Stand is 8-12 years old.

Litter: Leaf litter less than 1.5cm deep, patchy. Deeper litter layer under older Dryandras (up to 3cm depth). Logs absent.

Soils: Sandy laterite/gravels (SG) Pale orange-brown sandy-gravels. Gravel size 1mm-12mm diameter.
Maunsell Soil Colour Chart = 7.5YR 6/6

Topography: Lower to mid slopes, 2-3° slope.

SITE 6

General Description: Low woodland of *Eucalyptus calophylla - Eucalyptus wandoo.*

Muir Description: Low Woodland A *over* Open Scrub *over* Low Heath C *over* Open Dwarf Scrub D *over* Very Open Herbs.

Muir Code: e_4LAi.xSr.xSCc.xSDr.xJr/S

e_4 = Eucalyptus calophylla
x = mixed species

Stratum 1. *Eucalyptus calophylla - Eucalyptus wandoo.* Stratum 5-15m tall, 10-30% canopy cover at sample point. Average foliage density 20%.

Stratum 2. *Hakea prostrata, Jacksonia sternbergiana* and *Gastrolobium spinosum.* Stratum >2m tall, 2% - 10% canopy cover at sample point. Average foliage density 3%.

Stratum 3. *Pericalymma ellipticum, Hypocalymma angustifolium* and *Petrophile squamata* shrubs. Stratum 0.5-1m tall, 30-70% canopy cover at sample point. Average foliage density 45%.

Stratum 4. *Leucopogon* aff. *obtusatus* and *Hibbertia enervia.* Stratum 0-0.5m tall, 2-10% canopy cover at sample point. Average foliage density 2%.

Stratum 5. Mixed herbaceous and Poaceae species. Stratum less than 30cm tall, 2-10% canopy cover at sample point. Average foliage density 3%.

Comments: No evidence of fire in recent years. Weeds and introduced grasses absent. Stand is approximately 20 years plus old.

Litter: 1-4cm deep leaf litter, mostly fine twigs and leaves. Occasional large log present.

Soils: Grey sandy-soils.
Maunsell Soil Colour Chart = 5YR 8/1

Topography: Valley slopes, 1-3° slope.

SITE 7

General Description: Forest of *Allocasuarina huegeliana - Eucalyptus wandoo.*

Muir Description: Low Forest A *over* Open Low Scrub A *over* Open Dwarf Scrub D *open* Very Open Herbs.

Muir Code: aLAc.xSAr.xSDr.xJr/SC

a = Allocasuarina huegeliana
x = mixed species

Stratum 1. *Allocasuarina huegeliana - Eucalyptus wandoo.* Stratum 8-12m tall, 30-70% canopy cover at sample point. Average foliage density close to 70%.

Stratum 2. *Calothamnus* sp. and *Gastrolobium calycinum.* Stratum 1.5-2m tall, 2% - 10% canopy cover at sample point. Average foliage density 2%.

Stratum 3. *Hypocalymma angustifolium* shrubs. Stratum 0-0.5m tall, 2-10% canopy cover at sample point. Average foliage density 2%.

Stratum 4. Mixed herbaceous and Poaceae species. Stratum less than 30cm tall, 2-10% canopy cover at sample point. Average foliage density 1%.

Comments: No evidence of fire in recent years. Some annual weed grasses,

Litter: 1-4cm deep leaf litter, occasional twigs only.

Soils: Brown sandy-clays over granite outcrops.
Maunsell Soil Colour Chart = 10YR 6/4

Topography: Valley slopes, 3-5° slope.

APPENDIX 2a Bird species recorded in systematic sampling at Mallet Sites 1 and 2, showing densities per hectare per transect at Dryandra State Forest between October 20 and 24, 1990.

BIRD TRANSECT	1A	1B	1C	2A	2B	2C
Pacific Black Duck	-	-	-	-	-	-
Wedge-tailed Eagle	-	-	-	-	-	-
Painted Button-quail	-	-	-	-	-	-
Common Bronzewing	0.5	0.1	0.5	0.13	-	-
White-tailed Black-Cockatoo	-	-	0.13	-	-	-
Purple-crowned Lorikeet	-	-	-	-	-	-
Red-capped Parrot	-	-	-	-	-	-
Western Rosella	-	-	0.25	-	-	-
Port Lincoln Ringneck	2.0	1.5	0.1	-	-	-
Elegant Parrot	-	-	-	-	-	-
Fan-tailed Cuckoo	-	-	-	-	-	-
Horsfield's Bronze-Cuckoo	0.1	0.17	0.17	-	-	-
Shining Bronze-Cuckoo	-	-	0.17	-	-	-
Southern Boobook	-	-	-	-	-	-
Tawny Frogmouth	-	-	-	0.2	-	-
Australian Owlet-nightjar	-	-	-	-	-	-
Laughing Kookaburra	-	-	0.25	-	-	-
Sacred Kingfisher	-	-	-	-	-	-
Rainbow Bee-eater	-	-	-	-	-	-
Tree Martin	-	-	-	-	-	-
Black-faced Cuckoo-shrike	0.17	0.5	-	-	0.17	-
Red-capped Robin	0.1	-	-	-	-	-
Western Yellow Robin	0.5	0.25	0.5	-	-	-
Golden Whistler	1.0	0.3	0.13	0.2	-	-
Rufous Whistler	1.0	1.5	0.5	0.1	-	-
Grey Shrike-thrush	0.2	-	-	-	-	-
Restless Flycatcher	-	-	-	-	-	-
Willie Wagtail	-	-	-	-	-	-
White-browed Babbler	-	-	-	-	-	-
Blue-breasted Fairy-wren	-	-	-	-	-	-
White-browed Scrubwren	-	0.13	-	-	0.5	-
Weebill	0.33	0.25	0.17	0.25	2.5	0.83
Western Gerygone	0.13	0.17	-	-	-	0.17
Inland Thornbill	-	-	-	-	0.5	-
Yellow-rumped Thornbill	-	0.38	-	-	-	1.5
Varied Sittella	-	-	-	-	-	-
Rufous Treecreeper	0.1	0.67	0.5	0.25	-	-
Red Wattlebird	-	-	-	-	-	0.5
Little Wattlebird	0.5	-	-	-	-	-
Yellow-plumed Honeyeater	-	-	0.17	-	-	-
Brown-headed Honeyeater	1.0	0.5	0.2	4.5	-	-
White-naped Honeyeater	3.5	2.0	3.0	2.0	0.5	-
Brown Honeyeater	0.13	0.6	0.38	0.1	-	-
White-cheeked Honeyeater	-	0.13	-	-	-	-
Western Spinebill	0.2	-	0.5	0.2	-	1.0
Striated Pardalote	1.1	1.88	4.0	2.0	1.13	-
Masked Woodswallow	-	-	-	-	-	-
Dusky Woodswallow	-	-	-	-	-	-
Grey Currawong	0.75	0.17	-	0.1	-	-
Australian Raven	-	-	3.5	-	0.1	-
TOTAL DENSITIES	13.3	11.17	15.09	9.85	5.39	4.0

APPENDIX 2b Bird species recorded in systematic sampling at Wandoo Sites 3 and 4, showing densities per hectare per transect at Dryandra State Forest between October 20 and 24, 1990.

BIRD TRANSECT	3A	3B	3C	4A	4B	4C
Pacific Black Duck	1.0	-	-	-	-	-
Wedge-tailed Eagle	-	-	-	-	0.17	-
Painted Button-quail	-	0.5	-	-	-	-
Common Bronzewing	1.0	0.13	-	-	-	0.1
White-tailed Black-Cockatoo	0.5	-	1.5	-	-	-
Purple-crowned Lorikeet	0.1	-	0.5	-	-	-
Red-capped Parrot	1.5	0.1	1.6	-	-	-
Western Rosella	-	0.83	0.17	-	-	-
Port Lincoln Ringneck	1.5	1.0	3.83	0.17	0.6	1.0
Elegant Parrot	-	0.2	-	-	-	-
Fan-tailed Cuckoo	0.4	0.4	0.5	-	-	-
Horsfield's Bronze-Cuckoo	-	0.17	0.1	-	-	-
Shining Bronze-Cuckoo	0.3	0.2	-	0.1	-	-
Southern Boobook	0.1	-	-	0.1	-	-
Tawny Frogmouth	-	-	-	-	-	-
Australian Owlet-nightjar	0.1	-	-	-	-	-
Laughing Kookaburra	-	-	-	-	-	-
Sacred Kingfisher	0.13	0.1	0.1	-	-	-
Rainbow Bee-eater	2.0	0.8	0.5	-	-	-
Tree Martin	-	-	0.5	-	-	-
Black-faced Cuckoo-shrike	0.13	-	1.0	-	-	1.5
Red-capped Robin	-	-	-	-	-	-
Western Yellow Robin	-	-	-	-	2.0	2.0
Golden Whistler	-	-	-	0.5	0.1	-
Rufous Whistler	0.2	-	-	-	-	0.17
Grey Shrike-thrush	0.8	0.7	0.8	0.1	0.13	0.4
Restless Flycatcher	-	2.0	0.63	-	-	-
Willie Wagtail	-	3.0	0.1	-	-	-
White-browed Babbler	0.5	0.67	-	-	-	-
Blue-breasted Fairy-wren	2.5	-	1.5	-	-	-
White-browed Scrubwren	1.0	-	1.0	-	-	-
Weebill	-	-	-	0.3	0.5	-
Western Gerygone	-	-	-	0.25	0.25	-
Inland Thornbill	-	-	-	-	-	0.13
Yellow-rumped Thornbill	-	-	-	-	-	-
Varied Sittella	-	-	1.5	-	-	-
Rufous Treecreeper	0.25	3.0	0.6	-	-	0.25
Red Wattlebird	-	-	-	-	-	-
Little Wattlebird	-	-	-	-	-	-
Yellow-plumed Honeyeater	7.0	3.5	9.0	-	0.17	1.0
Brown-headed Honeyeater	-	-	-	-	-	-
White-naped Honeyeater	-	-	-	-	1.0	0.33
Brown Honeyeater	0.75	-	-	-	-	0.38
White-cheeked Honeyeater	-	-	-	-	-	-
Western Spinebill	0.13	-	-	-	-	-
Striated Pardalote	4.0	0.5	0.33	5.5	4.17	2.67
Masked Woodswallow	2.0	-	-	-	-	2.0
Dusky Woodswallow	0.5	1.5	5.5	-	-	-
Grey Currawong	0.5	-	0.1	-	0.1	-
Australian Raven	-	-	0.1	-	-	-
TOTAL DENSITIES	28.88	19.29	31.46	7.01	9.15	11.89

APPENDIX 3 **List of mammal species not recorded during this study but previously known from the Dryandra area (Kitchener and Vicker 1981).**

DASYURIDAE	
Dasyurus geoffroii,	Chuditch
Phascogale tapoatafa,	Brush-tailed Phascogale
P. calura,	Red-tailed Phascogale
Sminthopsis gilberti,	Common Dunnart
S. crassicaudata,	Fat-tailed Dunnart
PERAMELIDAE	
Isoodon obesulus,	Southern Brown Bandicoot
POTOROIDAE	
Bettongia lesueur,	Burrowing Bettong
MACROPODIDAE	
Lagostrophus fasciatus,	Banded Hare-wallaby
Macropus eugenii,	Tammar Wallaby
MOLOSSIDAE	
Tadarida australis,	White-striped Mastiff-bat
VESPERTILIONIDAE	
Scotorepens balstoni,	Western Broad-nosed Bat
Falsistrellus mckenziei,	Great Pipistrelle
MURIDAE	
Rattus rattus,	Black Rat
Mus musculus,	House Mouse
FELIDAE	
Felis catus,	Feral Cat

APPENDIX 4 List of amphibian and reptile species not recorded during this survey but known from the Dryandra area. Compiled from information supplied by members of the W.A. Naturalists Club.

LEPTODACTYLIDAE - Frogs
Crinia insignifera
Myobatrachus gouldii
Neobatrachus pelobatoides
Pseudophryne guentheri
HYLIDAE - Frogs
Litoria moorei
GEKKONIDAE - Geckos
Diplodactylus polyophthalmus
D. pulcher
Gehyra variegata
PYGOPODIDAE - Legless Lizards
Aprasia pulchella
A. repens
Delma australis
D. fraseri
D. grayii
Lialis burtonis
AGAMIDAE - Dragon Lizards
Ctenophorus ornatus
Moloch horridus
Pogona m. minor
SCINCIDAE - Skinks
Ctenotus impar
C. labillardieri
Egernia kingii
Eremiascincus richardsonii
Hemiergis initialis
Leiolopisma trilineatum
Morethia lineoocellata
Tiliqua occipitalis
VARANIDAE - Monitors
Varanus t. tristis
TYPHLOPIDAE - Blind Snakes
Ramphotyphlops pinguis
R. waitii
BOIDAE - Pythons
Morelia spilota imbricata
M. s. stimsoni
ELAPIDAE - Elapid Snakes
Acanthophis antarcticus
Demansia psammophis reticulata
Notechis scutatus occidentalis
Pseudechis australis
Pseudonaja a. affinis
P. nuchalis
Vermicella bertholdi
V. bimaculata