

**PROPOSED GWINDINUP MINERAL SANDS MINE**

**Fauna Surveys; August and December 1999**

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04/01/'00

## EXECUTIVE SUMMARY

This fauna survey was undertaken as part of a Consultative Environmental Review being prepared by Cable Sands to assess the environmental impacts of the proposed Gwindinup mineral sands mine. The survey had two components: a field programme carried out from the 31<sup>st</sup> of July to the 5<sup>th</sup> of August, and from the 12<sup>th</sup> to the 17<sup>th</sup> of December 1999, involving the use of pitfall, cage and Elliott Traps, bird censussing and spotlighting; and a review of published and unpublished records of fauna in the area, including WA Museum specimen records and the Department of Conservation and Land Management's Rare Fauna Database.

On the basis of the literature review, the vertebrate fauna predicted to be present at the site consists of 12 species of frogs, 36 species of reptiles, 120 species of birds and 29 species of mammals. A further 4 species of birds and 6 species of mammals are considered to be locally extinct, while one native freshwater fish may also be locally extinct. This is a rich fauna, and it reflects the diversity of habitats present at the site. This habitat diversity is a result of the position of the site across the Whicher Escarpment, which means that it encompasses forest on lateritic soil above the escarpment, transitional vegetation along the escarpment, drainage lines, the adjacent coastal sandplain and agricultural areas. Some species have specific habitat requirements, and therefore the juxtaposition of so many different habitats results in the area being expected to support a greater range of species than might otherwise be present.

The field programme resulted in the recording of 7 species of frogs, 17 species of reptiles, 17 species of mammals and 67 species of birds in the project area. The presence of all these species was predicted on the basis of the review of published and unpublished records, but the Honey Possum *Tarsipes rostratus* had not previously been found in the immediate vicinity of Gwindinup, while the mammal fauna in general was unusually rich and several species were unusually common. For example, four species of dasyurid, the Chuditch *Dasyurus geoffroii*, the Brush-tailed Phascogale *Phascogale tapoatafa*, the Mardo *Antechinus flavipes* and Gilbert's Dunnart *Sminthopsis gilberti* were recorded, which is a good result from a short trapping programme in an area of mixed forestry, agriculture and silviculture. Fox control in the region has probably contributed to the high levels of abundance of some mammals. Other notable features of the fauna recorded during the field programme were closely related species associated with different soil types, an abundance of birds associated with farmland, and the presence of a group of Western Yellow Robins *Eopsaltria georgiana* in a Blue Gum plantation.

The vertebrate fauna predicted to occur on the site includes a number of threatened species: 1 reptile, 8 birds and 5 mammals. Of these, 3 bird and 4 mammal species were recorded. Most of these are dependent upon native vegetation, the mammal species benefit from Fox control and the majority of the birds utilise hollows in large trees for nesting and roosting.

All of the vertebrate species recorded or expected in the Gwindinup project area are widespread at least through the South-West, but the study area is unusual in

supporting or probably supporting a wide variety of species, and in the abundance of some species recorded during the field programme.

Significant features of the site with respect to fauna include:

- The diversity of habitats in a small area because of the site's location across the Whicher Escarpment, which contributes to the diversity of the fauna;
- Large tracts of some habitats, notably eucalypt forest and woodland above the Whicher Escarpment, are important for some species;
- Large trees containing hollows are important for a number of bird and mammal species, including several listed as Threatened;
- Seasonal wetlands and swamps are important for a range of fauna;
- Remnant vegetation along roadsides in agricultural areas, especially dense bushes, are important for the persistence of some bird and mammal species;
- The mammal fauna of the area in particular has been influenced by Fox control;
- Agricultural areas are locally significant for a number of species;
- Blue Gum plantations may be locally significant for a few species.

Impacts of the proposed Gwindinup Mine upon fauna can be minimised by:

- Minimising loss of native vegetation, including loss of remnant vegetation along road verges and isolated large trees;
- Rehabilitation of disturbed areas to recreate fauna habitat;
- Minimising impacts on local patterns of hydrology so that seasonal patterns of streams and wetlands persist.

Available species lists for the general region of Gwindinup are comprehensive, therefore the field work carried out in 1999 served mainly to confirm the presence of species expected to occur in the area and to collect quantitative data on some of these species. The field programme also provided the opportunity to examine the distribution and types of fauna habitats, and their relation to the proposed mine.

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## INTRODUCTION

As part of the preparation of a Consultative Environmental Review to assess the environmental impacts of the proposed Gwindinup mineral sands mine, the Environmental Protection Authority has requested that Cable Sands undertake a comprehensive fauna survey. This survey was to include a trapping programme to be undertaken in late winter and late spring/early summer, supplemented by species records from the Department of Conservation and Land Management's Threatened Fauna Database, and specimen records from the WA Museum. The focus of the study was upon vertebrate fauna but some information on invertebrate fauna, particularly associated with wetlands, was to be reviewed.

A study of fauna involving an extensive field programme and a review of other records has a number of purposes. It can:

- Provide an overview of the fauna species present or expected to occur in the project area, from published and unpublished records, including species scheduled as Threatened;
- Identify areas or habitats within a site that are of special significance for fauna;
- Produce quantitative data on levels of abundance of fauna species through standard sampling procedures. Such data can be compared with information collected elsewhere, and also provide a baseline which can be used for the assessment of any future rehabilitation.

## METHODS

### Site Description

The proposed Gwindinup mineral sands mine is situated on the edge of the Whicher Escarpment and consists of several disjunct ore bodies between 5 and 15 km south of Boyanup. Because of its position in the landscape, the proposed mine is in a region of variable topography, soils and natural vegetation, with the environment further complicated by extensive clearing for agriculture and the establishment of plantations of Tasmanian Blue Gums *Eucalyptus globulus* in some areas. Some of the ore bodies were located in areas cleared for agriculture or planted with Blue Gums, but there were also ore bodies located in areas of natural vegetation.

The vegetation was surveyed by Dr Dennis Backshall (Environmental Survey and Management 1999), and variations in the natural vegetation were found to correlate closely with position in the landscape (see Figure 1). Main vegetation associations were:

- Kingia complexes in upland areas along and above the Whicher Escarpment, these being associated with laterite and lateritic gravels close to the surface;
- Rosa complex in steep-sided, seasonally swampy valleys above the Whicher Escarpment;
- Whicher complex #1 along the escarpment on sandy soils overlying laterite;
- Whicher complex #2 along drainage lines running across the Whicher Escarpment;
- Cartis complex on the lower sandy slopes and adjacent sandplain.

In addition to these natural vegetation associations, extensive areas of agricultural land and plantations were mapped, these being located principally in areas that formerly supported the Cartis complex and parts of the Whicher complexes closest to the coastal plain. The coastal plain in the region may also have historically supported seasonal wetlands, but these were mostly cleared except as remnants on a property not involved in the survey. During the period of the survey, large areas of pasture were flooded to depths of up to 30 cm, creating extensive, shallow, seasonal and open wetlands.

### **Trapping and Field Survey Programme**

Field work for this project was undertaken primarily by Dr Mike Bamford and Mr Peter Smith, of Bamford Consulting Ecologists, with assistance in establishing and closing sites from Cable Sands staff. Field work for the winter survey took place from 29<sup>th</sup> July to 5<sup>th</sup> August, with trapping occurring over five nights from 31<sup>st</sup> July to 5<sup>th</sup> August 1999, while sampling for the late spring, summer survey took place within the period 12<sup>th</sup> to 17<sup>th</sup> December. Work carried out in the field included systematic trapping for amphibians, reptiles and mammals, censussing for birds, spotlighting for mammals, mist-netting for bats and hand-searching for frogs and reptiles. Table 1 summarises the types of surveys carried out, and when and where they were undertaken. The range of sampling techniques used included methods, such as cage trapping and spotlighting, which target Threatened Fauna.

Systematic trapping for amphibians, reptiles and mammals took place at five sites, with the layout of traps being that recommended by CALM. This layout consists of a grid of pitfall, Elliott and cage traps as illustrated in Figure 2. Five such grids were established in the first few days of the field programme and were operated for five nights in winter and late spring/summer as indicated above, with the Elliott and cage traps baited with universal bait, consisting of a stiff mixture of rolled oats, peanut paste and sardines. Trapping efforts in each sampling period were therefore 45 trapnights with cage traps and 75 trapnights with each of Elliott and pitfall traps at each site. For each trap type, total effort within each sampling period was: cage traps - 225 trapnights; Elliott traps - 375 trapnights; and pitfall traps - 375 trapnights. The pitfall traps were closed and the Elliott and cage traps removed between sampling periods, and all traps were removed at the end of the December field trip.

The five trapping sites were selected so that they were well spread over the project area and sampled vegetation types that might be affected by the proposed sand mine (see Figure 1). They were also selected to avoid areas that had been recently burnt (except site 4) and areas that had been heavily logged and consisted almost entirely of regrowth. Details on the five sites are as follows:

Site 1. 33° 34' 25"S, 115° 41' 51"E. Whicher complex #2 in sandy valley, consisting of a Jarrah *Eucalyptus marginata* and *Allocasuarina* tall woodland over a shrubby understorey, straddling a seasonal stream. Some light trampling by cattle.

Site 2. 33° 34' 18"S, 115° 41' 54"E. Whicher complex #1 on a sandy slope, consisting of Jarrah tall woodland over a shrubby understorey, but with laterite on the surface in the north-western corner of the site. Some light trampling by cattle.

Site 3. 33° 32' 52"S, 115° 42' 25"E. Cartis complex on sandplain, consisting of *Banksia* woodland with a dense, shrubby understorey. Some degradation due to grazing and trampling by cattle, and mass death of *Banksia* specimens in the south-western corner of the area of woodland. Cattle were present at this site in August but were fenced out of the area shortly after, and were absent during the December field trip.

Site 4. 33° 33' 27"S, 115° 42' 51"E. Kingia complex on upland laterite, but including the edge of a swamp supporting dense stands of *Kingia australis*. Most of the vegetation was Jarrah forest. This area had been burnt one or two summers previously, but there were no similar areas of vegetation that had not either been burnt or intensively logged.

Site 5. 33° 31' 22"S, 115° 43' 45"E. A site encompassing the transition between Whicher complex #1 and Cartis. The vegetation therefore consisted of Jarrah woodland, including some very large trees, sloping down into *Banksia* woodland. There was a seasonal wetland supporting patches of dense, low heath on the edge of a Blue Gum plantation to the north-west of the site.

Trapping sites were checked each morning and all specimens caught were identified, some basic measurements were taken and mammals were marked with an ear-punch. Details on specimens caught are presented in Appendix Two. Trapping and all handling of specimens was carried out under Licence to Take Fauna for Scientific Purposes No. SF002878.

In addition to trapping, hand-searching for frogs and reptiles was carried out for at least 1 man-hour at each site in each field trip. This involved actively searching for specimens by looking under logs and rocks, and scratching through leaf-litter and loose soil with a three-pronged cultivator. Information on frogs was also collected by listening to their calls and checking the identity of the calling species with reference to a recording of frog calls prepared by Dr Dale Roberts of the University of Western Australia. When listening to frogs, streams and swamps were also examined for freshwater fish.

Because some components of the fauna, particularly birds and mammals, are nocturnal and do not enter traps, spotlighting was carried out on most nights. Two approaches to this were undertaken. At least one man-hour was spent on foot at each site over the course of each field trip, the spotlighting being carried out by a powerful torch and a hand-held spotlight, while two vehicle-based spotlighting runs were conducted along the route shown on Figure 1. This was a 7 km route, it took approximately an hour to complete and observation was by 2 or 3 people using a powerful spotlight operated from the vehicle battery. Therefore, a total of 7 hours was spent spotlighting in the project area during each field trip, which was considered sufficient time to detect the presence of nocturnal species such as owls, frogmouths and possums if they are moderately common in the area.

Spotlighting can reveal the presence of bats, but identification is usually difficult. Therefore, mist-netting for bats was carried out on two evenings during the December field trip. On each occasion, three nets (total length 36 m) were erected around a small dam in the Baljeu property at approximately 33° 33' 44"S, 115° 42' 30"E. and were monitored from just before sunset (about 1930 hours) until about 2200 hours. This dam was on the edge of Jarrah forest and was adjacent to a Blue Gum plantation, so was considered to be a likely location for bats to come to drink on warm summer evenings.

Records of birds were made opportunistically both at and when travelling between sites, but two systematic approaches were also used. Whenever trapping sites were checked a bird-list was prepared, providing presence/absence information for each species for six and five survey events at each site in August and December respectively. This information was converted to a percentage frequency for each species at each site, making it possible to compare the relative frequency of observation between sites and between August and December. To avoid bias introduced by different levels of bird activity at different times of the day, the order in which sites were checked was varied so that each site was checked at a range of times through the morning.

The second systematic approach used to record birds involved censusing at each site. The method used was a 20 minute, 3 ha area search technique, with two to four (usually three) search-areas being covered at each site. Search areas were also surveyed in an area of Blue Gum plantation, around 33° 33' 44"S, 115° 42' 30"E. This technique has been recommended by Birds Australia (the Royal Australasian Ornithologists Union) as being robust and producing consistent results in varying habitats and with different observers.

In addition to surveys of birds in areas of native vegetation, observations on birds in farmland areas were made. These observations included counting waterbirds utilising flooded pasture within approximately 200 m of the road when driving along Boundary Road between site 3 and site 5 on the 4<sup>th</sup> of August. This was carried out twice and the maximum counts were used to get an indication of the abundance of waterbirds in this area. These observations were repeated in December, but the paddocks were dry at that time.

### **Sources of Information**

Because even an intensive field study cannot be expected to record all species present in an area, the survey results were supplemented with records from a number of sources. Specimen records of frogs, reptiles and mammals were requested from the WA Museum for the area bounded by 33° 15' to 33° 45' S, and 115° 30' to 116° 00' E, while species on CALM's Threatened Fauna Database were obtained for a similar area. Bird records for the nearby Capel (formerly RGC) Wetlands Centre, where observations have been made continuously since the mid 1980s, were obtained from Doyle and Carter (1998). Additional information on birds that could be expected in the area was obtained from Blakers *et al.* (1984) and Johnstone and Storr (1999), while

additional information on reptiles was obtained from Storr *et al.* (1981, 1983, 1986 and 1990).

These supplementary sources of information were used to create lists of species expected to occur at the site. As far as possible, expected species are those that are very likely to utilise the project area, and such lists exclude species that have been recorded in the general region as vagrants. Particularly among the birds, for example, vagrants can be recorded almost anywhere and the Capel Wetlands Centre species list includes a number of seabirds, but such species have not been included as expected in the Gwindinup Project Area.

Taxonomic orders and names used in this report generally follow Tyler *et al.* (1984) for amphibians, Storr *et al.* (1983, 1986, 1990 and 1999) for reptiles, Strahan (1983) for mammals and Christidis and Boles (1994) for birds. Where recent taxonomic revisions have occurred, earlier names are given in parenthesis.

Species are considered to be of conservation significance if they are listed under the WA Wildlife Protection Act, in CALM's Priority Species List, in Cogger *et al.* (1993) or in Garnett (1992). See Appendix One for categories used in these lists.

## RESULTS

### Sampling for Freshwater Fish, Frogs, Reptiles and Mammals

The trapping programme resulted in the capture of 7 frogs of 3 species, 5 reptiles of 4 species and 21 mammals of 8 species in August (Table 2a), and 233 frogs of 6 species, 81 reptiles of 13 species and 23 mammals of 5 species in December (Table 2b). Very strong seasonal differences, especially in the numbers of captures of frogs and reptiles, were apparent. The numbers of captures are summarised on Table 2c. Including the results of searching and spotlighting (Tables 3 and 4), 7 frog species, 17 reptile species and 15 mammal species were recorded (see Tables 8 to 10 for complete species lists). A single species of freshwater fish, the introduced Goldfish *Carassius auratus*, was found in a farm dam on the Baljeu property in December and, during a brief site visit in January 2000, was also found in the northern branch of Gynudup Brook, near Site 5.

Sampling effort by trapping, searching and spotlighting was standardised and was approximately evenly distributed across the five sites in different vegetation types; therefore the results provide baseline measures of abundance for comparison and future reference. Furthermore, some of the results suggested differences in the fauna of the different vegetation types, and are consistent with what is known about the habitat preferences of some species.

For example, the Moaning Frog *H. eyrei* was recorded only at Sites 3 and 5, which were in Cartis vegetation complex on sand close to seasonal wetlands. The Moaning Frog was particularly abundant at Site 5 in December (167 captures; mostly recently-metamorphosed specimens), suggesting that the seasonal wetlands on the adjacent coastal sandplain were an important breeding site. In contrast, the related Marbled Frog *H. psammophilus* was represented by only 7 specimens, with most at Site 4, in

*Kingia* complex on upland laterite. The Moaning and Marbled Frogs are known to favour sandplain and laterite habitats respectively (Bush *et al.* 1995, Main 1965).

The seasonal wetlands of the coastal sandplain near Sites 3 and 5 contributed to the large numbers of frog species recorded calling (and therefore presumably breeding) at these sites in August (Table 3), while Site 4 was adjacent to a swampy valley where several frog species were calling. The two species of frogs heard at Site 1 in August were calling along a seasonal stream, and tadpoles of one of these, the Quacking Frog *C. georgiana*, were present at the time. Recently metamorphosed specimens of this species were caught at Site 1 in December.

A similar difference between related species to that observed with the Moaning and Marbled Frogs is known to exist with the skinks *M. lineocellata* and *M. obscura*, the former occurring on sandy soils and the latter often being associated with lateritic areas (Bush *et al.* 1995). *M. lineocellata* was caught at Sites 1, 2, 3 and 5, these locations having sandy soils, while *M. obscura* was caught at Site 4 (8 specimens) and Site 2 (1 specimen). Site 8 had large areas of exposed laterite, while Site 2 had some small areas of laterite and was the only site where the two species co-existed.

Among the mammals, the Mardo *A. flavipes* and the Western Pygmy Possum *C. concinnus* are associated with eucalypt forests and woodlands (Strahan 1983) and their captures in Sites 1, 2 and 4 in August are consistent with this. The absence of these species in December probably reflects a change in activity levels. The captures of the two introduced rodents may also reflect local patterns in distribution. Both Sites 3 and 5 were close to disturbed areas where introduced species may be favoured. Both species are also often associated with damp environments and both Sites 3 and 5 were close to seasonal wetlands on the coastal plain.

Other mammals are almost certainly more wide-ranging than was suggested by the trapping results. For example, although the Quenda *I. obesulus* was caught only at Sites 2, 3 and 4, fresh diggings were found at Sites 1 and 5. Western Grey Kangaroos were present throughout but were most often seen, and their tracks were most abundant, close to pasture where they were able to graze. The poorest site for mammals was Site 5 where the only species trapped were the two introduced rodents and a single Brush-tailed Phascogale. However, Site 5 was also the only location where the Ring-tailed *P. occidentalis* was observed during spotlighting. The lack of captures of Chuditch, Quenda and Brush-tailed Possum at this site probably reflects low levels of abundance, perhaps due to this site being largely surrounded by farmland and therefore partly isolated from other areas of forest. No Foxes or Feral Cats were observed during spotlighting, but Fox tracks were present at Sites 3 and 5, which were close to farmland, while Feral Cats are almost certainly present.

## Bird Surveys and Censusing

The results of bird censusing, both by the percentage of visits on which each species was observed and through conducting area searches, are presented on Tables 5 (a & b) and 6 (a & b) respectively. On the basis of observations made on daily visits (Table 5 a & b), Site 5 supported the most species in August, while Site 3 did so in December. Both these sites are in areas where several different habitats are represented, while the differences between August and December are probably due to seasonal patterns. Site 2 supported the fewest species and had the lowest mean number of species per visit in August, and the fewest species and equal lowest mean number of species per visit in December. It is not clear why this occurred, although Site 2 was further from seasonal wetlands than any other site and may therefore have been a more uniform habitat.

The results of bird censusing present some different patterns (Tables 6 a & b). Numbers of species and overall densities of birds tended to be higher in December than August, due largely to nectar-feeding species such as Brown Honeyeaters and Silvereyes, especially at Sites 3 and 5. These were apparently attracted to flowering specimens of *Banksia attenuata* and Jarrah *Eucalyptus marginata*. Censusing results can also be variable because of the time of day and the chance recording of birds during a single short period of time.

Despite the variation in results between the two survey techniques, they do provide baseline measures of abundance, while some consistent seasonal differences and habitat preferences among the species are apparent. A few species that were regularly recorded in one field trip were absent from the other, most noticeably the Spotted Pardalote that was abundant in August. A consistent trend was for variations in levels of abundance, and even presence/absence, between sites with Cartis vegetation on sandplain compared with sites supporting eucalypt woodland on either sand or laterite. For example, nectar feeding species such as the Brown Honeyeater, Red Wattlebird and Silvereye were confined or largely confined to the two sandplain sites (Sites 3 and 5) in August, but were more widespread in December when Jarrah was flowering. Some insectivorous species were also affected by the dichotomy between Cartis vegetation on sandplain and eucalypt woodland on the Whicher Scarp. For example, the Rufous and Golden Whistlers favoured sandplain and scarp respectively in both field trips.

The abundance of some species was associated with vegetation structure independent of the dichotomy between Cartis and eucalypt associations. For example, the Splendid Fairy-wren was recorded only at Sites 1, 3 and 5, and was always in dense vegetation close to seasonal wetlands. The White-browed Scrubwren, although recorded only at Sites 3 and 5, was also confined to dense vegetation close to seasonal wetlands and therefore could be expected to occur wherever appropriate vegetation is found.

Records of the Willie Wagtail, Black-faced Cuckoo-shrike and Australian Magpie were mostly of birds utilising farmland close to Sites 3, 4 and 5. The recently burnt nature of Site 4 may have contributed to the abundance of Magpies at this site. The distribution of a few species was enigmatic but can probably be explained by the small data-set gathered. For example, almost all records of the Shining Bronze-Cuckoo in August were made at Site 1, where a single bird was calling persistently.

The area searches in the Blue Gum plantation proved interesting, most of all because two species, the White-naped Honeyeater and the Western Yellow Robin, were recorded only at this site in August and were again present in December. Both species were definitely utilising the plantation trees, although they were also visiting “islands” of Jarrah forest that had been left within the plantation. The other species recorded in the plantation survey were also making use of these remnants, so it isn’t certain that the Blue Gums would have supported these species in the absence of the native vegetation.

Waterbird counts on flooded farmland along Boundary and Lowrie Roads are presented on Table 7. In August, species such as the Pacific Black Duck, Grey Teal, Australasian Grebe, White-faced Heron and Purple Swamphen were observed around distinct pools, particularly with scattered paperbark trees *Melaleuca* spp.. In contrast, the Australian Shelduck, Australian Wood Duck, Australian White Ibis and Straw-necked Ibis were seen foraging in areas of open pasture, often well away from surface water. The paddocks were largely dry in December and few waterbirds were present.

### **The Faunal Assemblage of the Gwindinup Project Area**

A brief field survey, even when it incorporates a large number of traps and some detailed bird censusing, will only record the species most abundant on the site at the time, and can provide some measures of abundance of these species. Therefore, a review of published and unpublished records was undertaken to generate lists of species expected to occur at the site, and these lists are presented on Tables 8, 9 and 10. The habitats where species are expected based on available literature, if known, are indicated. Species considered to be locally extinct appear on Table 11.

#### Freshwater Fish

The only freshwater fish recorded was the introduced Goldfish, while it is considered unlikely that any native species would be present. The Black-striped Jollytail may once have occurred in seasonal wetlands on the coastal sandplain in the region, but is very unlikely to persist in the region due to the extensive disturbance of such wetlands by clearing for agriculture.

#### Frog Fauna

Twelve species of frogs may be present in the project area, of which 7 were recorded during the field survey (Table 8). All have aquatic larvae and it was clear that numbers of some species, such as the Quacking, Glauert’s and Sandplain Froglets, the Pobblebonk and the Slender Tree-Frog were highest around seasonal wetlands on the coastal sandplain, even where these were extensively cleared for agriculture. However, the greatest concentration of calling activity was around wetlands just to the north of Site 3, an area that was not inspected but where riparian vegetation had been retained.

Although wetlands on the coastal sandplain were important for frogs, seasonal watercourses and swamps of the Whicher Range also supported frogs, and species such as the Marbled Burrowing Frog and Granite Froglet may breed only in such locations. A number of the frog species also range widely into upland habitats outside the breeding season. For example, at the Iluka Wetlands Centre near Capel, Bamford (1997) found that individual Moaning Frogs first caught in woodland were later recaptured at seasonal wetlands up to 1.5 km away.

None of the frog species recorded or expected is considered to be of conservation significance, although several are known to be sensitive to the chytrid fungus which has recently been reported in media releases from the WA Museum to be responsible for deaths of frogs in some areas. No dead or dying frogs showing symptoms of infection with this fungus were found. Investigations into the distribution and importance of this fungus are currently under way.

### Reptile Fauna

Only about half of the 36 reptile species expected to occur in the Gwindinup Project Area were recorded (Table 8). The cool weather experienced during part of the December trip may have suppressed numbers of captures, but few specimens were found even during hand-searching.

As with the frogs, the distinction between sandy soils of the coastal plain and edge of the Whicher Range, and the lateritic soils above the escarpment, is important for some reptile species. A number of species can be expected to be confined to the areas of lateritic soil, including: Speckled Stone Gecko, Barking Gecko, Pretty Worm-Lizard, Red-legged Skink, *H. initialis*, *M. obscura* and perhaps the Black-backed Snake. In contrast, a few species may be confined to sandy soils, including: Sandplain Worm-Lizard, *L. elegans*, *M. lineocellata* and Jan's Bandy-bandy. Other species may be independent of soil type. For example, the Marbled Gecko, Fence Skink and Salmon-bellied Skink are all partly arboreal and live on trees, particularly favouring dead trunks with loose bark. Even for such species, however, areas extensively cleared for agriculture are of little value. The Dwarf Skink, Bobtail and large species like the two goannas and some of the snakes, are the only reptiles in the region that seem able to survive in agricultural areas (Bamford 1997).

Only one reptile species of conservation significance, the South-West Carpet Python, may be present. In the region, it is known from coastal heathlands south of Bunbury and from jarrah forest with areas of exposed laterite south-east of Capel (pers. obs.) and it is therefore likely to be present along the Whicher Escarpment at low population densities.

## Avifauna

The Gwindinup region may support 120 species of birds, of which 67 were recorded (Table 9). The avifauna of the Project Area is particularly diverse because the site straddles the Whicher Escarpment and thus encompasses a range of habitats from Jarrah forest above the escarpment, through transitional vegetation complexes along the escarpment, to farmland and remnant native vegetation on the adjacent coastal sandplain.

Because of the mobility of birds, it is possible for almost any species to be observed in any habitat, but there are species with distinct habitat preferences as was discussed in relation to the bird censusing results. There are even species with seasonal habitat preferences, such as some of the honeyeaters utilising *Cartis* vegetation in August, but moving into eucalypt woodlands in December.

Thirty-six of the species expected to occur in the region are likely to be largely confined to agricultural areas, including waterbirds using flooded pasture and farm dams, and 15 of these farmland species were included in the species recorded during the August field trip. Many of the remaining species are largely restricted to native vegetation and may range widely within natural habitats, but a few have very specific requirements. For example, species such as both fairy-wrens, the White-browed Scrubwren, White-breasted Robin and Red-eared Firetail favour dense understorey vegetation, particularly along streams, and the only record of the White-breasted Robin was in a small, riparian thicket near Site 5. Other species, including the Red-tailed and Long-billed Black-Cockatoos, Red-capped Parrot, Western Rosella, Australian Owllet-nightjar, Rufous Treecreeper, Spotted Pardalote, Weebill, White-naped Honeyeater, Crested Shrike-tit and Golden Whistler favour eucalypt forest and woodland (*Kingia* and Whicher vegetation associations).

Eight of the bird species recorded or expected are of conservation significance (Table 9), and the habitat preferences of these can be used to assess the importance of different parts of the region for birds. Both birds of prey of conservation significance, the Square-tailed Kite and Peregrine Falcon, may be present at low population densities and individuals may range over large areas, including farmland, although the Square-tailed Kite is known to forage over areas of heath surrounded by forest. Both require large trees for nest sites, the Peregrine Falcon often nesting in large hollows. A pair of Peregrine Falcons was observed near the piggery on Boundary Road in both August and December.

All three black-cockatoos are of conservation significance, with both the Short-billed and Long-billed species being classed as Schedule 1. The Short-billed species, however, is considered Endangered, whereas the Long-billed species is classed as Vulnerable and is therefore less threatened. The Red-tailed and Long-billed Black-Cockatoos are probably regularly present in the region and may breed in large hollows in eucalypts. They also feed primarily upon eucalypt seeds. The Endangered Short-billed Black-Cockatoo does not breed in the region but may be a seasonal visitor. It feeds on seeds of *Banksia* and *Hakea* species, as well as visiting pine plantations to extract pine seeds. It is endangered primarily because of the destruction of breeding habitat in the wheatbelt (Garnett 1992). Flocks of Red-tailed Black-Cockatoos were

recorded on several occasions in both field trips, while a flock of one of the other species was seen at Site 1 in August, but the species could not be determined.

Little is known concerning the Barking and Masked Owls in the region, but both nest in large tree hollows. The Masked Owl has been recorded in the Ludlow Tuart Forest (pers. obs.), but it is not known how widespread it is in the region.

The final bird species of conservation significance, the Crested Shrike-tit, has not been definitely recorded in the region and favours smooth-barked eucalypts over stringy-barked species such as the Jarrah. It is known to be common in Flooded Gum *Eucalyptus rudis* growing along the Blackwood Rive near Boyup Brook (Garnett 1992), and there may be some areas of suitable habitat along watercourses along the Whicher Escarpment. It is not known if it utilises Blue Gum plantations as while Blue Gums are smooth-barked, they may not have the associated invertebrate fauna upon which shrike-tits feed. However, the presence of the Western Yellow Robin among Blue Gums indicates that such plantations may be suitable for local birds, as the robin also favours smooth-barked eucalypts.

Bird species which may have been present in the region but which are now locally extinct are listed in Table 11. Leeuwin's Rail and the Black Bittern are both waterbirds that may have been present in wetlands on the coastal plain, while the Western Whipbird and Western Bristlebird may have occurred in heathland, also on the coastal plain.

### Mammal Fauna

Sampling recorded 15 mammal species out of an expected mammal fauna of 29 species (Table 10). The capture of some of these species during a short trapping programme almost certainly is a result of Fox control in the region, resulting in increased levels of abundance of some native species. The capture of four species of dasyurids over a short time period in one area was a particularly good result.

Numbers of captures were too low to indicate any clear differences in habitat utilisation between species, but all native species, with the exception of the Western Grey Kangaroo and possibly some of the bats, can be expected to be largely confined to native vegetation. Eucalypt forest and woodland may be more important for native mammals than *Banksia* woodland, but the main *Banksia* woodland site, Site 3, was degraded by cattle grazing and trampling. Furthermore, the Cartis vegetation complex may be of seasonal importance to nectar-feeding species such as the Honey Possum. The most significant factor for some mammals, such as the Chuditch, may be large areas of native habitat, which may be why a few species were absent from Site 5, which was partly isolated from other areas of native vegetation.

Introduced species are a significant component of the mammal fauna, and species such as the Fox and Cat are important because of their impact on native fauna. Feral Pigs can be important because they disturb habitat, and they were reported to be present by Frank Baljeu (pers. comm.).

Five of the mammal species expected in the Project Area, and four of those recorded, are of conservation significance. Although only recorded at some of the sites, the Chuditch, Brush-tailed Phascogale, Quenda and Ring-tailed Possum are probably present in all areas of native vegetation, although the Quenda has a preference for areas of dense understorey. Partly isolated and slightly degraded areas, such as the Cartis vegetation of Site 3 and the woodland of Site 5, might be least favoured by mammals. Frank Baljeu (pers. comm.) reported that in the recent past, Domestic Cats regularly brought young phascogales into their home near Site 4. He also reported that a fifth mammal of conservation significance, the Brush Wallaby, had been present but hadn't been seen for several years. It is known from the Capel Nature Reserve (pers. obs.) so is very likely to be present in the Gwindinup area.

The record of the Western Ring-tailed Possum at Site 5 is interesting as while the species is abundant in the Ludlow Tuart Forest and within the town of Capel, CALM's rare fauna database contains only a single record from Jarrah/Marri forest just south of Boyanup. This suggests that the species may be expanding its range into the Gwindinup region. Although commonly associated with Peppermint Trees *Agonis flexuosa*, which were not recorded in the area, the Ring-tailed Possum occurred outside the range of the Peppermint Tree prior to the colonisation of the South-West by the Fox. Therefore, it may increase in abundance in the Gwindinup area with ongoing Fox control. All the species of conservation significance benefit from Fox control.

A number of mammal species may be locally extinct in the area and several of these are of conservation significance (Table 11). Of these, the Quokka persists at some nearby locations and therefore with ongoing Fox control, could re-colonise the region. It is usually associated with dense vegetation around swamps, but it is not clear to what extent this is an artefact of Fox predation preventing Quokkas from living in more open areas.

## **THE SIGNIFICANCE OF THE GWINDINUP PROJECT AREA FOR FAUNA**

The Gwindinup Project area may support 12 species of frogs, 36 species of reptiles, 120 species of birds and 29 species of mammals. This suite of fauna is typical of much of that recorded in the Jarrah forest of the South-West (Christensen *et al.* 1985, Nichols and Muir 1988), with some elements from the Coastal Plain, recorded locally at the Capel Wetlands Centre (Doyle and Cater 1998). The species recorded during field work represented a high proportion of the species expected to be present. The survey even recorded the Honey Possum, which was not listed in the WA Museum records for the region, but is known from the Jarrah forest, and has also been recorded in the Leeuwin-Naturaliste National Park and from the Kemerton region, north-east of Bunbury (M. Bamford, unpub. data).

The project area can therefore be said to support a rich fauna typical of a large part of the South-West. The project area's fauna is particularly rich because the site encompasses a diverse range of habitats along the Whicher Escarpment, from forest on lateritic soils above the escarpment, through transitional vegetation assemblages along the escarpment itself, to the coastal sandplain and agricultural areas. A similar

diversity of habitats and of fauna can be expected to exist both north and south of the project area. The importance of habitat diversity is partly due to this diversity providing opportunities for species with specific habitat requirements. However, the habitat diversity is also important for wide-ranging species that will utilise a range of habitats if this is available.

The fauna is also rich because of recent Fox control that has allowed some species, such as the Chuditch, Brush-tailed Phascogale, Quenda and Brush-tailed Possum, to increase in abundance. The increase in abundance of such species has been a widespread phenomenon in the South-West since broad scale Fox control has been undertaken.

With respect to fauna, significant features of the area can be summarised as follows:

- The Project Area includes large tracts of eucalypt forest and woodland that are important for species that require extensive, contiguous habitat, such as Chuditch and the Red-tailed Black-Cockatoo.
- Because the project area lies across a major geomorphic transition from a lateritic escarpment to a coastal sandplain, there is a great diversity of habitats and a number of species at the edge of their range.
- Seasonal wetlands and swamps both along the escarpment and on the coastal plain are important for a range of fauna.
- The use of open, seasonal wetlands and pasture by waterbirds is significant, even though some of the species, such as the Straw-necked Ibis, have increased in abundance in the region because of the creation of such habitats.
- Hollow trees in the eucalypt forest and woodland are significant breeding and sheltering sites for a number of bird and mammal species, including several of conservation significance.
- Dense understorey vegetation is important for several bird species. Such vegetation is associated with wetlands but also occurs along roads in agricultural areas.
- Blue Gum plantations, although a commercial crop of an introduced species, may be locally significant for some fauna, including the Western Yellow Robin.
- The impact of control of introduced predators is apparent, especially in the mammal fauna.

## **IMPLICATIONS OF THE PROPOSED GWINDINUP SAND MINE**

- The project area contains habitat types such as eucalypt forest, Blue Gum plantations and wetlands that are widespread. For example, the project area is on the edge of the Jarrah Forest that extends far to the south-east and north, while farmland and wetlands occupy large areas of coastal plain, especially to the west and north. Even habitats associated with the transition from the escarpment to the coastal plain, such as the Whicher valleys (Whicher complex #2), are well represented in the region. The most restricted fauna habitats in the region are probably relicts of natural vegetation on the coastal plain, such as Cartis vegetation complex and remnants of native vegetation associated with coastal plain wetlands.
- The proposed mine largely avoids native vegetation, particularly these restricted habitats, and as part of the project the area of Cartis vegetation around site 3 has

been fenced to exclude livestock. Despite this there will be some disturbance of native vegetation, and the area of this disturbance should be minimised. This includes remnant native vegetation along road verges on the coastal plain. Such remnants allow birds and mammals, including the Splendid Fairy-wren and the Quenda, to persist and move through agricultural areas, which may be important for their survival in the region. Even the retention of single trees, especially large specimens containing hollows, has the potential to benefit fauna.

- The juxtaposition of the proposed mine and large areas of native vegetation, and the small proportion of local native vegetation that would be directly affected by mining activity, mean that regional populations of fauna should persist. Mobile fauna may be displaced when areas are developed for the mine, while colonisation of rehabilitated areas should be facilitated by the presence of large tracts of native vegetation nearby.
- Wetlands, both forest streams and swamps on the coastal plain, are important. All are seasonal and their hydrological patterns should not be disrupted.
- Grazing by cattle in native vegetation on private property near Site 1 and at Sites 2 and 3 is causing some degradation and should be discouraged.

## **FUTURE STUDIES**

Because fauna in the general region of Gwindinup has been reasonably well-studied, field work carried out in August and December 1999 served mainly to confirm the presence of species expected to occur in the area. In addition, the field studies provided some quantitative data on birds and mammals which may be useful as a baseline for the assessment of changes in fauna populations due to factors such as Fox control and rehabilitation after mining. The field programme also provided the opportunity to examine the distribution and types of fauna habitats, and their relation to the proposed mine.

TABLE ONE. Survey programme, indicating when and where different survey procedures were undertaken. Note that opportunistic observations were made at all times, both at and between sites.

## July-August field trip

Procedure	Site number					Blue Gum	Farmland
	1	2	3	4	5		
Trapping (5 nights per site)	31/07- 05/08	31/07- 05/08	31/07- 05/08	31/07- 05/08	31/07- 05/08	-	-
Presence/absence of birds (6 mornings)	31/07- 05/08	31/07- 05/08	31/07- 05/08	31/07- 05/08	31/07- 05/08	-	-
Area search for birds	04/08	01/08	02/08	01/08	04/08	04/08	-
Hand-searching	04/08	01/08	02/08	01/08	01/08	04/08	-
Spot-lighting on foot	29/07	29/07	02/08	02/08	01/08	-	-
Survey of waterbirds on farmland	-	-	-	-	-	-	04/08
Vehicle-based spot- lighting	On route shown on Figure 1, 02/08 (2020-2120 pm) and 04/08 (7.30-8.30 pm)						

## December field trip

Procedure	Site number					Blue Gum	Farmland
	1	2	3	4	5		
Trapping (5 nights per site)	12-17 Dec.	12-17 Dec.	12-17 Dec.	12-17 Dec.	12-17 Dec.	-	-
Presence/absence of birds (5 mornings)	12-17 Dec.	12-17 Dec.	12-17 Dec.	12-17 Dec.	12-17 Dec.	-	-
Area search for birds	13/12	13/12	14/12	15/12	15/12	16/12	-
Hand-searching	16/12	16/12	14/12	15/12	16/12	13/12	-
Spot-lighting on foot	29/07	29/07	02/08	02/08	01/08	-	-
Survey of waterbirds on farmland	-	-	-	-	-	-	12-17 Dec
Vehicle-based spot- lighting	On route shown on Figure 1, 13/12 (2030-2130) and 16/12 (2030-2130)						
Netting for bats	13/12 and 16/12						

TABLE TWO. Results of trapping on Sites 1 to 5 in August and December surveys. Complete species lists, including common and scientific names, appear in Tables 8, 9 and 10. Details on dates of captures and morphometrics of specimens are given in Appendix Two. Note that recaptured specimens are not included in these figures. + indicates species observed but not trapped, including evidence from diggings and tracks. <sup>Int.</sup> indicates introduced species.

Table 2A. Numbers of specimens of frogs, reptiles and mammals caught on the trapping grid at Sites 1-5, 31<sup>st</sup> July to 5<sup>th</sup> August 1999.

Species	1	2	3	4	5
<i>Crinia georgiana</i>	1	-	-	-	-
<i>Heleioporus eyrei</i>	-	-	1	-	4
<i>Heleioporus psammophilus</i>	-	-	-	1	-
<i>Acritoscincus trilineatum</i>	-	1	-	-	-
<i>Morethia lineocellata</i>	-	-	1	-	1
<i>Morethia obscura</i>	-	-	-	1	-
<i>Notechis scutatus</i>	-	-	-	-	1
<i>Tachyglossus aculeatus</i>				+	
<i>Antechinus flavipes</i>	-	4	-	1	-
<i>Dasyurus geoffroii</i>	1	-	-	2	-
<i>Phascogale tapoatafa</i>	2	-	-	-	1
<i>Isodon obesulus</i>	+	+	1	+	-
<i>Tarsipes rostratus</i>	-	-	-	2	-
<i>Cercartetus concinnus</i>	1	1	-	-	-
<i>Macropus fuliginosus</i> (Grey Kangaroo)	+	+	+	+	+
<i>Mus musculus</i> <sup>Int.</sup>	-	-	2	1	-
<i>Rattus rattus</i> <sup>Int.</sup>	-	-	-	-	2
<i>Oryctolagus cuniculus</i> (Rabbit <sup>Int.</sup> )			+		+
<i>Vulpes vulpes</i> (Fox <sup>Int.</sup> )			+		+
Number of species trapped: frogs	1	-	1	1	1
reptiles	-	1	1	1	2
mammals	3	2	2	4	2
Number of specimens trapped: frogs	1	-	1	1	4
reptiles	-	1	1	1	2
mammals	4	5	3	6	3

Table 2B. Numbers of specimens of frogs, reptiles and mammals caught on the trapping grid at Sites 1-5, 12<sup>th</sup> to 17<sup>th</sup> December 1999.

Species	1	2	3	4	5
<i>Crinia georgiana</i>	21	-	6	8	-
<i>Crinia glauertii</i>	2	-	-	-	-
<i>Crinia insignifera</i>	-	-	12	-	-
<i>Heleioporus eyrei</i>	-	-	9	-	167
<i>Heleioporus psammophilus</i>	2	1	-	3	-
<i>Aprasia pulchella</i>	-	-	1	1	-
<i>Pogona minor</i>	-	-	2	-	2
<i>Cryptoblepharus plagiocephalus</i>	-	-	-	2	1
<i>Ctenotus impar</i>	3	4	-	1	-
<i>Ctenotus labillardieri</i>	3	-	-	4	-
<i>Egernia napoleonis</i>	-	2	-	1	-
<i>Hemiernis peronii</i>	3	1	1	1	1
<i>Lerista distinguenda</i>	4	2	2	1	1
<i>Menetia greyii</i>	-	-	-	1	-
<i>Morethia lineocellata</i>	3	3	5	-	4
<i>Morethia obscura</i>	-	1	-	7	-
<i>Tiliqua rugosa</i>	1	-	3	-	7
<i>Ramphotyphlops australis</i>	-	1	-	-	1
<i>Tachyglossus aculeatus</i>			+	+	
<i>Dasyurus geoffroii</i>	1	2	-	3	-
<i>Phascogale tapoatafa</i>	1	1	1	-	-
<i>Sminthopsis gilberti</i>	-	-	1	-	-
<i>Isoodon obesulus</i>	+	1	1	2	+
<i>Trichosurus vulpecula</i>	1	3	-	4	-
<i>Macropus fuliginosus</i> (Grey Kangaroo)	+	+	+	+	+
<i>Mus musculus</i> <sup>Int.</sup>	1	-	-	-	1
<i>Oryctolagus cuniculus</i> (Rabbit <sup>Int.</sup> )			+		+
<i>Vulpes vulpes</i> (Fox <sup>Int.</sup> )			+		+
Number of species trapped: frogs	3	1	3	2	2
reptiles	6	7	6	9	7
mammals	4	4	3	3	1
Number of specimens trapped: frogs	25	1	27	13	167
reptiles	17	14	14	19	17
mammals	4	7	3	9	1

Table 2C. Numbers of specimens of frogs, reptiles and mammals caught on the trapping grid at Sites 1-5, August and December 1999 pooled.

Species	1	2	3	4	5
<i>Crinia georgiana</i>	22	-	6	8	-
<i>Crinia glauertii</i>	2	-	-	-	-
<i>Crinia insignifera</i>	-	-	12	-	-
<i>Heleioporus eyrei</i>	-	-	10	-	171
<i>Heleioporus psammophilus</i>	2	1	-	4	-
<i>Aprasia pulchella</i>	-	-	1	1	-
<i>Pogona minor</i>	-	-	2	-	2
<i>Acritoscincus trilineatum</i>	-	1	-	-	-
<i>Cryptoblepharus plagiocephalus</i>	-	-	-	2	1
<i>Ctenotus impar</i>	3	4	-	1	-
<i>Ctenotus labillardieri</i>	3	-	-	4	-
<i>Egernia napoleonis</i>	-	2	-	1	-
<i>Hemiergus peronii</i>	3	1	1	1	1
<i>Lerista distinguenda</i>	4	2	2	1	1
<i>Morethia lineocellata</i>	3	3	6	-	5
<i>Morethia obscura</i>	-	1	-	8	-
<i>Tiliqua rugosa</i>	1	-	3	-	7
<i>Ramphotyphlops australis</i>	-	1	-	-	1
<i>Notechis scutatus</i>	-	-	-	-	1
<i>Tachyglossus aculeatus</i>				+	
<i>Antechinus flavipes</i>	-	4	-	1	-
<i>Dasyurus geoffroii</i>	2	2	-	5	-
<i>Phascogale tapoatafa</i>	3	1	1	-	1
<i>Isodon obesulus</i>	+	1	2	2	+
<i>Trichosurus vulpecula</i>	1	3	-	4	-
<i>Tarsipes rostratus</i>	-	-	-	2	-
<i>Cercartetus concinnus</i>	1	1	-	-	-
<i>Macropus fuliginosus</i> (Grey Kangaroo)	+	+	+	+	+
<i>Mus musculus</i> <sup>Int.</sup>	1	-	2	1	1
<i>Rattus rattus</i> <sup>Int.</sup>	-	-	-	-	2
<i>Oryctolagus cuniculus</i> (Rabbit <sup>Int.</sup> )			+		+
<i>Vulpes vulpes</i> (Fox <sup>Int.</sup> )			+		+
Number of species trapped: frogs	3	1	3	2	1
reptiles	6	8	6	8	7
mammals	5	6	3	6	3
Number of specimens trapped: frogs	26	1	28	14	171
reptiles	17	15	15	20	19
mammals	8	12	5	15	4

TABLE THREE. Numbers of captures of frogs and reptiles made during hand searching at each site in August (A) and December (D). Time spent searching at each site ranged from 1.5 to 2 person/hours. + indicates species observed but not caught, including frogs heard.

Species	1		2		3		4		5	
	A	D	A	D	A	D	A	D	A	D
<i>Crinia georgiana</i>	+				+		+		+	
<i>Crinia glauerti</i>	+				+		+			
<i>Crinia insignifera</i>					+		+		+	
<i>Limnodynastes dorsalis</i>					+				+	
<i>Litoria adelaidensis</i>					+					
<i>Aprasia pulchella</i>				1						
<i>Pogona minor</i>			1							
<i>Cryptoblepharus plagiocephalus</i>		1	1	1	1	1		1		
<i>Ctenotus impar</i>			1							
<i>Egernia napoleonis</i>					1					
<i>Hemiernis peronii</i>		2		3	1	3	1	3		
<i>Lerista distinguenda</i>		2		2	1	3			1	
<i>Morethia lineocellata</i>	1		1			2				

TABLE FOUR. Observations made during spotlighting at each site and on the vehicle-based spotlighting transect.

Table 4a. August 1999.

Species	Sites					Vehicle transect	
	1	2	3	4	5	02/08	04/08
Tawny Frogmouth	1					1	1
Australian Owlet Nightjar	1						
Southern Boobook Owl	1	1		1	2	2	3
Brush-tailed Possum							1
Western Grey Kangaroo		3			2	4	6
bat ? <i>Vespedalus regulus</i>					1		

Table 4b. December 1999.

Species	Sites						Vehicle transect	
	1	2	3	4	5	Blue Gum	13/12	15/12
Speckled Stone Gecko				1			1	1
Tawny Frogmouth						1		
Southern Boobook Owl	1	1		1		1	3	2
Ring-tailed Possum					1			
Western Grey Kangaroo	3	4		4		2	3	5
White-striped Bat						1		

TABLE FIVE. Bird observations.

Table 5a. Results of daily bird observations made at each site in August 1999, expressed as the percentage of visits (6 to each site) on which each species was observed. + indicates species observed at a site at times other than these visits.

Species	1	2	3	4	5
Emu		17.7			
Australian Shelduck	17.7			17.7	
Pacific Black Duck	17.7				
Painted Button-quail		17.7		17.7	
Common Bronzewing			17.7		17.7
Red-tailed Black-Cockatoo	33.3				
Short-billed Black-Cockatoo	17.7				
Red-capped Parrot	17.7		33.3	83.3	33.3
Western Rosella	17.7			17.7	
Australian Ringneck (twenty-eight)	66.7	17.7	50.0	33.3	33.3
Elegant Parrot		17.7		17.7	17.7
Fan-tailed Cuckoo				33.3	
Horsfield's Bronze-Cuckoo			17.7		33.3
Shining Bronze-Cuckoo	83.3				17.7
Laughing Kookaburra	17.7				17.7
Splendid Fairy-wren	17.7		17.7		33.3
Spotted Pardalote	50.0	66.7		17.7	
Striated Pardalote	17.7	66.7		66.7	33.3
White-browed Scrubwren				+	17.7
Weebill				+	
Western Gerygone	66.7	83.3	83.3	50.0	83.3
Inland Thornbill	50.0	33.3	17.7	66.7	17.7
Western Thornbill	33.3	33.3		17.7	17.7
Red Wattlebird			66.7	17.7	33.3
Brown Honeyeater			66.7		
Western Spinebill	100.0	83.3	83.3	66.7	50.0
Scarlet Robin		17.7	50.0		17.7
Varied Sittella	17.7				17.7
Golden Whistler	50.0	17.7		33.3	17.7
Rufous Whistler		17.7	83.3	17.7	50.0
Grey Shrike-thrush			17.7		33.3
Grey Fantail	66.7	83.3	83.3	33.3	100.0
Willie Wagtail			33.3		
Black-faced Cuckoo-shrike		17.7	17.7		66.7
Grey Butcherbird			+		
Australian Magpie				66.7	17.7
Australian Raven	17.7			17.7	33.3
Silvereye	17.7		66.7		17.7
Number of species:	21	15	17	19	25
Mean number of species/visit:	8.2	5.7	8.0	6.8	8.2

Table 5b. Results of daily bird observations made at each site in December 1999, expressed as the percentage of visits (5 to each site) on which each species was observed. + indicates species observed at a site at times other than these visits.

Species	1	2	3	4	5
Brown Goshawk	+				
Wedge-tailed Eagle			+		
Common Bronzewing	20	-	-	-	20
Red-tailed Black-Cockatoo	20	20	-	-	-
Red-capped Parrot	-	-	40	60	40
Australian Ringneck (twenty-eight)	-	40	20	40	-
Purple-crowned Lorikeet			+		
Horsfield's Bronze-Cuckoo	-	20	20	-	-
Shining Bronze-Cuckoo	-	-	40	-	-
Laughing Kookaburra	40	40	-	20	-
Sacred Kingfisher	-	-	20	-	20
Rainbow Bee-eater	-	-	40	-	-
Splendid Fairy-wren	20	-	80	-	40
Striated Pardalote	40	80	-	100	100
White-browed Scrubwren					+
Western Gerygone	60	60	80	80	80
Inland Thornbill	20	-	40	20	40
Western Thornbill	20	-	-	80	-
Yellow-rumped Thornbill	-	-	20	-	-
Red Wattlebird	-	-	40	-	100
Brown Honeyeater	40	20	100	-	100
Western Spinebill	80	40	40	40	40
Scarlet Robin	-	-	40	20	-
Western Yellow Robin	-	20	-	20	-
White-breasted Robin					+
Varied Sittella	-	20	-	-	-
Golden Whistler	100	-	20	20	20
Rufous Whistler	20	-	60	-	80
Grey Shrike-thrush	20	20	-	-	20
Grey Fantail	100	-	80	60	80
Black-faced Cuckoo-shrike	-	-	20	-	20
Black-faced Woodswallow	-	-	20	-	-
Dusky Woodswallow	-	20	-	-	-
Grey Butcherbird	-	-	20	-	-
Australian Magpie	-	-	20	-	20
Grey Currawong	-	-	-	20	-
Australian Raven	-	-	60	-	-
Silvereye	20	-	-	-	40
Number of species:	15	12	22	13	17
Mean number of species/visit:	7.0	6.5	10.2	5.5	10.2

TABLE SIX. Bird censussing.

Table 6a. Results of bird censussing at each site in August 1999, expressed as the mean density per hectare, based upon numbers counted in two to four (usually three) search areas, each approximately 3 ha in area. The number of search areas in each site is given in parenthesis. Median times of surveys in each sites were: site 1, 1230 hrs; site 2, 1520 hrs; site 3, 1235 hrs; site 4, 1350 hrs; site 5, 1355 hrs; Blue Gum, 1530 hrs.

Species	1 (3)	2 (3)	3 (3)	4 (3)	5 (4)	Blue Gum (2)
Red-capped Parrot			0.50	0.33		
Western Rosella						0.33
Horsfield's Bronze-Cuckoo			0.11			
Splendid Fairy-wren			1.22			
Spotted Pardalote	0.22	0.11				
Striated Pardalote	0.33	0.22				
White-browed Scrubwren			0.44		0.08	
Western Gerygone	0.33	0.56	0.44	0.22	0.17	
Inland Thornbill	1.11	0.44	0.22	0.44	0.42	
Western Thornbill	0.56	0.33		0.22	0.25	
Yellow-rumped Thornbill			0.22			0.33
Red Wattlebird			0.11			
Brown Honeyeater			0.11			
White-naped Honeyeater						0.67
Western Spinebill	0.44	0.44	0.11	0.33	0.08	
Scarlet Robin		0.11				0.17
Western Yellow Robin						0.67
Rufous Whistler	0.11	0.11	0.11		0.08	
Grey Shrike-thrush		0.11		0.11		0.17
Grey Fantail	0.33	0.56	0.33		0.67	1.17
Welcome Swallow			0.89			
Silvereye	0.56		0.67			
Number of species:	9	10	14	6	7	7
Mean density, all birds:	4.0	3.0	5.33	1.67	1.75	3.50

Table 6b. Results of bird censusing at each site in December 1999, expressed as the mean density per hectare, based upon numbers counted in two to four (usually three) search areas, each approximately 3 ha in area. The number of search areas in each site is given in parenthesis. Median times of surveys in each sites were: site 1, 1330 hrs; site 2, 1330 hrs; site 3, 1330 hrs; site 4, 1530 hrs; site 5, 1400 hrs; Blue Gum, 1500 hrs.

Species	1 (4)	2 (4)	3 (3)	4 (3)	5 (4)	Blue Gum (4)
Brown Goshawk	0.083					
Wedge-tailed Eagle			0.11			
Red-tailed Black-Cockatoo				0.17		
Red-capped Parrot		0.083	0.11	0.33		
Australian Ringneck						0.33
Shining Bronze-Cuckoo			0.11			
Laughing Kookaburra	0.42	0.50		0.083		
Sacred Kingfisher					0.083	
Splendid Fairy-wren	0.33		1.33		1.17	
Striated Pardalote	0.25	0.75		1.17	0.42	
White-browed Scrubwren					0.25	
Western Gerygone	0.42	0.50	0.22	0.50	0.17	0.083
Inland Thornbill		0.25	0.22	0.17	0.25	0.17
Western Thornbill				0.33		
Red Wattlebird						
Brown Honeyeater	0.42		1.56		3.00	0.42
White-naped Honeyeater	0.083					0.17
Western Spinebill	0.17	0.50	0.11	0.33	0.25	0.42
Scarlet Robin				0.17		0.17
Western Yellow Robin				0.083		0.25
Varied Sittella		1.58				
Golden Whistler	0.25					0.17
Rufous Whistler			0.22		0.17	
Grey Shrike-thrush		0.083				0.17
White-winged Triller			0.22			
Grey Fantail	0.75	0.92	0.22	0.17	0.42	0.42
Black-faced Woodswallow			0.22			
Grey Butcherbird		0.083				
Australian Raven			0.11			
Silvereye	0.083		0.67		1.00	0.83
Number of species:	11	10	14	10	11	12
Mean density, all birds:	3.25	5.25	5.44	3.33	7.17	3.58

TABLE SEVEN. Numbers of waterbirds observed along Boundary and Lawrie Roads.

Table 7a. 4<sup>th</sup> August 1999.

Species	Number observed	Notes
Australian Shelduck	18	Foraging on pasture
Australian Wood Duck	9	Foraging on pasture near pools
Pacific Black Duck	16	On pools
Grey Teal	11	On pools. A brood of 6 young ducklings on one pool
Australasian Grebe	7	Three nests on separate pools
White-faced Heron	4	On pools
Australian White Ibis	4	Foraging on pasture
Straw-necked Ibis	134	Foraging on pasture
Total:	203	

Table 7b. 15<sup>th</sup> December 1999.

Species	Number observed	Notes
White-faced Heron	3	On pools
Total:	3	

TABLE EIGHT. Frog and reptile species known from the general region of the project area and which are expected to occur on the site, indicating those species recorded during the August (A) and December (D) surveys, and those species or sub-species that are of conservation significance. Details on the categories of conservation significance can be found in Appendix One. Habitats in which species are expected to occur, if known on the basis of available literature, are indicated. Habitats are: Kg - Kingia complexes; Wh - Whicher complexes (including streams within Whicher valleys); Ca - Cartis complex; and Fl -farmland (including flooded pasture, dams and drains).

Species	Habitat	Status
<b>FROGS</b>		
<b>Myobatrachidae</b> (ground frogs)		
Quacking Froglet <i>Crinia georgiana</i>	Kg,Wh,Ca, Fl	A, D
Glauert's Froglet <i>Crinia glauerti</i>	Kg,Wh,Fl	A, D
Sandplain Froglet <i>Crinia insignifera</i>	Ca,Fl	A, D
Granite Froglet <i>Crinia pseudinsignifera</i>	Kg,Wh	
Green-bellied Froglet <i>Geocrinia leai</i>	Wh	
Moaning Frog <i>Heleioporus eyrei</i>	Wh,Ca	A, D
Chocolate Burrowing Frog <i>Heleioporus inornatus</i>	Wh,Kg	
Marbled Burrowing Frog <i>Heleioporus psammophilus</i>	Kg	A, D
Pobblebonk <i>Limnodynastes dorsalis</i>	Wh,Ca,Fl	A
Guenther's Toadlet <i>Pseudophryne guentheri</i>	Wh	
<b>Hylidae</b> (tree frogs)		
Slender Tree Frog <i>Litoria adelaidensis</i>	Fl	A, D
Motorbike Frog <i>Litoria moorei</i>	Wh,Fl	
<b>REPTILES</b>		
<b>Chelidae</b> (side-neck tortoises)		
South-West Long-necked Tortoise <i>Chelodina oblonga</i>	Fl	D
<b>Gekkonidae</b> (geckoes)		
Speckled Stone Gecko <i>Diplodactylus polyophthalmus</i>	Kg	D
Marbled Gecko <i>Phyllodactylus marmoratus</i>	Kg,Wh,Ca	
Barking Gecko <i>Underwoodisaurus milii</i>	Kg	
<b>Pygopodidae</b> (legless-lizards)		
Pretty Worm-Lizard <i>Aprasia pulchella</i>	Kg,Wh,Ca	D
Sandplain Worm-Lizard <i>Aprasia repens</i>	Wh,Ca	
Burton's Legless-Lizard <i>Lialis burtonis</i>	Kg,Wh,Ca	
Common Scaleyfoot <i>Pygopus lepidopodus</i>	Kg,Wh,Ca	
<b>Agamidae</b> (dragon lizards)		
Bearded Dragon <i>Pogona minor</i>	Kg,Wh,Ca	A, D
<b>Varanidae</b> (monitors or goannas)		
Gould's Sand Goanna <i>Varanus gouldii</i>	Kg,Wh,Ca	
Rosenberg's Goanna <i>Varanus rosenbergi</i>	Kg,Wh,Ca	

Table 8 (cont.)

Species		Habitat	Status
<b>Scincidae</b> (skink lizards)			
	<i>Acritoscincus (Bassiana) trilineatum</i>	Wh	A
Fence Skink	<i>Cryptoblepharus plagioccephalus</i>	Kg, Wh, Ca	A, D
	<i>Ctenotus australis</i>		
	<i>Ctenotus impar</i>	Kg, Wh, Ca	A, D
Red-legged Skink	<i>Ctenotus labillardieri</i>	Wh, Kg	D
King's Skink	<i>Egernia kingii</i>	Kg, Wh, Ca	
Salmon-bellied Skink	<i>Egernia napoleonis</i>	Kg, Wh, Ca	A, D
	<i>Glaphyromorphus gracilipes</i>		
	<i>Hemiergis initialis</i>	Kg	
	<i>Hemiergis peronii</i>	Kg, Wh, Ca	A, D
	<i>Lerista distinguenda</i>	Kg, Wh, Ca	A, D
	<i>Lerista elegans</i>	Ca	
	<i>Lerista microtis</i>		
Dwarf Skink	<i>Menetia greyii</i>	Kg, Wh, Ca, Fl	D
	<i>Morethia lineocellata</i>	Wh, Ca	A, D
	<i>Morethia obscura</i>	Kg, Wh	A, D
Bobtail	<i>Tiliqua rugosa</i>	Kg, Wh, Ca, Fl	D
<b>Typhlopidae</b> (blind snakes)			
	<i>Ramphotyphlops australis</i>	Kg, Wh, Ca	D
<b>Boidae</b> (pythons)			
South-West Carpet Python	<i>Morelia spilota imbricata</i>	Kg, Wh	(Schedule 4; (Vulnerable)
<b>Elapidae</b> (front-fanged snakes)			
Crowned Snake	<i>Drysdalia (Notechis) coronata</i>		
Bardick	<i>Echiopsis (Notechis) curtus</i>		
Tiger Snake	<i>Notechis scutatus</i>	Kg, Wh, Ca, Fl	A
Dugite	<i>Pseudonaja affinis</i>	Kg, Wh, Ca, Fl	
Jan's Bandy-bandy	<i>Simoselaps bertholdi</i>	Ca	
Gould's Snake	<i>Suta (Rhinoplocephalus) gouldii</i>	Kg, Wh, Ca	
Black-backed Snake	<i>Suta (Rhinoplocephalus) nigriceps</i>	Kg	
	Number of frog species expected (recorded):	12 (7)	
	Number of reptile species expected (recorded):	37 (17)	

TABLE NINE. Bird species known from the general region of the project area and which are expected to occur on the site, indicating those species recorded during the August (A) and December (D) surveys, and those species or sub-species that are of conservation significance; the classification under the WA Wildlife Conservation Act is given first, that of Garnett (1992) follows in parenthesis. Details on the categories of conservation significance can be found in Appendix One. Habitats in which species are expected to occur, if known on the basis of available literature, are indicated. Habitats are: Kg - Kingia complexes; Wh - Whicher complexes (including streams within Whicher valleys); Ca - Cartis complex; and Fl - farmland (including flooded pasture, dams and drains). Note that <sup>Int.</sup> indicates introduced species.

Species	Habitat	Status
<b>Casuariidae</b> (cassowaries and emus)		
Emu <i>Dromaius novaehollandiae</i>	Kg,Wh,Ca,Fl	A
<b>Phasianidae</b> (pheasants and quails)		
Brown Quail <i>Coturnix ypsilophora</i>		
Stubble Quail <i>Coturnix pectoralis</i>	Fl	
<b>Anatidae</b> (ducks, geese and swans)		
Black Swan <i>Cygnus atratus</i>	Fl	
Australian Shelduck <i>Tadorna tadornoides</i>	Fl	A
Pacific Black Duck <i>Anas superciliosus</i>	Wh,Fl	A
Grey Teal <i>Anas gibberifrons</i>	Fl	A
Australasian Shoveler <i>Anas rhynchotis</i>	Fl	
Hardhead (White-eyed Duck) <i>Aythya australis</i>	Fl	
Australian Wood Duck <i>Chenonetta jubata</i>	Fl	
<b>Podicepsidae</b> (grebes)		
Hoary-headed Grebe <i>Poliiocephalus poliocephalus</i>	Fl	
Australasian Grebe <i>Tachybaptus novaehollandiae</i>	Fl	A
<b>Phalacrocoracidae</b> (cormorants)		
Little Pied Cormorant <i>Phalacrocorax melanoleucos</i>	Fl	
<b>Ardeidae</b> (herons and egrets)		
White-faced Heron <i>Egretta novaehollandiae</i>	Fl	A, D
Little Egret <i>Egretta garzetta</i>	Fl	
White-necked Heron <i>Ardea pacifica</i>	Fl	
Great Egret <i>Egretta alba</i>	Fl	
Cattle Egret <i>Ardeola ibis</i>	Fl	
Nankeen Night Heron <i>Nycticorax caledonicus</i>	Wh,Fl	
<b>Plataleidae</b> (ibis and spoonbills)		
Glossy Ibis <i>Plegadis falcinellus</i>	Fl	
Australian White Ibis <i>Threskiornis molucca</i>	Fl	A
Straw-necked Ibis <i>Threskiornis spinicollis</i>	Fl	A
Yellow-billed Spoonbill <i>Platalea flavipes</i>	Fl	
<b>Accipitridae</b> (kites, hawks and eagles)		
Square-tailed Kite <i>Lophoictinia isura</i>	Kg,Wh,Ca	Priority 4 (Rare)
Black-shouldered Kite <i>Elanus axillaris</i>	Fl	
Whistling Kite <i>Haliastur sphenurus</i>	Kg,Wh,Ca,Fl	
Brown Goshawk <i>Accipiter fasciatus</i>	Kg,Wh,Ca	D

Table 9 (cont.)

Species	Habitat	Status
Collared Sparrowhawk <i>Accipiter cirrhocephalus</i>	Kg,Wh,Ca	
Wedge-tailed Eagle <i>Aquila audax</i>	Wh	A, D
Little Eagle <i>Hieraaetus morphnoides</i>	Wh	A
<b>Falconidae</b> (falcons)		
Peregrine Falcon <i>Falco peregrinus</i>	Kg,Wh,Ca,Fl	A, D Schedule 4
Australian Hobby <i>Falco longipennis</i>	Kh,Wh,Ca	
Brown Falcon <i>Falco berigora</i>	Wh,Ca,Fl	A
Nankeen Kestrel <i>Falco cenchroides</i>	Fl	A, D
<b>Turnicidae</b> (button-quails)		
Painted Button-quail <i>Turnix varia</i>	Kg,Wh	A
<b>Rallidae</b> (crakes and rails)		
Buff-banded Rail <i>Rallus philippensis</i>	Wh,Fl	
Baillon's Crake <i>Porzana pusilla</i>	Wh,Fl	
Spotless Crake <i>Porzana tabuensis</i>	Wh,Fl	
Dusky Moorhen <i>Gallinula tenebrosa</i>	Fl	
Purple Swamphen <i>Porphyrio porphyrio</i>	Fl	A, D
Eurasian Coot <i>Fulica atra</i>	Fl	
<b>Scolopacidae</b> (sandpipers)		
Wood Sandpiper <i>Tringa glareola</i>	Fl	
Marsh Sandpiper <i>Tringa stagnatilis</i>	Fl	
<b>Recurvirostridae</b> (stilts and avocets)		
Black-winged Stilt <i>Himantopus himantopus</i>	Fl	
<b>Charadriidae</b> (lapwings and plovers)		
Black-fronted Dotterel <i>Elsyornis melanops</i>	Fl	
Red-kneed Dotterel <i>Erythrogonys cinctus</i>	Fl	
<b>Columbidae</b> (pigeons and doves)		
Laughing Turtle-Dove <i>Streptopelia senegalensis</i> <sup>Int.</sup>		
Common Bronzewing <i>Phaps chalcoptera</i>	Wh,Ca	A, D
Crested Pigeon <i>Ocyphaps lophotes</i>	Fl	A, D
<b>Cacatuidae</b> (cockatoos)		
Red-tailed Black-Cockatoo (forest sub-species) <i>Calyptorhynchus banksii naso</i>	Kg,Wh	A, D Priority 4 (Insuff. Known)
Short-billed Black-Cockatoo <i>Calyptorhynchus latirostris</i>	Kg,Wh,Ca	?A Schedule 1; Endangered (Vulnerable)
Long-billed Black-Cockatoo <i>Calyptorhynchus baudinii</i>		Schedule 1; Vulnerable (Insuff. Known)
Galah <i>Cacatua roseicapilla</i>	Fl	A
<b>Psittacidae</b> (lorikeets and parrots)		
Purple-crowned Lorikeet <i>Glossopsitta porphyrocephala</i>	Kg,Wh,Ca	D
Regent Parrot <i>Polytelis anthopeplus</i>	Fl	
Red-capped Parrot <i>Purpureicephalus spurius</i>	Kg,Wh,Ca	
Western Rosella <i>Platycercus icterotis</i>	Kg,Wh	
Australian Ringneck <i>Barnardius zonarius</i>	Kg,Wh,Ca,Fl	
Elegant Parrot <i>Neophema elegans</i>	Kg,Wh	

Table 9 (cont.)

Species		Habitat	Status
<b>Cuculidae</b> (cuckoos)			
Pallid Cuckoo	<i>Cuculus pallidus</i>	Kg, Wh, Ca	
Fan-tailed Cuckoo	<i>Cuculus pyrrhophanus</i>	Kg	A
Horsfield's Bronze-Cuckoo	<i>Chrysococcyx basalis</i>	Wh, Ca	A, D
Shining Bronze-Cuckoo	<i>Chrysococcyx lucidus</i>	Wh	A, D
<b>Strigidae</b> (hawk-owls)			
Barking Owl (south-west sub-species)	<i>Ninox connivens connivens</i>	Kg, Wh	Priority 2
Southern Boobook Owl	<i>Ninox novaeseelandiae</i>	Kg, Wh	A, D
<b>Tytonidae</b> (barn owls)			
Masked Owl (southern sub-species)	<i>Tyto novaehollandiae novaehollandiae</i>	Kg, Wh	Priority 4 (Rare)
Barn Owl	<i>Tyto alba</i>	Kg, Wh, Ca, Fl	
<b>Podargidae</b> (frogmouths)			
Tawny Frogmouth	<i>Podargus strigoides</i>	Kg, Wh, Ca, Fl	A, D
<b>Caprimulgidae</b> (nightjars)			
Spotted Nightjar	<i>Eurostopodus argus</i>		
<b>Aegothelidae</b> (owlet-nightjars)			
Australian Owlet-nightjar	<i>Aegotheles cristatus</i>	Kg, Wh	A
<b>Halcyonidae</b> (forest kingfishers)			
Laughing Kookaburra	<i>Dacelo novaeguineae</i> <sup>Int.</sup>	Kg, Wh	A, D
Sacred Kingfisher	<i>Todiramphus sanctus</i>	Kg, Wh, Ca, Fl	D
<b>Meropidae</b> (bee-eaters)			
Rainbow Bee-eater	<i>Merops ornatus</i>		
<b>Climacteridae</b> (treecreepers)			
Rufous Treecreeper	<i>Climacteris rufus</i>	Kg, Wh	
<b>Maluridae</b> (fairy-wrens)			
Red-winged Fairy-wren	<i>Malurus elegans</i>	Wh	
Splendid Fairy-wren	<i>Malurus splendens</i>	Kg, Wh, Ca	A, D
<b>Pardalotidae</b> (pardalotes)			
Spotted Pardalote	<i>Pardalotus punctatus</i>	Kg, Wh	A
Striated Pardalote	<i>Pardalotus striatus</i>	Kg, Wh	A, D
White-browed Scrubwren	<i>Sericornis frontalis</i>	Kg, Wh	A, D
Weebill	<i>Smicromis brevirostris</i>	Wh	A
Western Gerygone	<i>Gerygone fusca</i>	Kg, Wh, Ca	A, D
Inland Thornbill	<i>Acanthiza apicalis</i>	Kg, Wh, Ca	A, D
Western Thornbill	<i>Acanthiza inornata</i>	Kg, Wh	A, D
Yellow-rumped Thornbill	<i>Acanthiza chrysorrhoa</i>	Fl	A, D
<b>Meliphagidae</b> (honeyeaters)			
Red Wattlebird	<i>Anthochaera carunculata</i>	Kg, Wh, Ca	A, D
Little Wattlebird	<i>Anthochaera chrysoptera</i>	Ca	
Brown-headed Honeyeater	<i>Melithreptus brevirostris</i>		
White-naped Honeyeater	<i>Melithreptus lunatus</i>	Kg, Wh	A, D
Brown Honeyeater	<i>Lichmera indistincta</i>	Kg, Wh, Ca	A, D

Table 9 (cont.)

Species	Habitat	Status
New Holland Honeyeater <i>Phylidonyris novaehollandiae</i>	Ca	A, D
White-cheeked Honeyeater <i>Phylidonyris nigra</i>		
Tawny-crowned Honeyeater <i>Phylidonyris melanops</i>		
Western Spinebill <i>Acanthorhynchus superciliosus</i>	Kg,Wh,Ca	A, D
<b>Petroicidae</b> (Australian robins)		
Scarlet Robin <i>Petroica multicolor</i>	Kg,Wh,Ca	A, D
Western Yellow Robin <i>Eopsaltria griseogularis</i>	Kg,Wh	A, D
White-breasted Robin <i>Eopsaltria georgiana</i>	Wh	D
<b>Neosittidae</b> (sittellas)		
Varied Sittella <i>Daphoenositta chrysoptera</i>	Kg,Wh,Ca	A, D
<b>Pachycephalidae</b> (whistlers)		
Crested Shrike-tit <i>Falcunculus frontatus</i>	Kg,Wh	Priority 4
Golden Whistler <i>Pachycephala pectoralis</i>	Kg,Wh	A, D
Rufous Whistler <i>Pachycephala rufiventris</i>	Kg,Wh,Ca	A, D
Grey Shrike-thrush <i>Colluricincla harmonica</i>	Kg,Wh,Ca	A, D
<b>Dicuridae</b> (flycatchers)		
Magpie-lark <i>Grallina cyanoleuca</i>	Fl	A, D
Restless Flycatcher <i>Myiagra inquieta</i>		
Grey Fantail <i>Rhipidura fuliginosa</i>	Kg,Wh,Ca	A, D
Willie Wagtail <i>Rhipidura leucophrys</i>	Fl	A, D
<b>Campephagidae</b> (cuckoo-shrikes)		
Black-faced Cuckoo-shrike <i>Coracina novaehollandiae</i>	Kg,Wh,Ca	A, D
White-winged Triller <i>Lalage sueurii</i>	Ca,Fl	D
<b>Artamidae</b> (woodswallows)		
Black-faced Woodswallow <i>Artamus cinereus</i>	Kg,Wh,Ca,Fl	A, D
Dusky Woodswallow <i>Artamus cyanopterus</i>	Kg,Wh	D
Grey Butcherbird <i>Cracticus torquatus</i>	Kg,Wh,Ca	A, D
Australian Magpie <i>Gymnorhina tibicen</i>	Kh,Wh,Ca, Fl	A, D
Grey Currawong <i>Strepera versicolor</i>	Kg,Wh	D
<b>Corvidae</b> (ravens and crows)		
Australian Raven <i>Corvus coronoides</i>	Kg,Wh,Ca,Fl	A, D
<b>Motacillidae</b> (pipits and true wagtails)		
Richard's Pipit <i>Anthus novaeseelandiae</i>	Fl	A, D
<b>Passeridae</b> (finches)		
Red-eared Firetail <i>Stagonopleura oculata</i>	Kg,Wh	
<b>Hirundinidae</b> (swallows)		
Welcome Swallow <i>Hirundo neoxena</i>	Kg,Wh,Ca,Fl	A, D
Tree Martin <i>Hirundo nigricans</i>	Kg,Wh,Ca,Fl	A, D
<b>Sylviidae</b> (old world warblers)		
Clamorous Reed-Warbler <i>Acrocephalus stentoreus</i>	Fl	
Little Grassbird <i>Megalurus gramineus</i>	Fl	
Rufous Songlark <i>Cincloramphus mathewsi</i>	Fl	D
<b>Zosteropidae</b> (white-eyes)		
Silvereye <i>Zosterops lateralis</i>	Kg,Wh,Ca	A, D
Number of bird species expected (observed):	121 (67)	

TABLE TEN. Mammal species known from the general region of the project area and which are expected to occur on the site, indicating those species recorded during the August (A) and December (D) surveys, and those species that are of conservation significance. Details on the categories of conservation significance can be found in Appendix One. Habitats in which species are expected to occur, if known on the basis of available literature, are indicated. Habitats are: Kg - Kingia complexes; Wh - Whicher complexes (including streams within Whicher valleys); Ca - Cartis complex; and Fl - farmland (including flooded pasture, dams and drains). Note that <sup>Int.</sup> indicates introduced species.

Species		Habitat	Status
<b>Tachyglossidae</b> (echidnas)			
Echidna	<i>Tachyglossus aculeatus</i>	Kg,Wh,Ca	A, D
<b>Dasyuridae</b>			
Mardo	<i>Antechinus flavipes</i>	Kg,Wh	A
Chuditch	<i>Dasyurus geoffroii</i>	Kg,Wh	A, D
Brush-tailed Phascogale	<i>Phascogale tapoatafa</i>	Kg,Wh,Ca	Schedule 1; Vulnerable A, D
Gilbert's Dunnart	<i>Sminthopsis gilberti</i>	Kg,Wh,Ca	Priority 3 D
<b>Peramelidae</b> (bandicoots)			
Quenda (Southern Brown Bandicoot)	<i>Isodon obesulus</i>	Kg,Wh,Ca	A, D Priority 4
<b>Phalangeridae</b> (possums)			
Brush-tailed Possum	<i>Trichosurus vulpecula</i>	Kg,Wh,Ca	A, D
<b>Pseudocheiridae</b> (ring-tailed possums)			
Western Ring-tailed Possum	<i>Pseudocheirus occidentalis</i>	Wh	D Schedule 1; Vulnerable
<b>Burramyidae</b> (pygmy possums)			
Western Pygmy Possum	<i>Cercartetus concinnus</i>	Kg,Wh	A
<b>Tarsipedidae</b> (honey possum)			
Honey Possum	<i>Tarsipes rostratus</i>	Kg,Wh,Ca	A
<b>Macropodidae</b> (kangaroos and wallabies)			
Western Grey Kangaroo	<i>Macropus fuliginosus</i>	Kg,Wh,Ca,Fl	A, D
Brush or Black-gloved Wallaby	<i>Macropus irma</i>	Kg,Wh,Ca	Priority 4
<b>Mollosidae</b> (mastiff bats)			
White-striped Bat	<i>Nyctinomus australis</i> <i>Mormopterus planiceps</i>		D
<b>Vespertilionidae</b> (vesper bats)			
Gould's Wattled Bat	<i>Chalinolobus gouldii</i>		?A
Chocolate Wattled Bat	<i>Chalinolobus morio</i>		
	<i>Vespedalus (Eptesicus) regulus</i>		
	<i>Falsistrellus mackenziei</i>		
Lesser Long-eared Bat	<i>Nyctophilus geoffroyi</i>		
Gould's Long-eared Bat	<i>Nyctophilus gouldii</i>		
Greater Long-eared Bat	<i>Nyctophilus timoriensis</i>		

Table 10 (cont.)

Species		Habitat	Status
<b>Muridae</b> (rats and mice)			
Rakali or Water Rat	<i>Hydromys chrysogaster</i>	Wh, Fl	A, D
House Mouse	<i>Mus musculus</i> <sup>Int.</sup>	Kg, Wh, Ca, Fl	
Moodit or Southern Bush Rat	<i>Rattus fuscipes</i>	Kg, Wh, Ca	A, D
Black Rat	<i>Rattus rattus</i> <sup>Int.</sup>	Wh, Fl	
<b>Leporidae</b> (rabbits and hares)			
Rabbit	<i>Oryctolagus cuniculus</i> <sup>Int.</sup>	Ca, Fl	A, D
<b>Canidae</b> (foxes and dogs)			
European Red Fox	<i>Vulpes vulpes</i> <sup>Int.</sup>	Kg, Wh, Ca, Fl	A, D
<b>Felidae</b> (cats)			
Feral Cat	<i>Felis catus</i> <sup>Int.</sup>	Kg, Wh, Ca, Fl	
<b>Suidae</b> (pigs)			
Feral Pig	<i>Sus scrofa</i> <sup>Int.</sup>	Wh	A
Number of species expected (observed):		29 (17)	

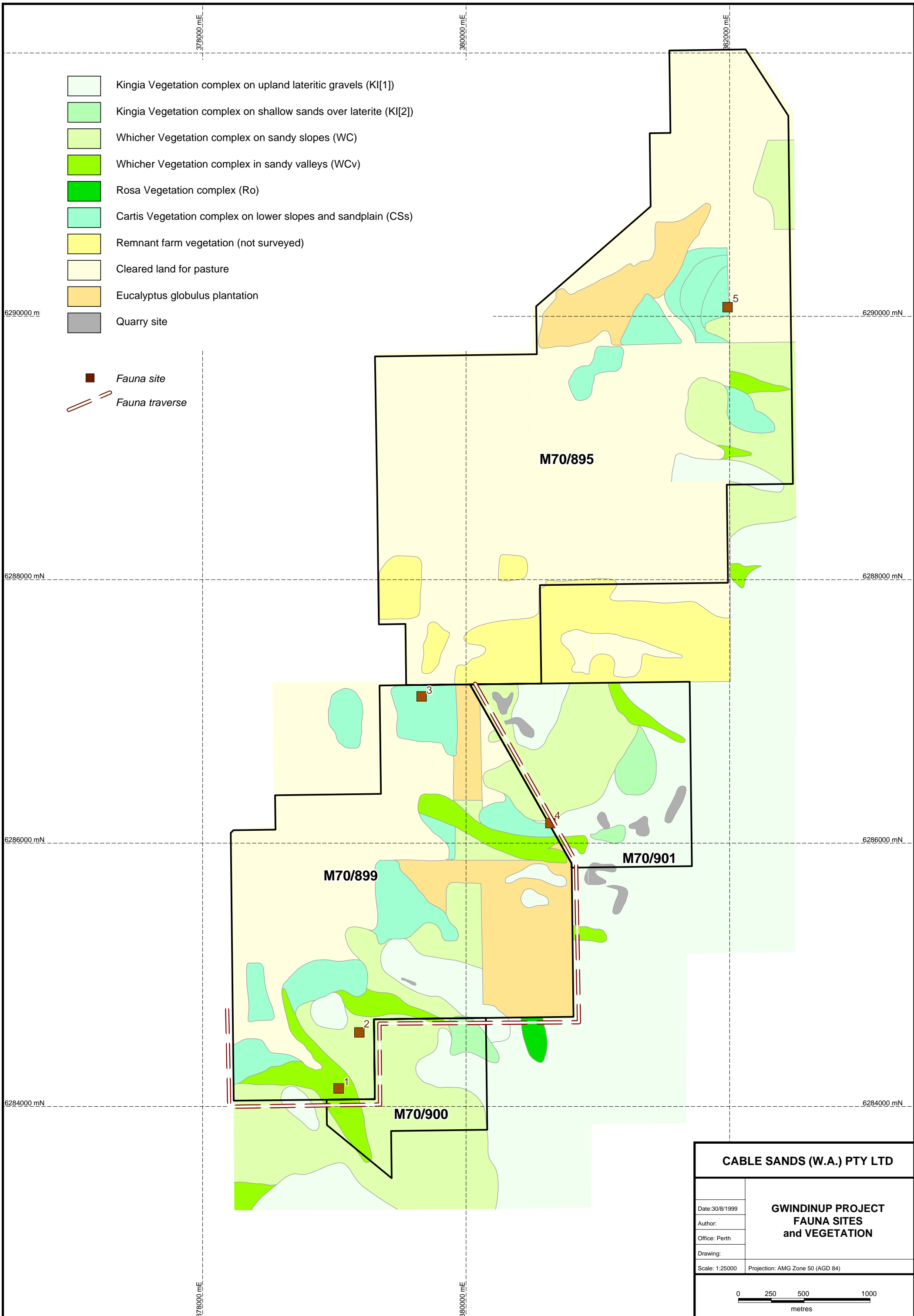
TABLE ELEVEN. Species believed to have been present in the general region of the study area at the time of European settlement, but which are now locally extinct. Note that these species are included on the basis of general information, as there are no specific records of such rare species in the study area.

Species		Status
<b>Galaxiidae</b> (native minnows)		
Black-striped Jollytail	<i>Galaxiella nigrostriata</i>	Priority 4
<b>Rallidae</b> (crakes and rails)		
Lewin's Rail (SW race)	<i>Rallus pectoralis clelandi</i>	Sched. 1; Extinct (Extinct)
<b>Ardeidae</b> (herons and allies)		
Black Bittern (SW population)	<i>Ixobrychus flavicollis</i>	Priority 2
<b>Pardalotidae</b> (pardalotes and allies)		
Western Bristlebird	<i>Dasyornis longirostris</i>	Schedule 1; Vulnerable (Endangered)
<b>Cinclosomatidae</b> (quail-thrush and allies)		
Western Whipbird (heath sub-species)	<i>Psophodes nigrogularis nigrogularis</i>	Schedule 1; Endangered (Endangered)
<b>Potoroidae</b> (rat-kangaroos and allies)		
Woylie	<i>Bettongia penicillata</i>	Priority 4
Boodie	<i>Bettongia lesueur</i>	Schedule 1; Vulnerable
<b>Macropodidae</b> (kangaroos and wallabies)		
Tammar	<i>Macropus eugenii</i>	Priority 4
Quokka	<i>Setonix brachyurus</i>	Schedule 1; Vulnerable
<b>Muridae</b> (rats and mice)		
Noodji or Ashy-grey Mouse	<i>Pseudomys albocinereus</i>	
<b>Canidae</b> (foxes and dogs)		
Dingo	<i>Canis lupus dingo</i>	

FIGURE ONE. Distribution of vegetation complexes in the Gwindinup Project Area (from Environmental Survey and Management 1999) and locations of fauna sampling sites (numbers 1-5). The heavy broken line indicates the vehicle-based spotlighting run.

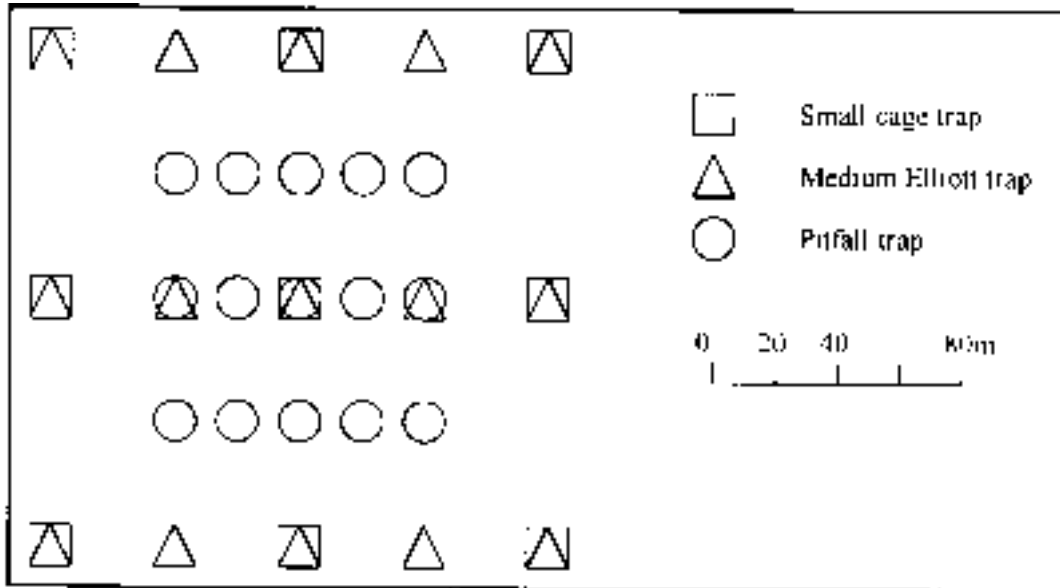
- Kingia Vegetation complex on upland lateritic gravels (KI[1])
- Kingia Vegetation complex on shallow sands over laterite (KI[2])
- Whicher Vegetation complex on sandy slopes (WC)
- Whicher Vegetation complex in sandy valleys (WCv)
- Rosa Vegetation complex (Ro)
- Cartis Vegetation complex on lower slopes and sandplain (CSs)
- Remnant farm vegetation (not surveyed)
- Cleared land for pasture
- Eucalyptus globulus plantation
- Quarry site

- Fauna site
- Fauna traverse



<b>CABLE SANDS (W.A.) PTY LTD</b>	
Date: 30/8/1999 Author: Office: Perth Drawing: Scale: 1:25000    Projection: AMG Zone 50 (AGD 84)	<b>GWINDINUP PROJECT          FAUNA SITES          and VEGETATION</b>

FIGURE TWO. Trapping layout recommended by CALM, consisting of 15 assisted pitfall traps (20 l buckets each with an *ca.* 7 m driftfence, 15 medium Elliott Traps and 9 cage traps).



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APPENDIX ONE. Categories used in the recognition of conservation significance.

**WA Wildlife Conservation Act.**

Schedule 1. Fauna which is rare or likely to become extinct

Schedule 2. Fauna presumed to be extinct

Schedule 3. Birds protected under an international agreement

Schedule 4. Other specially protected fauna.

**WA Department of Conservation and Land Management** (species not listed under the Conservation Act, but for which there is some concern).

Priority 1. Taxa with few, poorly known populations on threatened lands.

Priority 2. Taxa with few, poorly known populations on conservation lands; or taxa with several, poorly known populations not on conservation lands.

Priority 3. Taxa with several, poorly known populations, some on conservation lands.

Priority 4. Taxa in need of monitoring.

**International Union for the Conservation of Nature and Natural Resources (IUCN)** These categories are used by Garnett (1992), Cogger *et al.* (1993) and for Scheduled species under the WA Wildlife Conservation Act. Note that the IUCN categories were refined in 1994 (Mace and Stuart 1994) but that the following categories are still applicable.

Extinct. Taxa not definitely located in the wild during the past 50 years.

Endangered. Taxa in danger of extinction and whose survival is unlikely if the causal factors continue to operate.

Vulnerable. Taxa believed likely to become Endangered in the near future if the causal factors continue to operate.

Rare. Taxa with small populations that are not considered Endangered or Vulnerable, but which are threatened (if only by virtue of their small population size).

Insufficiently Known. Taxa suspected of being Rare, Vulnerable or Endangered, but whose true status cannot be determined without more information.

APPENDIX TWO. Capture records and morphometric data for all frog, reptile and mammal specimens caught on the trapping grids during the Gwindinup Fauna Survey, August and December 1999. Column abbreviations are:

Wt = weight (g); Crn = crown length (mm); GW = gonad width (mm); SVL = snout to vent length (mm); Tot = total length (mm).

A number in parenthesis in the notes column is the number with which the specimen was marked (ear punch; mammals only). An "R" alongside this number indicates that the specimen was a recapture. py = pouch young.

Appendix 2a. Mammal captures on trapping grids.

Date	Species	Grid No.	Trap type	Wt	Crn	GW	sex	Notes
01/08	<i>Cercartetus concinnus</i>	2	pit	10.0	23.8	6.5	M	(1)
01/08	<i>Dasyurus geoffroii</i>	4	cage	700	84.0	-	F	(1) 6 small py
01/08	<i>Phascogale tapoatafa</i>	5	cage	140	24.0		F	(1) 8 small py
02/08	<i>Isodon obesulus</i>	3	cage	600	77.0	20.0	M	(1)
02/08	<i>Antechinus flavipes</i>	4	Elliott	50	34.5	13.7	M	(1)
03/08	<i>D. geoffroii</i>	1	cage	895	91.0	-	F	(2) 6 small py
03/08	<i>P. tapoatafa</i>	1	cage	130	59.0	-	F	(2) virgin pouch
03/08	<i>A. flavipes</i>	2	pit	26.5	32.0	-	F	(2) virgin pouch
03/08	<i>D. geoffroii</i>	4	cage	690	84.5	-	F	(R1) 6 small py
03/08	<i>Tarsipes rostratus</i>	4	pit	10.5	26.8	-	F	(1) small py
03/08	<i>D. geoffroii</i>	4	cage	780	96.0	31.0	M	(4)
04/08	<i>C. concinnus</i>	2	pit				M	(R1)
04/08	<i>A. flavipes</i>	2	Elliott	25.0	31.0	-	F	(-) virgin pouch
04/08	<i>D. geoffroii</i>	4	cage				F	(R1)
04/08	<i>D. geoffroii</i>	4	cage				M	(R4)
04/08	<i>Rattus rattus</i>	5	cage					(-)
05/08	<i>C. concinnus</i>	1	pit	13.5	24.5	9.8	M	(2)
05/08	<i>P. tapoatafa</i>	1	Elliott	155	53.3	-	F	(16) virgin pouch
05/08	<i>A. flavipes</i>	2	Elliott	50.0	35.9	13.8	M	(4)
05/08	<i>A. flavipes</i>	2	Elliott	50.0	35.3	12.0	M	(-)
05/08	<i>A. flavipes</i>	2	Elliott	26.0	31.3	-	F	(R2) virgin pouch
05/08	<i>Mus musculus</i>	3	Elliott	-	23.5	-	M	testes ascended
05/08	<i>M. musculus</i>	3	pit	13.0	23.3		F	vagina perforate
05/08	<i>I. obesulus</i>	3	cage	540	-	-	M	(R1)
05/08	<i>T. rostratus</i>	4	pit	7.5	26.4	-	F	(-) small py
05/08	<i>M. musculus</i>	4	Elliott	15.0	22.4	-	M	testes ascended
05/08	<i>D. geoffroii</i>	4	cage				F	(R1)
05/08	<i>D. geoffroii</i>	4	cage				M	(R4)
05/08	<i>R. rattus</i>	5	cage					(-) second animal
13/12	<i>T. vulpecula</i>	2	cage	2000	85.0		F	(-) 2 py
13/12	<i>I. obesulus</i>	3	cage				M	(R1)
13/12	<i>I. obesulus</i>	3	cage	1120			M	(-)
13/12	<i>S. gilberti</i>	3	pit	9.5	28.2	4.2	M	(-) immature
13/12	<i>D. geoffroii</i>	4	cage	1200	98.0	25.4	M	(-)

## Appendix 2 a (cont.)

14/12	<i>P.tapoatafa</i>	1	Elliott	165	57.7		F	regressed pouch
14/12	<i>D. geoffroii</i>	2	cage	290	68.3		F	immature
14/12	<i>I. obesulus</i>	2	cage				F	(-) py present. No tail
14/12	<i>T. vulpecula</i>	4	cage	2000		31.2	M	(-)
14/12	<i>D. geoffroii</i>	4	cage	1200	104	16.0	M	
15/12	<i>M. musculus</i>	1	pit	15.0				
15/12	<i>D. geoffroii</i>	2	cage	300	71.8		F	(16) immature
15/12	<i>T. vulpecula</i>	2	cage	940	77.6	15.2	M	(8) immature
15/12	<i>P. tapoatafa</i>	3	Elliott	180	52.1		F	Lactating
15/12	<i>I. obesulus</i>	3	cage	1060		27.9	M	(R1)
15/12	<i>D. geoffroii</i>	4	cage	560	81.0	9.3	M	Immature
15/12	<i>T. vulpecula</i>	4	cage				M	(R from 14/12)
16/12	<i>D. geoffroii</i>	1	cage	250	71.6		M	Immature
16/12	<i>T. vulpecula</i>	2	cage	750			U	
16/12	<i>I. obesulus</i>	3	cage	1050		21.5	M	(R1)
16/12	<i>I. obesulus</i>	4	cage	1600	93.2	27.9	M	(-)
16/12	<i>I. obesulus</i>	4	cage	1000	89.7	26.5	M	(-)
16/12	<i>D. geoffroii</i>	4	cage				M	(R18)
17/12	<i>T. vulpecula</i>	1	cage				F	Lactating
17/12	<i>D. geoffroii</i>	2	cage	290			F	(R16) immature
17/12	<i>P. tapoatafa</i>	2	cage	125	53.5		F	Lactating
17/12	<i>I. obesulus</i>	3	cage	1050		27.2	M	(R1)
17/12	<i>D. geoffroii</i>	4	cage	1100	97.3	20.0	M	(R from 13/12)
17/12	<i>I. obesulus</i>	4	cage				M	(R from 16/12)
17/12	<i>T. vulpecula</i>	4	cage				F	Large py
17/12	<i>T. vulpecula</i>	4	cage	800			F	Immature
17/12	<i>I. obesulus</i>	4	cage	1000	89.0	28.0	M	
17/12	<i>M. musculus</i>	5	pit		22.4		M	Scrotal testes

## Appendix 2b. Frog and Reptile captures on trapping grids.

Date	Species	Grid No.	Trap type	Wt	SVL	Tot	sex	Notes
01/08	<i>Morethia lineocellata</i>	3	pit		26	66		
01/08	<i>Heleioporus eyrei</i>	3	pit		47			
02/08	<i>M. lineocellata</i>	5	pit		42	110	M	
02/08	<i>Crinia georgiana</i>	1	pit		38		F	
02/08	<i>M. lineocellata</i>	1	pit		41	84		
02/08	<i>H. eyrei</i>	5	pit		51			
02/08	<i>H. eyrei</i>	5	pit		50			
03/08	<i>H. eyrei</i>	3	pit		44			
03/08	<i>H. eyrei</i>	5	pit		57			

## Appendix 2b (cont.)

05/08	<i>Acritoscincus trilineatum</i>	2	pit		53	140		
05/08	<i>Morethia obscura</i>	4	pit		26	53		
05/08	<i>H. psammophilus</i>	4	pit		54			
05/08	<i>Notechis scutatus</i>	5	cage		800			
13/12	<i>H. psammophilus</i>	1	Pit		53			
13/12	<i>C. georgiana</i>	1	Pit		12			
13/12	<i>C. georgiana</i>	1	Pit		13			
13/12	<i>C. georgiana</i>	1	Pit		19			
13/12	<i>C. georgiana</i>	1	Pit		12			
13/12	<i>C. georgiana</i>	1	Pit		15			
13/12	<i>M. lineocellata</i>	1	Pit		42	106	M	Red throat
13/12	<i>C. georgiana</i>	1	Pit		18			
13/12	<i>C. georgiana</i>	1	Pit		19			
13/12	<i>C. georgiana</i>	1	Pit		21			
13/12	<i>C. glauertii</i>	1	Pit		13			
13/12	<i>C. glauertii</i>	1	Pit		16			
13/12	<i>M. lineocellata</i>	1	Pit		45	98	F	Gravid
13/12	<i>L. distinguenda</i>	1	Pit		38	85		
13/12	<i>C. georgiana</i>	1	Pit		19			
13/12	<i>H. psammophilus</i>	1	Pit		50			
13/12	<i>C. georgiana</i>	1	Pit		15			
13/12	<i>C. georgiana</i>	1	Pit		19			
13/12	<i>C. glauertii</i>	1	Pit		17			
13/12	<i>H. peronii</i>	1	Pit		34	40		
13/12	<i>C. georgiana</i>	1	Pit		19			
13/12	<i>R. australis</i>	2	Pit		250	260		
13/12	<i>H. psammophilus</i>	2	Pit		64		M	
13/12	<i>C. impar</i>	2	Pit		45	125		
13/12	<i>C. insignifera</i>	3	Pit		18			
13/12	<i>C. insignifera</i>	3	Pit		21			
13/12	<i>C. insignifera</i>	3	Pit		17			
13/12	<i>C. insignifera</i>	3	Pit		18			
13/12	<i>M. lineocellata</i>	3	Pit		44	96		
13/12	<i>C. georgiana</i>	3	Pit		26			
13/12	<i>H. eyrei</i>	3	Pit		53			
13/12	<i>T. rugosa</i>	3	Elliot		265	310		
13/12	<i>C. georgiana</i>	4	Pit		16			
13/12	<i>C. georgiana</i>	4	Pit		17			
13/12	<i>A. pulchella</i>	4	Pit		90	155		
13/12	<i>H. psammophilus</i>	4	Pit		59		M	
13/12	<i>H. eyrei</i>	5	Pit		54			
13/12	<i>H. eyrei</i>	5	Pit		54			
13/12	<i>H. eyrei</i>	5	Pit		53			
13/12	<i>H. eyrei</i>	5	Pit		34			
13/12	<i>H. eyrei</i>	5	Pit		26			

## Appendix 2b (cont.)

13/12	<i>H. eyrei</i>	5	Pit	58			
13/12	<i>H. eyrei</i>	5	Pit	40			
13/12	<i>H. eyrei</i>	5	Pit	53			
13/12	<i>H. eyrei</i>	5	Pit	51			
13/12	<i>H. eyrei</i>	5	Pit	51			
13/12	<i>H. eyrei</i>	5	Pit	54			
13/12	<i>H. eyrei</i>	5	Pit	51			
13/12	<i>H. eyrei</i>	5	Pit	31			
13/12	<i>C. plagiocephalus</i>	5	Pit	39	97		
13/12	<i>C. georgiana</i>	5	Pit	27			
13/12	<i>M. lineocellata</i>	5	Pit	38	100	M	
14/12	<i>C. georgiana</i>	1	pit	8			
14/12	<i>C. georgiana</i>	1	pit	9			
14/12	<i>C. georgiana</i>	1	pit	16			
14/12	<i>C. georgiana</i>	1	pit	10			
14/12	<i>C. georgiana</i>	1	pit	10			
14/12	<i>C. georgiana</i>	1	pit	17			
14/12	<i>C. georgiana</i>	1	pit	17			
14/12	<i>C. georgiana</i>	1	pit	18			
14/12	<i>C. georgiana</i>	1	Pit	31			
14/12	<i>H. eyrei</i>	1	Pit	51			
14/12	<i>H. eyrei</i>	1	Pit	53			
14/12	<i>H. eyrei</i>	1	Pit	54			
14/12	<i>C. labillardieri</i>	1	Pit	56	160		
14/12	<i>C. labillardieri</i>	1	Pit	58	170		
14/12	<i>H. peronii</i>	1	Pit	35	75		
14/12	<i>H. peronii</i>	1	Pit	49	116		
14/12	<i>L. distinguenda</i>	1	Pit	30	55		
14/12	<i>E. napoleonis</i>	2	Elliot	100	192		
14/12	<i>L. distinguenda</i>	2	Pit	35			
14/12	<i>C. impar</i>	2	Pit	60	161		
14/12	<i>C. impr</i>	2	Pit	58	170		
14/12	<i>M. lineocellata</i>	2	Pit	44	88	F	
14/12	<i>C. insignifera</i>	3	Pit	19			
14/12	<i>C. insignifera</i>	3	Pit	18			
14/12	<i>C. insignifera</i>	3	Pit	17			
14/12	<i>C. insignifera</i>	3	Pit	19			
14/12	<i>C. insignifera</i>	3	Pit	18			
14/12	<i>C. insignifera</i>	3	Pit	18			
14/12	<i>C. insignifera</i>	3	Pit	19			
14/12	<i>C. georgiana</i>	3	Pit	19			
14/12	<i>C. georgiana</i>	3	Pit	20			
14/12	<i>H. eyrei</i>	3	Pit	55			
14/12	<i>H. eyrei</i>	3	Pit	55			
14/12	<i>H. eyrei</i>	3	Pit	28			

## Appendix 2b (cont.)

14/12	<i>H. eyrei</i>	3	Pit		20			
14/12	<i>H. eyrei</i>	3	Pit		29			
14/12	<i>H. eyrei</i>	3	Pit		51			
14/12	<i>M. lineocellata</i>	3	Pit		48	116	F	
14/12	<i>C. georgiana</i>	4	Pit		19			
14/12	<i>C. georgiana</i>	4	Pit		17			
14/12	<i>C. georgiana</i>	4	Pit		17			
14/12	<i>C. georgiana</i>	4	Pit		20			
14/12	<i>C. labillardieri</i>	4	Pit		51	75		
14/12	<i>M. obscura</i>	4	Pit		48	105		
14/12	<i>M. obscura</i>	4	Pit		40	86	M	
14/12	<i>M. obscura</i>	4	Pit		42	96	F	
14/12	<i>H. peronii</i>	4	Pit		48	105		
14/12	<i>C. plagiocephalus</i>	4	Pit		41	80		
14/12	<i>H. eyrei</i>	5	Pit		*			* 97 caught 7 adults, 90 immature
14/12	<i>R. australis</i>	5	Pit		160	165		
14/12	<i>T. rugosa</i>	5	Cage		280	370		
15/12	<i>C. impar</i>	1	Pit		-			
15/12	<i>C. impar</i>	1	Pit		52	167		
15/12	<i>T. rugosa</i>	1	Cage		203	275		
15/12	<i>L. distinguenda</i>	1	Pit		36	80		
15/12	<i>C. georgiana</i>	3	Pit		18			
15/12	<i>C. georgiana</i>	3	Pit		18			
15/12	<i>T. rugosa</i>	3	Cage		270	342		
15/12	<i>M. lineocellata</i>	3	Pit		42	99		
15/12	<i>M. lineocellata</i>	3	Pit		35	92	M	
15/12	<i>A. pulchella</i>	3	Pit		79	123		
15/12	<i>L. distinguenda</i>	3	Pit		35	78		
15/12	<i>H. eyrei</i>	3	Pit		30			
15/12	<i>C. insignifera</i>	3	Pit		19			
15/12	<i>H. psammophilus</i>	4	Pit		44			
15/12	<i>H. psammophilus</i>	4	Pit		26			
15/12	<i>C. georgiana</i>	4	Pit		18			
15/12	<i>C. georgiana</i>	4	Pit		18			
15/12	<i>C. impar</i>	4	Pit		55	161		
15/12	<i>H. eyrei</i>	5	Pit		*			* 58 caught 2 adult, 56 immature
15/12	<i>T. rugosa</i>	5	Cage		250	307		
15/12	<i>T. rugosa</i>	5	Cage		275	360		
15/12	<i>T. rugosa</i>	5	Cage		272	350		
15/12	<i>T. rugosa</i>	5	Cage		307	365		
15/12	<i>T. rugosa</i>	5	Cage		315	385		
15/12	<i>L. distinguenda</i>	5	Pit		34	78		
15/12	<i>M. lineocellata</i>	5	pit		40	116		

## Appendix 2b (cont.)

16/12	<i>M. lineocellata</i>	1	Pit		41	56		
16/12	<i>H. peronii</i>	2	Pit		33	80		
16/12	<i>L. distinguenda</i>	2	Pit		28	40		
16/12	<i>E. napoleonis</i>	2	Elliot		92	185		
16/12	<i>C. georgiana</i>	3	Pit		18			
16/12	<i>T. rugosa</i>	3	Cage		290	370		
16/12	<i>L. distinguenda</i>	3	Pit		36	81		
16/12	<i>P. minor</i>	3	Pit		95	275		
16/12	<i>M. obscura</i>	4	Pit		37	95	M	
16/12	<i>M. obscura</i>	4	Pit		43	113	M	
16/12	<i>M. obscura</i>	4	Pit		36	93	M	
16/12	<i>M. obscura</i>	4	Pit		40	92	M	
16/12	<i>C. labillardieri</i>	4	Pit		55	142		
16/12	<i>C. labillardieri</i>	4	Pit		51	140		
16/12	<i>L. distinguenda</i>	4	Pit		35	55		
16/12	<i>E. napoleonis</i>	4	Elliot		87	139		
16/12	<i>H. eyrei</i>	5	Pit		27			
16/12	<i>H. eyrei</i>	5	Pit		24			
16/12	<i>H. eyrei</i>	5	Pit		27			
16/12	<i>H. eyrei</i>	5	Pit		27			
16/12	<i>H. eyrei</i>	5	Pit		45			
16/12	<i>H. eyrei</i>	5	Pit		27			
16/12	<i>H. eyrei</i>	5	Pit		29			
16/12	<i>M. lineocellata</i>	5	Pit		33	92		
16/12	<i>P. minor</i>	5	Pit		70	210		
17/12	<i>C. impar</i>	1	Pit		58	165		
17/12	<i>L. distinguenda</i>	1	Pit		32	65		
17/12	<i>M. lineocellata</i>	2	Pit		43	100	M	
17/12	<i>M. lineocellata</i>	2	Pit		41	113	M	
17/12	<i>M. obscura</i>	2	Pit		50	118	F	Gravid
17/12	<i>C. impar</i>	2	Pit		62	162		
17/12	<i>T. rugosa</i>	3	Cage		280	362		
17/12	<i>P. minor</i>	3	Pit		115	326		
17/12	<i>H. eyrei</i>	3	Pit		-			
17/12	<i>H. peronii</i>	3	Pit		42	95		
17/12	<i>M. lineocellata</i>	3	Pit		38	98	M	
17/12	<i>M. greyii</i>	4	Pit		32	75	F	
17/12	<i>C. labillardieri</i>	4	Pit				F	Gravid
17/12	<i>C. plagiocephalus</i>	4	Pit		32	75		
17/12	<i>H. eyrei</i>	5	Pit		31			
17/12	<i>H. eyrei</i>	5	Pit		30			
17/12	<i>H. eyrei</i>	5	Pit		27			
17/12	<i>H. eyrei</i>	5	pit		45			
17/12	<i>H. eyrei</i>	5	Pit		26			
17/12	<i>H. eyrei</i>	5	pit		31			
17/12	<i>M. lineocellata</i>	5	Pit		38	95	M	
17/12	<i>T. rugosa</i>	5	Cage		275	350		
17/12	<i>H. peronii</i>	5	Pit		50	130		
17/12	<i>P. minor</i>	5	Pit		70	187		

APPENDIX THREE. Observations made along the north branch of Gynudup Brook.

An inspection of the north branch of Gynudup Brook was carried out on 5<sup>th</sup> January 2000 after a report of Long-necked Tortoises and freshwater fish at the site. This inspection involved walking through the area for about 2 hours and setting fish traps.

This section of the brook consists of a drain that has been dug into an area that would naturally be inundated with gently flowing water in winter, and would probably remain damp in summer. The drain forms an elongate pool edged with pasture that is grazed by cattle. Wildlife observed along this pool consisted of: Goldfish *Carassius auratus* (a single, large specimen), Glauert's Froglet *Crinia glauertii* (calling), Pobblebonk *Limnodynastes dorsalis* (tadpoles), Slender Tree-Frog *Litoria adelaidensis* (tadpoles), Tiger Snake *Notechis scutatus*, Pacific Black Duck *Anas superciliosus* (5 seen) and White-faced Heron *Ardea novaehollandiae* (1 seen). Although no South-West Long-necked Tortoises *Chelodina oblonga* were observed, the habitat appeared suitable for them, while the fauna that was observed was typical of a degraded, permanent body of water in a paddock. The only notable feature was the absence of the introduced Mosquito Fish *Gambusia holbrooki*.

In addition to the drain, a swampy area at the head of this drain was inspected and was found to contain a probably permanent pool that had been dug in the centre of a thicket of *Agonis linearifolia*. This thicket was in turn surrounded by a tall shrubland of *Kunzea* sp. and was within 200 m of Site 5. The pool supported large numbers of tadpoles (mostly Slender Tree-Frogs). Birds observed in the *Agonis* thicket included a pair of White-breasted Robins *Eopsaltria georgiana*; the only record of this species for the Gwindinup project. Although not of conservation significance, the White-breasted Robin is endemic to the South-West and has largely disappeared from the coastal plain south of Perth due to clearing. Diggings of the Quenda *Isoodon obesulus* were also abundant in the *Agonis* thicket.

The *Agonis* thicket covered an area of less than 1 ha and is of local conservation significance because of the White-breasted Robins and probably a high density of Quendas. Winter flooding of this thicket and surrounding areas may also be important for breeding by frogs in the region, as Site 5 recorded very large numbers of captures of the Moaning Frog *Heleioporus eyrei*.

#### APPENDIX FOUR. Notes on the aquatic invertebrate fauna of the Gwindinup area.

Aquatic invertebrates are an important component of wetland ecosystems in the region but were beyond the scope of the Gwindinup fauna survey. However, the freshwater mussel *Westralunio carteri* is known from the general region and is listed as Priority 4 by the Department of Conservation and Land Management. Therefore, opportunistic searches were undertaken for this species but it was not found. In general, all wetlands examined were either too temporary or were too choked with fine sediment for the mussel, which is commonly associated with permanent or nearly permanent streams that have moderate flows and sandy or silty substrates.

Wetlands in the Gwindinup region are largely seasonal with the exception of the drain and possibly the pool described above, and farm dams such as those on the Baljeu property. Seasonal wetlands include watercourses that flow down the Whicher Range, and drains and swamps on the coastal plain. Wetlands on the coastal plain are highly disturbed by agriculture, but the watercourses of the Whicher Range have suffered minimal disturbance. Permanent and nearly permanent streams of the nearby Darling Scarp support an aquatic invertebrate fauna that includes a number of endemic species, while the fauna is characterised by being very variable seasonally and ecologically dependent upon inputs from terrestrial ecosystems. For example, many species feed upon eucalypt leaf-litter that falls or is washed into the stream. These faunal assemblages are disturbed by an increase in nutrients, changes in natural flow patterns and loss of overhanging vegetation (based upon studies by J.A. Davis, L.A. Barmuta and S.A. Balla, (1988), Dirk Brook Aquatic Fauna Study, unpub. Report to the WA Water Authority).

The aquatic invertebrate fauna of watercourses of the Whicher Range probably share the characteristics of the invertebrate fauna of streams in the Darling Range, although may be depauperate due to the Whicher Range streams being highly seasonal. To protect the invertebrate fauna of these watercourses, it is important that seasonal patterns of flow not be altered and fringing/overhanging vegetation not be removed. Nutrient levels and turbidity should not increase. Drains and swamps on the adjacent coastal plain could probably be brought to a more natural condition by increasing fringing and overhanging vegetation.