

Forrestania Fauna Monitoring Survey- Flying Fox Phases III and IV



Prepared for
Western Areas NL

Prepared by
Biota Environmental Sciences Pty Ltd

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Flying Fox Fauna Survey Phases III and IV

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1.0 Summary

1.1 Background and Methods

Western Areas NL currently operates the Flying Fox nickel sulphide mine, east of Hyden (32° 25'S, 119° 41'E). Mining involves the construction of underground declines to access nickel. The box cut at Flying Fox has resulted the clearing and removal of some native vegetation, and groundwater extraction may impact upon hydrological regimes in the area. The proximity of the Lake Cronin Nature Reserve is a particular consideration for the project in this respect.

Biota Environmental Sciences was commissioned to undertake an ongoing fauna assemblage monitoring survey within the Forrestania project area, specifically surrounding the Flying Fox mine. This report documents results obtained during monitoring Phases III and IV conducted during May 2006 and November 2006 respectively.

As for earlier phases, the original scope of the Phase III and IV fauna surveys, was primarily to satisfy a commitment to the Department of Conservation to monitor the effect of mining on the area surrounding the Flying Fox mine, including the Lake Cronin nature reserve. However, due to the difficulties in meaningfully achieving this, it was mutually agreed to focus on obtaining information relating to community composition of the fauna within the area adjacent to the mine. This included:

- describing the fauna habitats occurring within the study area;
- identifying any habitats of particular conservation significance within the area;
- recording the fauna assemblage occurring within the study area using a combined approach of desk-top reviews of existing data, and a site specific fauna survey comprising a suite of established survey techniques;
- identifying fauna of particular conservation significance (including Scheduled fauna, Priority fauna and other fauna of interest including but not limited to short-range endemic taxa); and
- providing recommendations for the direction of future monitoring at Forrestania.

The central component of the systematic censusing consisted of 10 trapping grids comprising pit-traps, box traps (Elliott traps) and a cage trap, each located within a defined habitat. Additional trapping grids consisting of box and cage traps were also installed. Avifauna censuses were conducted at each trapping site. Finally, micro-bats were targeted using harp nets and Anabat units designed to record bat calls.

1.2 Results

The Phase III and IV surveys recorded a total of 21 herpetofauna species, 61 bird species and 18 species of mammal, giving a total of 100 vertebrate fauna species.

The herpetofauna comprised two frogs, five geckos, seven skinks, three dragons, one monitor, one blind snake and two front-fanged snakes.

The total of 61 species of birds comprised 21 families, and included 20 non-passerine and 41 passerine species.

The non-volant mammals comprised three dasyurids (carnivorous marsupials), one burramyid (pygmy possum), one tarsiped (honey possum), two macropods (kangaroos and wallabies), one canine (dogs), one feline (cats), one leporid (rabbits), and two murids (murid rodents). Six bat species were also recorded, comprising four vespertilionids (evening bats) and two molossids (freetail bats).

One reptile, 13 bird and six mammal species listed as threatened or migratory were either recorded or have the potential to occur in the study area (Table 1.1).

Seven potential Short Range Endemic species of Mygalomorph spider were recorded from the Flying Fox study area, representing the Nemesiidae, Idiopidae and Barychelidae families. The conservation significance of these species has not been established.

Table 1.1 Schedule and Priority fauna listed at State and Federal levels recorded or potentially occurring in the Flying Fox study area.

Species	State Wildlife Conservation Act 1950-1979	Federal Environment Protection and Biodiversity Conservation (EPBC) Act 1999
Carnaby's Cockatoo <i>Calyptorhynchus latirostris</i> *† Red-tailed Phascogale <i>Phascogale calura</i> Western Whipbird <i>Psophodes nigrogularis</i> Heath Mouse <i>Pseudomys shortridgei</i> Numbat <i>Myrmecobius fasciatus</i> Δ Malleefowl <i>Leipoa ocellata</i> †Δ Western Quoll (Chudich) <i>Dasyurus geoffroii</i> *†Δ Western Rosella <i>Platycercus icterotis zanthogenys</i> *†Δ	Schedule 1 Endangered Endangered Endangered Vulnerable Vulnerable Vulnerable Vulnerable Vulnerable	Endangered Endangered Vulnerable Vulnerable Vulnerable Vulnerable Vulnerable Not listed
Peregrine Falcon <i>Falco peregrinus</i> *†Δ Carpet Python <i>Morelia spilota imbricata</i> †	Schedule 4 Schedule 4	
Bustard <i>Ardeotis australis</i> Shy Groundwren <i>Hylacola cauta whitlocki</i> *† Rufous Fieldwren <i>Calamanthus campestris montanellus</i> *† Western Shrike-tit <i>Falcunculus frontatus leucogaster</i> Crested Bellbird <i>Oreoica gutturalis gutturalis</i> *† White-browed Babbler <i>Pomatostomus superciliosus ashbyi</i> *†Δ Western Brush Wallaby <i>Macropus irma</i> *†Δ Western Mouse <i>Pseudomys occidentalis</i> Δ	Priority 4 Priority 4 Priority 4 Priority 4 Priority 4 Priority 4 Priority 4 Priority 4	
Fork-tailed Swift <i>Apus pacificus</i> Rainbow Bee-eater <i>Merops ornatus</i> †		Migratory Species Migratory Species

* Denotes species recorded in the study area during this survey.

† Denotes species recorded in the area during other surveys by Biota.

Δ Denotes species recorded in DEC's threatened and priority fauna database (see Appendix 1).

1.3 Future Monitoring

The survey phases completed to date at Flying Fox have illustrated the value of medium to long-term fauna studies in respect of both more comprehensive community descriptions and documenting changes in community structure and species representation over time. Most fauna studies conducted for impact assessment purposes are short-term in nature and generally conducted over short timeframes. Even in research organizations, there are limited examples of systematic long-term studies of terrestrial fauna over longer timeframes. There would therefore be value in continuing the terrestrial fauna trapping at the established sites, perhaps with consideration to reducing the frequency of data collection. This would yield a publication standard data set that could be submitted to a refereed journal, recognising the support provided by Western Areas.

In addition to this broader value, future fauna surveys (associated with ongoing monitoring commitments) will continue targeting the Western Quoll with individuals being marked to aid in identification of new individuals. Uncertainty also exists in resolving the conservation significance of mygalomorph spiders. Future fauna surveys should further target mygalomorph species with a view to utilising molecular techniques as a means of inferring levels of reproductive isolation in these spiders.

2.0 Introduction

2.1 Project Background

Western Areas NL is currently developing the Flying Fox nickel sulphide mine, east of Hyden (32° 25'S, 119° 41'E). The proposal involves the construction of underground declines to access nickel. The box cut at Flying Fox will involve the clearing and removal of some native vegetation, and groundwater extraction may impact upon hydrological regimes in the area. The proximity of the Lake Cronin Nature Reserve is a particular consideration for the project in this respect. As a result, the proponent has made a commitment to conduct an inventory survey of the lease to determine the species present in the area and provide a baseline from which to assess any potential impacts.

2.2 Scope of Study

Biota Environmental Sciences was commissioned to undertake an ongoing fauna assemblage monitoring survey within the Forrestania project area, specifically surrounding the Flying Fox mine. This report documents results obtained during monitoring Phases III and IV conducted during May 2006 and November 2006 respectively.

The survey was planned and implemented according to the Environmental Protection Authority (EPA) Position Statement No. 3 "Terrestrial Biological Surveys as an Element of Biodiversity Protection" (EPA 2002) and Guidance Statement No. 56 "Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia" (EPA 2004).

The scope of the Phase III and IV fauna survey, in conjunction with Phases I and II was to:

- describe the fauna habitats occurring within the study area;
- identify any habitats of particular conservation significance within the area;
- record the fauna assemblage occurring within the study area using a combined approach of desk-top reviews of existing data, and a site specific fauna survey comprising a suite of established survey techniques;
- identify fauna of particular conservation significance (including Scheduled fauna, Priority fauna and other fauna of interest including but not limited to short-range endemic taxa); and
- provide recommendations for the direction of future monitoring at Forrestania

2.3 Purpose of this Report

This report describes the methodology employed for the fauna survey of the area encompassing the Flying Fox mine and associated infrastructure. It documents the results of the survey and presents management recommendations to minimize the impacts of the project on fauna habitats and assemblages. The implementation of ongoing fauna monitoring fulfils Mining Lease M77/582 tenement condition 39 and Mining Lease M77/545 tenement condition 28. Both the survey and report are subject to specific limitations that are discussed in more detail in Section 4.4.6.

2.4 Previous Surveys

A number of fauna surveys have previously been conducted in the Forrestania area. These have been used to provide contextual data for the current project:

Flying Fox monitoring programme

- Biota (2005). Interim Summary Report of Flying Fox Fauna Survey, 30th January to 7th February, 2005;
- Biota (2005). Forrestania Fauna Survey - Fauna and Faunal Assemblages Report. February 2005 and November 2005;
- Biota (2004). Forrestania Fauna Monitoring Interim Summary Report, May 3rd to 9th, 2006;

Other Forrestania zoological surveys

- Biota (2006). Forrestania Water Disposal Pipeline Survey- Fauna and Faunal Assemblages Report, July 2006.
- Biota (2007). Diggers South Fauna Survey- Phase I. March 2007.
- Bamford (2004). Proposed Flying Fox, New Morning, Cosmic Boy and Digger Rocks Nickel Mines near Middle Ironcap.

3.0 Existing Environment

3.1 Geology

The Geological Survey of Western Australia 1:250,000 scale map shows a number geological types encompassing the Flying Fox study area (Figure 3.1). These comprise:

- Aab: Fine and medium-grained mafic amphibolite and metabasalt;
- Aad: Medium and coarse-grained mafic amphibolite and metagabbro;
- Alp: Muscovite-quartz schist; commonly contains biotite, garnet, andalusite and cordierite; metamorphosed shale and siltstone;
- Aue: Talc (-carbonate-tremolite) schist;
- Czg: Remnant sandplain - yellow and white sand containing locally abundant limonite pebbles; derived from Czl (Laterite- limonite cemented duricrust over deeply weathered bedrock);
- CZL: laterite – limonite cemented duricrust overlying deeply weathered bedrock; minor silcrete;
- Qa: Alluvium- silt, sand and gravel in streams and sheetwash areas;
- Qd: Eolian and alluvial deposits – silt and sand, gypsiferous in part, adjacent to playa lake systems
- Qe: Colluvium and eluvium - red-brown clay and silt derived from mafic amphibolite.

3.2 IBRA Bioregion

The Interim Biogeographic Regionalisation of Australia (IBRA) recognises 85 bioregions (Environment Australia 2000). The Flying Fox study area is located on the boundary between both the Coolgardie Biogeographic region (COO) and the Mallee Biogeographic region (MAL) with trapping sites located in both Biogeographic regions.

COO is defined by Environment Australia (2000) as comprising the following general features: "Granite Strata of Yilgarn Craton with Archaean Greenstone intrusions in parallel belts. Drainage is occluded. Mallees and scrubs on sandplains associated with lateritised uplands, playas and granite outcrops. Diverse woodlands rich in endemic eucalypts, on low greenstone hills, valley alluvials and broad plains of calcareous earths. In the west, the scrubs are rich in endemic Proteaceae, in the east they are rich in endemic acacias. Arid to Semi-arid Warm Mediterranean."

MAL is defined by Environment Australia (2000) as comprising the following general features: "The south-eastern part of Yilgarn Craton is gently undulating, with partially occluded drainage. Mainly mallee over myrtaceous-proteaceous heaths on duplex (sand over clay) soils. Melaleuca shrublands characterise alluvia, and Halosarcia low shrublands occur on saline alluvium. A mosaic of mixed eucalypt woodlands and mallee occur on calcareous earth plains and sandplains overlying Eocene limestone strata in the east. Semi-arid (Dry) Warm Mediterranean".

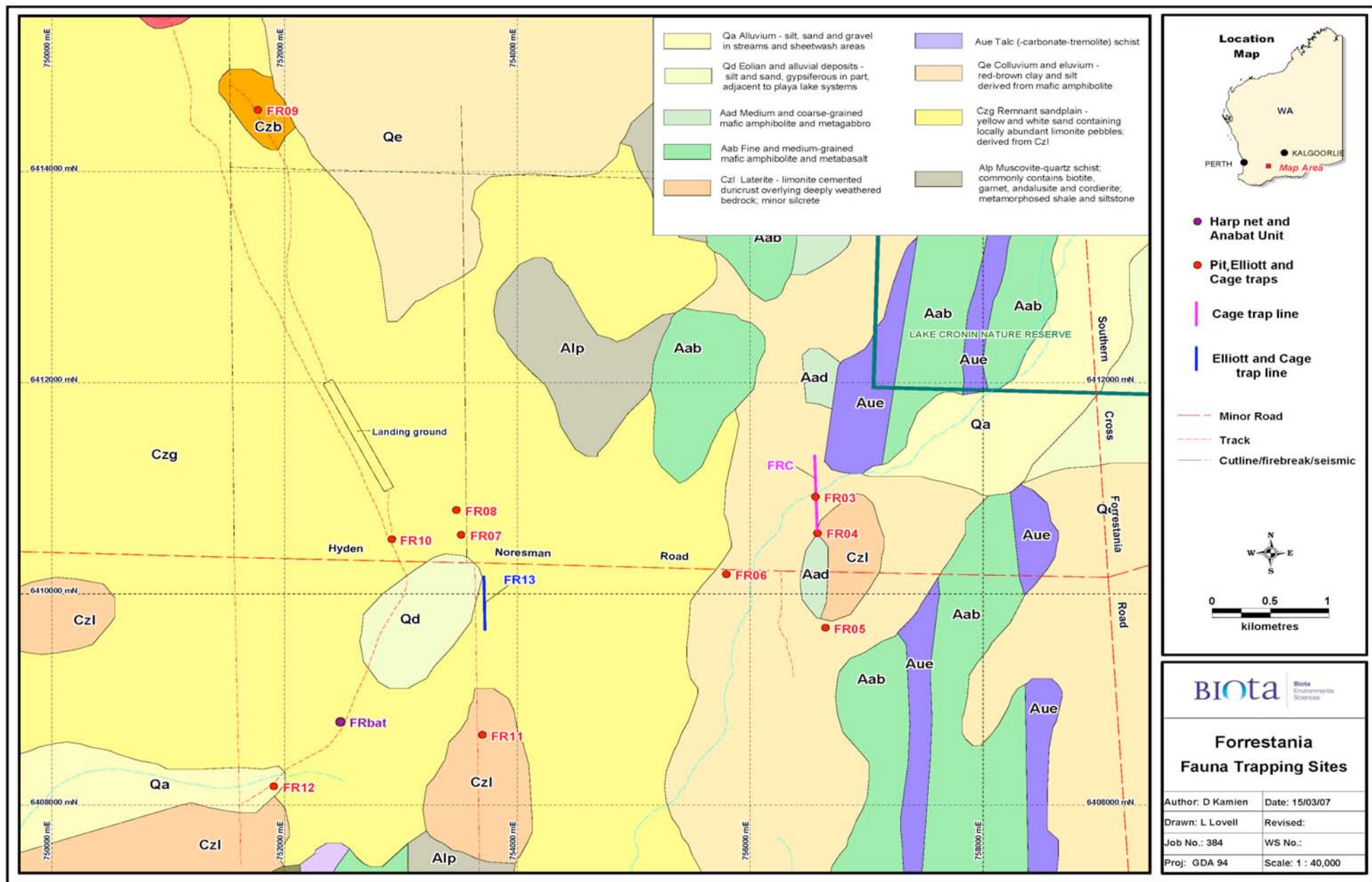


Figure 3.1: Geological map showing fauna trapping sites within the Flying Fox study area.

3.3 Conservation Reserves in the Locality

There is one formally gazetted conservation reserve in the immediate vicinity of the Flying Fox study area:

- Lake Cronin Nature Reserve (1,016 ha) is located approximately 5 km north-east of the Flying Fox mine (32° 23' 18"S, 119° 45' 16"E), (see Figure 3.2).

3.4 Land Systems

Land System (Rangelands) mapping, covering the project area is currently unavailable. Future surveys to be carried out by Department of Agriculture Western Australia are pending.

3.5 Vegetation Mapping

The Forrestania Tableland straddles an ancient watershed dividing the Swan-Avon Basin from palaeodrainage heading east (Beard 1981). The Forrestania System is developed on a greenstone belt, and comprises a variety of communities that are controlled by the underlying geology in a mosaic form (Beard 1981). The greenstones weather to form a flat tract of country with a heavy soil supporting eucalypt woodland broken by numerous salt small salt lakes. There are also granites and quartzites which form siliceous soils, accounting for areas of mallee, thicket and scrub-heath within the mosaic. The sclerophyll woodlands comprise only two major tree species, *Eucalyptus salmonophloia* and *E. longicornis*.

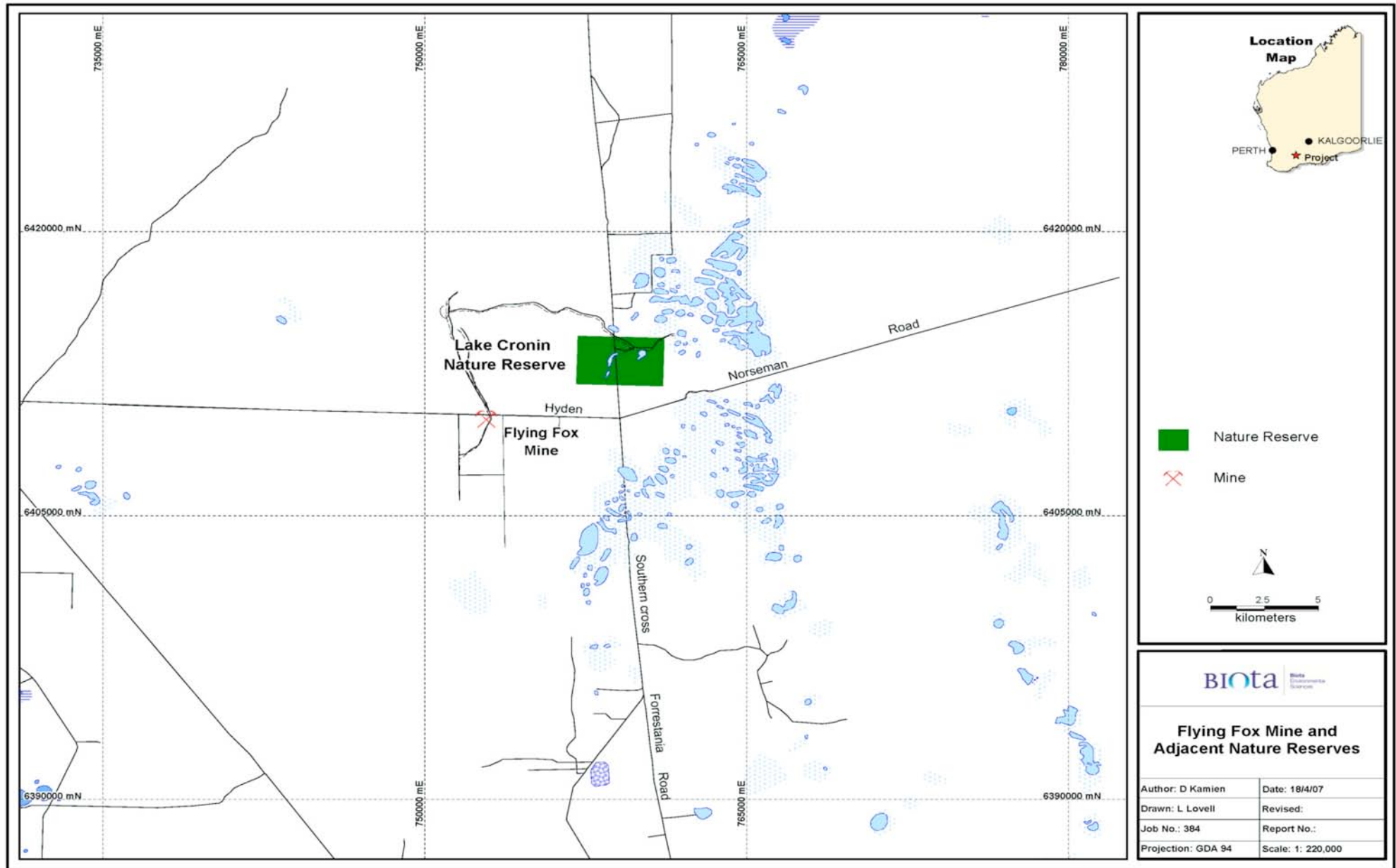


Figure 3.2: Location of Flying Fox mine in relation to adjacent nature reserves.

4.0 Methodology

4.1 Database Search

A search was commissioned of the Threatened Fauna Database held by the Department of Environment and Conservation (DEC) in January 2006 for threatened fauna records in the vicinity of the Flying Fox mine, including a 50 km buffer.

The bounding coordinates used were:

- 31.6361°S, 120.2642°E; and
- 32.8866°S, 119.1458°E.

The Western Australian Museum FaunaBase database was also searched for records of vouchered fauna specimens using the same coordinates as above.

Results of the two searches are contained in Appendices 1 and 2 respectively.

Finally, an EPBC Act 1999 Protected Matters Report was conducted using a point search with a 50km buffer at co-ordinate -32.43°S, 119.685°E (the existing Digger Rocks mine) (see Appendix 3).

4.2 Survey Timing and Weather

The Phase III survey (including trap installation) was conducted over a seven-day period between 03/05/06 and 09/05/06. Minimum temperatures during the survey ranged from 1.5°C to 11.0°C and maximum temperatures ranged from 18.6°C to 23.3°C (Table 4.1). Nil rainfall was recorded in Hyden during the survey. A total of 215.8 mm of rain fell in Hyden from January 2006 to May 2006, compared to an expected rainfall of 83.9 mm for this period (based on long term averages); this indicates that the Phase III survey was conducted following a relatively wet period (Figure 4.1 and Figure 4.2)

The Phase IV survey was conducted over a seven-day period between 24/11/06 to 30/11/06. Minimum temperatures during the survey ranged from 9.5°C to 17.8°C, and maximum temperatures ranged from 23.4°C to 41.0°C (Table 4.2). A total of 10.6 mm of rainfall was recorded in Hyden during the survey. A total of 162.5 mm of rain fell in Hyden from May to October 2006, compared to an expected rainfall of 229.0 mm from May to October inclusive, indicating that the survey was conducted following a period of slightly below average rainfall (Figure 4.1 and Figure 4.2)

Table 4.1 Daily meteorological observations at Hyden for Phase III of survey at 03/05/06 to 09/05/06 (data provided by the Western Australian Bureau of Meteorology).

Date	03/05	04/05	05/05	06/05	07/05	08/05	09/05	Mean
Maximum Temp (°C)	23.1	21.3	22.9	22.0	18.6	23.3	23.0	22.0
Minimum Temp (°C)	4.1	2.8	4.8	11.0	1.5	2.0	1.5	4.0
Rainfall (mm)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 4.2: Daily meteorological observations at Hyden for Phase IV of survey at 22/11/06 to 01/12/05 (data provided by the Western Australian Bureau of Meteorology).

Date	24/11	25/11	26/11	27/11	28/11	29/11	30/11	Mean
Maximum Temp (°C)	37.0	30.0	36.0	41.0	33.2	23.4	26.0	32.4
Minimum Temp (°C)	15.6	13.5	12.0	12.2	17.8	14.2	9.5	13.5
Rainfall (mm)	0.0	0.0	0.0	0.0	0.0	0.0	10.6	1.5

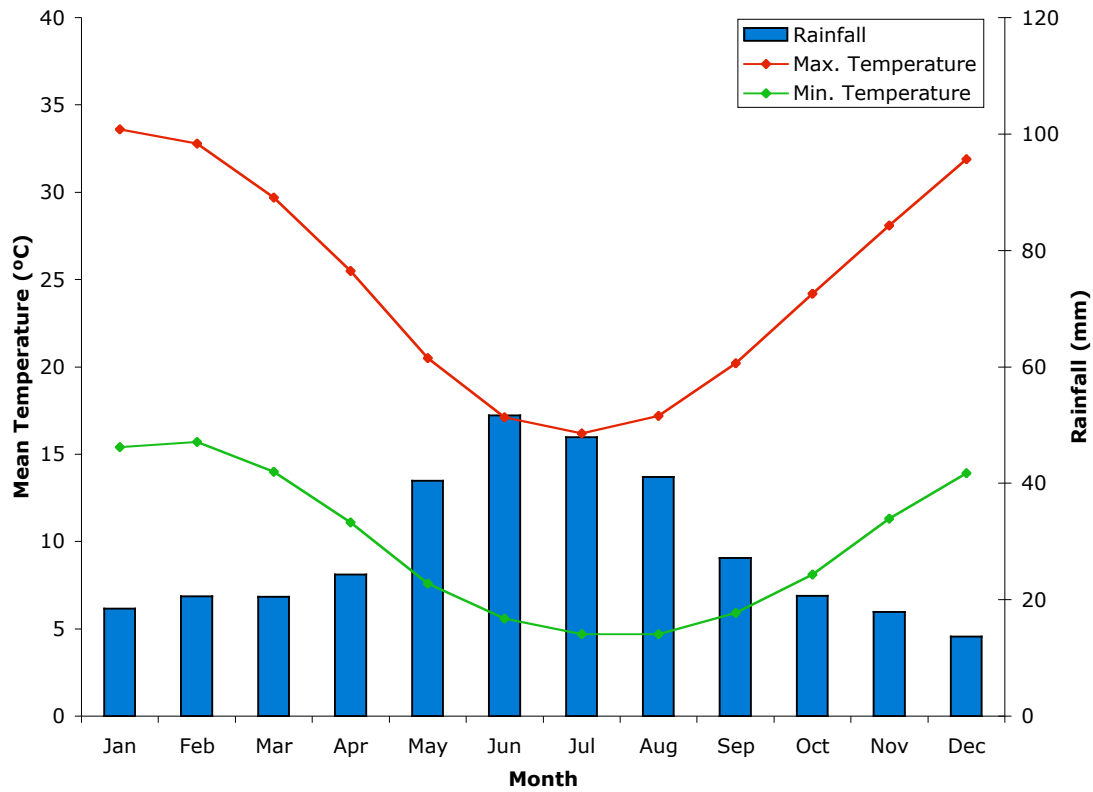


Figure 4.1: Climatological summary for Hyden using data from 1969 to 2004 (data provided by the Western Australian Bureau of Meteorology).

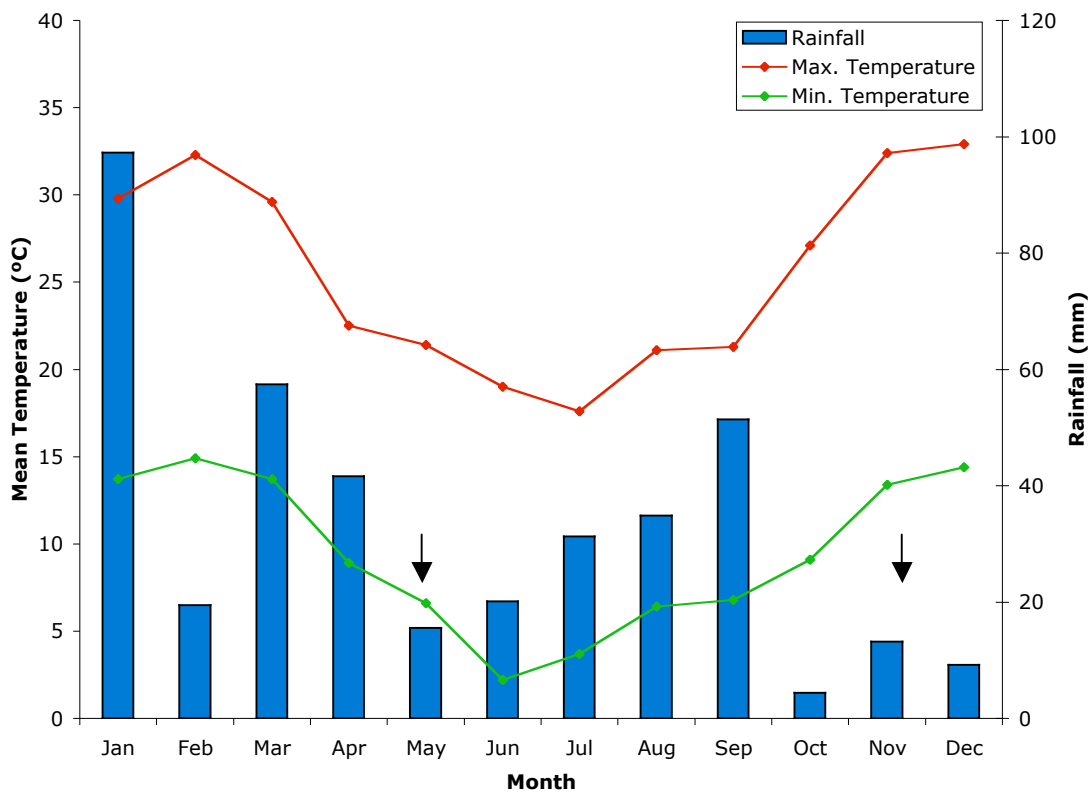


Figure 4.2: Climatological summary for Hyden 2006 (data provided by the Western Australian Bureau of Meteorology). Arrows indicate survey dates.

4.3 Fauna Survey Team

The Phase III study team comprised Mr. Roy Teale, Mr Dan Kamien (Biota) and Ms Angela Sanders and Mr Greg Harold (independent consultant)

The Phase IV study team comprised Mr. Dan Kamien, Ms Zoe Hamilton and Mr Mike Greenham (Biota) and Mr Greg Harold (independent consultant). The fauna survey was conducted under "Licence To Take Fauna For Scientific Purposes" No. SF005285 issued to Mr Roy Teale, which also authorised Mr Garth Humphries, Mr. Mike Greenham, Dr. Mike Craig, Mr. Greg Harold and Mr. Daniel Kamien (Appendix 4).

Analyses of bat recordings were completed by Dr. Kyle Armstrong (Molhar Pty Ltd). Invertebrate identifications were undertaken by Ms. Jane Adcroft and Mr. Dan Kamien (both of Biota), and Dr Mark Harvey (WA Museum). Mr Brad Maryan (WA Museum) assisted with confirmation of herpetofauna identifications.

4.4 Systematic Censusing

The central component of the systematic census consisted of 14 trapping grids (Table 4.3 and Table 4.4 and Figure 4.4), each located within a defined habitat. In selecting survey sites, consideration was given to accessibility of sites such that trap lines could be regularly checked.

Ten trapping grids (FR03-FR12) consisted of a single row of six pitfall traps (alternating 20 litre buckets and 60cm long pvc tubes) spaced at approximately 10m intervals and connected with a single length (60m) of 30 cm high flywire fence. A single cage trap and six medium-sized Elliott traps were also installed at each of the pitfall sites (Figure 4.3).

An additional Elliott trap/cage trap line was installed, consisting of 20 Elliott traps installed 25 m apart and 10 cage traps installed 50 m apart over a 500m transect (FR13). Further, an additional single trap line comprising 14 cage traps spaced 50 m apart over a 700m transect was installed during Phase III only (FRC). All grids were open for five trap nights giving (Table 4.3 and Table 4.4).

Bat echolocation calls were recorded using an Anabat II bat detector, which detects and transforms ultrasonic echolocation emitted during bat foraging. Sampling was undertaken at two locations. In addition, a harp net was deployed in an attempt to capture microbats.

The majority of captured specimens were released following identification. However, reptiles with ambiguous characteristics or unresolved species complexes were transported live to the Western Australian Museum for identification and lodgement.

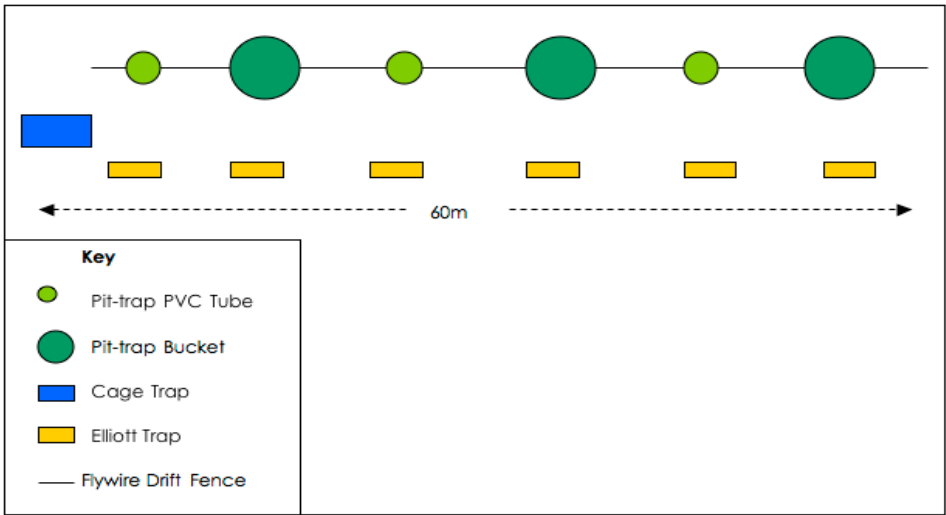


Figure 4.3: Fauna sampling grid layout

Table 4.3: Phase III trapping grid location and trap effort (Datum WGS84, Zone 50).

Site	Location (WGS84)	Trap Type	Date Opened	Date Closed	Nights Open	No. of Traps	Total Effort (trap nights)
FR03	756560mE 6410921mN	Cage	03/05/06	08/05/06	5	1	5
		Elliott	03/05/06	08/05/06	5	6	30
		Pit	03/05/06	08/05/06	5	6	30
FR04	756577mE 6410575mN	Cage	03/05/06	08/05/06	5	1	5
		Elliott	03/05/06	08/05/06	5	6	30
		Pit	03/05/06	08/05/06	5	6	30
FR05	756652mE 6409679mN	Cage	03/05/06	08/05/06	5	1	5
		Elliott	03/05/06	08/05/06	5	6	30
		Pit	03/05/06	08/05/06	5	6	30
FR06	755794mE 6410186mN	Cage	03/05/06	08/05/06	5	1	5
		Elliott	03/05/06	08/05/06	5	6	30
		Pit	03/05/06	08/05/06	5	6	30
FR07	753516mE 6410559mN	Cage	03/05/06	08/05/06	5	1	5
		Elliott	03/05/06	08/05/06	5	6	30
		Pit	03/05/06	08/05/06	5	6	30
FR08	753476mE 6410794mN	Cage	03/05/06	08/05/06	5	1	5
		Elliott	03/05/06	08/05/06	5	6	30
		Pit	03/05/06	08/05/06	5	6	30
FR09	754769mE 6414582mN	Cage	03/05/06	08/05/06	5	1	5
		Elliott	03/05/06	08/05/06	5	6	30
		Pit	03/05/06	08/05/06	5	6	30
FR10	752921mE 6410518mN	Cage	03/05/06	08/05/06	5	1	5
		Elliott	03/05/06	08/05/06	5	6	30
		Pit	03/05/06	08/05/06	5	6	30
FR11	753699mE 6408666mN	Cage	04/05/06	09/05/06	5	1	5
		Elliott	04/05/06	09/05/06	5	6	30
		Pit	04/05/06	09/05/06	5	6	30
FR12	751906mE 6408179mN	Cage	04/05/06	09/05/06	5	1	5
		Elliott	04/05/06	09/05/06	5	6	30
		Pit	04/05/06	09/05/06	5	6	30
FR13	753715mE 6410165mN	Cage	04/05/06	09/05/06	5	10	50
		Elliott	04/05/06	09/05/06	5	20	100
FRC	756553mE 6411305mN	Cage	04/05/06	09/05/06	5	14	70
					Total	Cage Elliott Pit	150 400 300

Table 4.4: Phase IV trapping grid location, and trap effort (Datum WGS84, Zone 50).

Site	Location (WGS84)	Trap Type	Date Opened	Date Closed	Nights Open	No. of Traps	Total Effort (trap nights)
FR03	756560mE 6410921mN	Cage	24/11/06	29/11/06	5	1	5
		Elliott	24/11/06	29/11/06	5	6	30
		Pit	24/11/06	29/11/06	5	6	30
FR04	756577mE 6410575mN	Cage	24/11/06	29/11/06	5	1	5
		Elliott	24/11/06	29/11/06	5	6	30
		Pit	24/11/06	29/11/06	5	6	30
FR05	756652mE 6409679mN	Cage	24/11/06	29/11/06	5	1	5
		Elliott	24/11/06	29/11/06	5	6	30
		Pit	24/11/06	29/11/06	5	6	30
		Anabat	25/11/06	27/11/06	2	1	2
FR06	755794mE 6410186mN	Cage	24/11/06	29/11/06	5	1	5
		Elliott	24/11/06	29/11/06	5	6	30
		Pit	24/11/06	29/11/06	5	6	30
FR07	753516mE 6410559mN	Cage	25/11/06	30/11/06	5	1	5
		Elliott	25/11/06	30/11/06	5	6	30
		Pit	25/11/06	30/11/06	5	6	30
FR08	753476mE 6410794mN	Cage	25/11/06	30/11/06	5	1	5
		Elliott	25/11/06	30/11/06	5	6	30
		Pit	25/11/06	30/11/06	5	6	30
FR09	754769mE 6414582mN	Cage	25/11/06	30/11/06	5	1	5
		Elliott	25/11/06	30/11/06	5	6	30
		Pit	25/11/06	30/11/06	5	6	30
FR10	752921mE 6410518mN	Cage	25/11/06	30/11/06	5	1	5
		Elliott	25/11/06	30/11/06	5	6	30
		Pit	25/11/06	30/11/06	5	6	30
FR11	753699mE 6408666mN	Cage	25/11/06	30/11/06	5	1	5
		Elliott	25/11/06	30/11/06	5	6	30
		Pit	25/11/06	30/11/06	5	6	30
FR12	751906mE 6408179mN	Cage	25/11/06	30/11/06	5	1	5
		Elliott	25/11/06	30/11/06	5	6	30
		Pit	25/11/06	30/11/06	5	6	30
FR13	753715mE 6410165mN	Cage	25/11/06	30/11/06	5	10	50
		Elliott	25/11/06	30/11/06	5	20	100
FRbat	752479mE 6408789mN	Anabat	27/11/06	28/11/06	1	1	1
		Harp Net	27/11/06	29/11/06	2	1	2
					Total	Cage Elliott Pit Anabat Harp Net	100 400 300 3 2

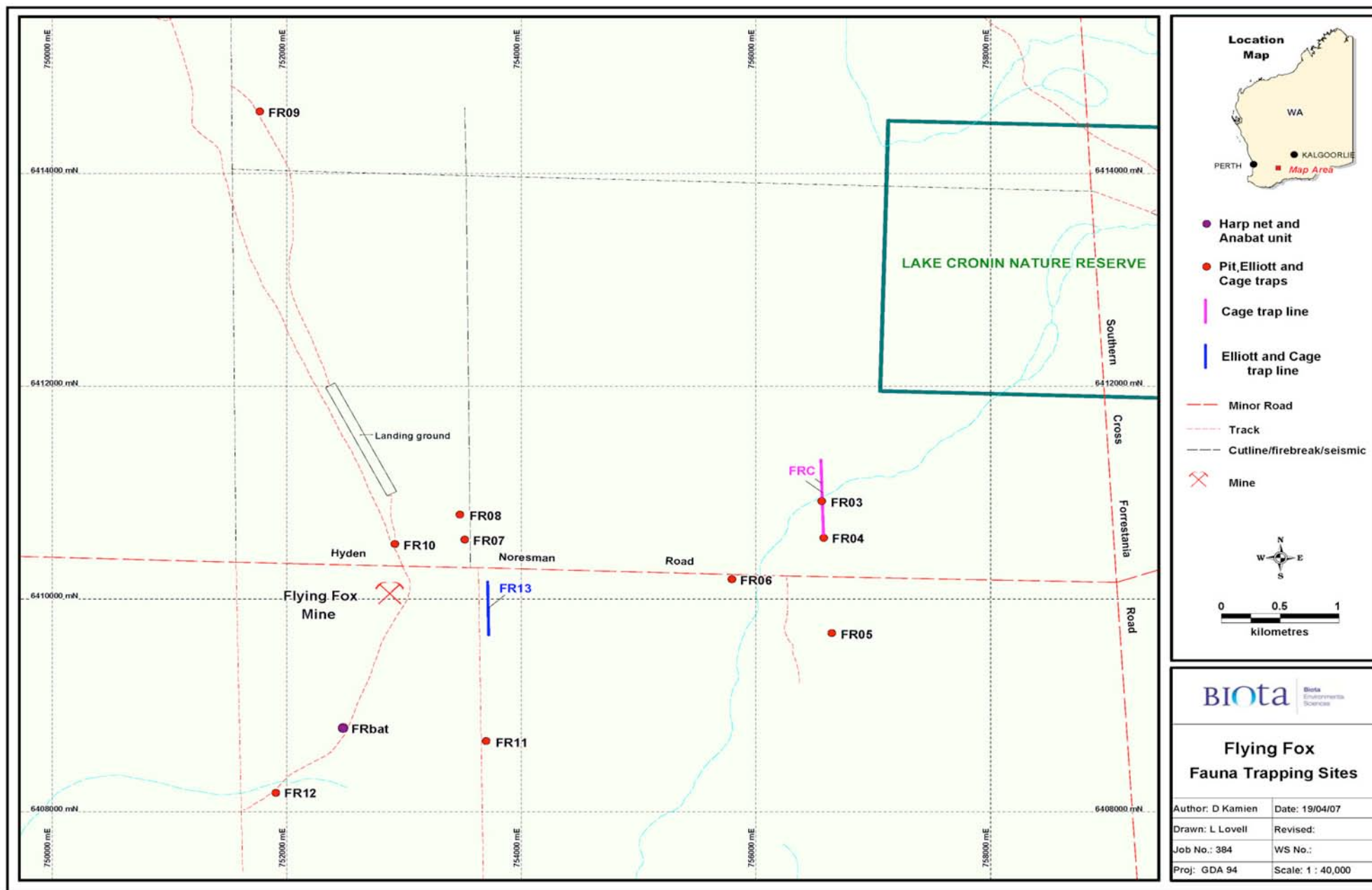


Figure 4.4: Map showing location of fauna trapping sites at the Flying Fox study area.

4.4.1 Avifauna

The avifauna was sampled using an unbounded area search. For both phases of the survey, area searches were conducted across 10 sites for a period of 40 minutes, so that each site was surveyed at least twice during each survey phase (Table 4.5 and Table 4.6). Censuses were typically conducted between 06:00 and 10:00 each morning.

Table 4.5: Time and date of systematic avifauna censuses undertaken at each fauna site during Phase III, 2006.

Site	4-May	5-May	6-May	7-May	8-May
FR03	07:00-07:30	10:35-11:05	07:05-07:35	–	06:50-07:20
FR04	07:35-08:05	–	07:50-08:20	–	07:25-07:55
FR05	08:15-08:45	09:27-09:57	08:25-08:55	11:41-12:11	07:55-08:25
FR06	09:00-09:30	08:46-09:16	09:05-09:35	10:14-10:44	11:00-11:30
FR07	09:40-10:10	11:15-11:45	–	–	–
FR08	10:15-10:45	–	11:25-11:55	09:32-10:02	10:10-10:40
FR09	–	07:30-08:00	10:00-10:30	08:36-09:06	–
FR10	10:55-11:25	–	10:50-11:20	07:37-08:07	08:35-09:05
FR11	–	–	–	07:00-07:30	09:05-09:35
FR12	–	–	–	07:00-07:30	09:35-10:05

Table 4.6: Time and date of systematic avifauna censuses undertaken at each fauna site during Phase IV, 2006.

Site	25-Nov	26-Nov	27-Nov	28-Nov	29-Nov	30-Nov
FR03	07:49- 9:29			07:40- 08:20		
FR04		–		07:00- 07:40		06:15- 07:55
FR05	09:33- 10:13		06:33- 07:13			
FR06		06:28- 7:08		10:09- 10:49		
FR07			08:47- 09:27	–	07:42- 08:22	
FR08		–	08:07- 08:47		07:02- 07:42	
FR09	–	09:05- 09:45			–	07:08- 07:48
FR10		–	09:30- 10:10			07:56- 08:36
FR11	–	07:31- 08:11	–	09:22- 10:02		
FR12	–	08:14- 08:54	–	08:40- 09:20		

4.4.2 Bats

Bats were sampled during Phase IV by recording echolocation calls and deploying harp nets. Echolocation calls were recorded using an Anabat II bat detector, which detects and transforms ultrasonic echolocation emitted during bat foraging. Sampling was undertaken at two locations (FR05 and FRbat; see Table 4.4). The harp net was set up at site FRbat at the edge of an ephemeral water source.

The calls were stored on a compact flash card after being processed by an Anabat CF ZCAIM. Calls were visualised on Analook 4.3f software. Only sequences containing good quality search phase calls were considered for identification.

4.4.3 Invertebrates

Invertebrate groups targeted during the survey included:

- Araneae (specifically trapdoor spiders)
- Pseudoscorpionida (pseudoscorpions);
- Diplopoda (millipedes); and
- Pulmonata (land snails);

Trapdoor spiders were targeted by searching for and excavating burrows. Individuals were subsequently preserved in 70% ethanol, with one leg removed and placed in 100% ethanol for future genetic studies.

Hand foraging was undertaken for pseudoscorpions, involving peeling bark and lifting rocks. The remaining two groups (millipedes and land snails) were searched for whilst raking leaf litter and other debris.

4.4.4 Non-systematic Sampling

A range of non-systematic fauna survey activities was undertaken by the survey team to supplement the trapping and investigate additional habitats identified during the course of the survey. These included:

- habitat specific searches for Schedule and Priority listed fauna species;
- searching (including head-torching) of microhabitats for reptile, frog and small mammal species;
- opportunistic sightings and records;
- identification of road kills and other animal remains; and
- recording and identification of secondary signs (where possible) including tracks, scats and diggings.

4.4.5 Survey Limitations

Not all sections of the study area were ground-truthed or equally sampled for fauna. Parts of the study area were inaccessible by vehicle and as a result regular checking of fauna traps in these areas would not have been possible. However, systematic fauna sampling, the primary component of the study, was completed on the basis of trapping grid installation in habitats considered to be representative of the range of units present within the project area.

Microbats were targeted during the Phase IV survey only. That is, harp traps and Anabat recorders were deployed solely during Phase IV.

4.5 Data Analysis

Sampling adequacy may be assessed by plotting species accumulation curves or rarefaction curves and examining the trend in the resultant curve over time. EstimateS v7.5 (Colwell 2005) was used to calculate species accumulation curves (rarefaction curves) based on 100 random sampling events of individuals recorded during each phase (Phases I to IV). That is, each phase was treated as a distinct pooled sample in order to create a sample based rarefaction curve (employing Sobs (Mao Tau) variable). This produced a randomised or smoothed curve that generated the expected number of species with collections of decreasing sample sizes (Gotelli and Colwell 2001).

It should be noted that rarefaction alone, cannot be used to extrapolate predicted species richness for hypothetical future biological sampling. In order to estimate asymptotic richness (i.e. extrapolation of species richness) asymptotic estimators were utilized (Gotelli and Colwell 2001).

During this study the average of four estimators was used to extrapolate species richness within the Flying Fox study area (Colwell 2005). These include:

- ACE Mean - Abundance-based coverage estimator of species richness;
- ICE Mean - Incidence-based coverage estimator of species richness;
- Chao 2 Mean- Chao 2 richness estimator; and
- Jack 2 Mean - Second-order jackknife richness estimator.

5.0 Vertebrate Fauna Inventory

5.1 Habitats of the Study Area

The project area comprised a number of different habitat types (Table 5.1).

Table 5.1: Habitat description for each trapping site.

Trapping Grid	Habitat description
FR03	Mallee. Relatively dense mid-storey of mallee eucalypts to 3 m over a relatively dense understorey of <i>Lepidosperma</i> to 0.5 m. Very occasional emergent eucalypts to 10 m.
FR04	Mallee. Overstorey consisting primarily of mallee eucalypts to 3 m, with some acacias to the same height. The mixed understorey was dominated by <i>Lepidosperma</i> to 0.4 m.
FR05	Woodland. Relatively dense woodland of <i>Eucalyptus salmonophloia</i> to 9 m, with most trees showing no signs of senescence. Mid-storey primarily of melaleucas, with some <i>Acacia</i> growing in dense patchy clumps to 2 m. Understorey very open and consisting mostly of acacias to 0.6 m.
FR06	Woodland. Very open overstorey of <i>Eucalyptus salmonophloia</i> to 10 m, with a relatively dense mid-storey of mallee eucalypts to 2 m. Very sparse understorey, primarily of acacias to 0.7 m.
FR07	Shrubland. Very dense mid-storey of melaleucas to 2 m with an open overstorey of eucalypts to 6 m. Very little understorey.
FR08	Tall heath. Relatively open tall heath with main strata relatively species poor and consisting primarily of acacias to 0.5 m. Very scattered overstorey of eucalypts to 3 m.
FR09	Tall heath. Relatively open tall heath with main strata relatively species poor and consisting primarily of <i>Acacia</i> and <i>Allocasuarina</i> to 0.8 m. Patchy, clumped, sparse overstorey of eucalypts to 3 m.
FR10	Heath. Open mallee eucalypts to 2.5 m over a species rich, relatively open heath to 0.4 m.
FR11	Heath. Main strata a species rich heath to 0.3 m with some proteaceous emergents to 0.6 m. Very scattered overstorey of mallees to 2 m.
FR12	Tall heath. Species rich tall heath to 1m with acacias dominating. Very scattered emergents of <i>Grevillea</i> and eucalypts to 2 m.
FR13	Shrubland. Very dense mid-storey of melaleucas to 2 m.
FR14	Mallee. Relatively dense mid-storey of mallee eucalypts to 3 m over a relatively dense understorey of <i>Lepidosperma</i> to 0.5 m. Very occasional emergent eucalypts to 10 m.
FRC	Mallee. Relatively dense mid-storey of mallee eucalypts to 3 m over a relatively dense understorey of <i>Lepidosperma</i> to 0.5 m. Very occasional emergent eucalypts to 10 m.
FRBat	Cleared area adjacent rehabilitation area and water.



Plate 5.1: Site FR03: Mallee *Eucalyptus* over *Lepidosperma*.



Plate 5.2: Site FR04: Mallee *Eucalyptus* and *Acacia* over *Lepidosperma*.



Plate 5.3: Site FR05: *Eucalyptus salmonophloia* woodland over *Melaleuca* over *Acacia*.



Plate 5.4: Site FR06: *Eucalyptus salmonophloia* open woodland over mallee *Eucalyptus* over *Acacia*.



Plate 5.5: Site FR07: *Eucalyptus* open woodland over dense *Melaleuca* shrubland.



Plate 5.6: Site FR08: *Eucalyptus* sparse woodland over *Acacia* heath.



Plate 5.7: Site FR09: *Eucalyptus* sparse shrubland over open *Acacia* and *Allocasuarina* tall heath.



Plate 5.8: Site FR10: *Eucalyptus* open mallee over a species rich, open heath.



Plate 5.9: Site FR11: *Eucalyptus* sparse / scattered mallee over species rich heath with proteaceous emergents.



Plate 5.10: Site FR12: *Eucalyptus* and *Grevillea* sparse / scattered emergents over *Acacia* heath.



Plate 5.11: Site FR13: Very dense mid-storey *Melaleuca* to 2 m.



Plate 5.12: Site FRC: Mallee. *Eucalyptus* mallee over *Lepidosperma* sp.



Plate 5.13: Site FRbat: Cleared area adjacent rehabilitation area, with water.

5.2 Overview of Vertebrate Fauna of the Study Area

The Phase III and IV surveys of the Flying Fox study area recorded a combined total of 100 vertebrate species representing 38 families. Table 5.2 provides a summary of the number of species recorded from each major vertebrate group during the survey.

Table 5.2 Number of species recorded during the Phase III and IV surveys.

Fauna Group	Total
Amphibians	2
Reptiles	19
Avifauna	61
Native Non-Volant Mammals	8
Native Volant Mammals (Bats)	6
Introduced Mammals	4
Total	100

Figure 5.1 shows a sample based rarefaction curve for mammals, avifauna and herpetofauna collected over four sampling phases within the Flying Fox study area Estimate (generated using EstimateS v7.5 (Colwell 2005)).

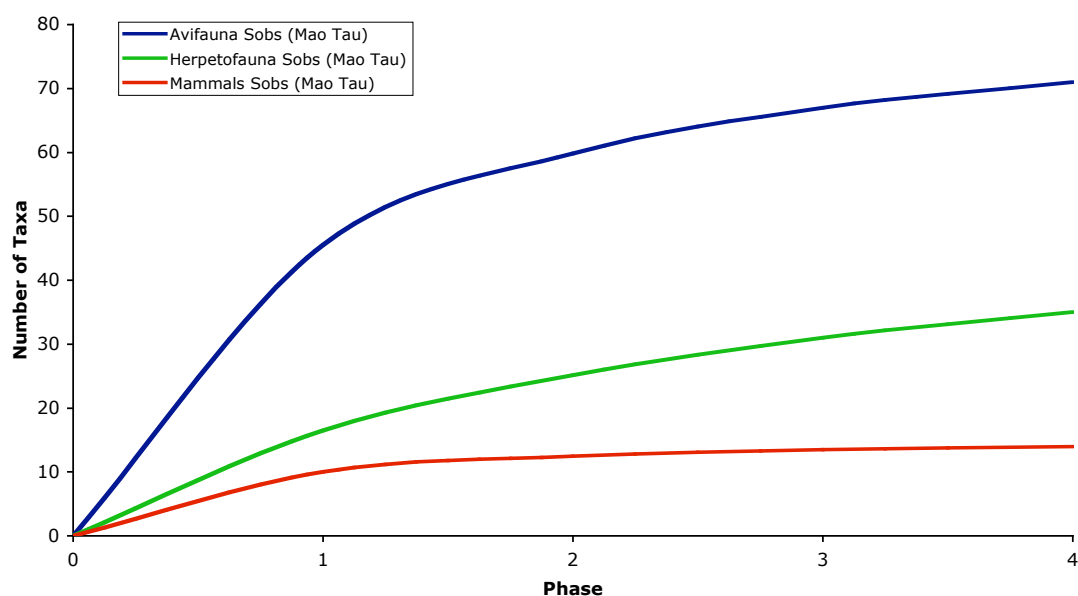


Figure 5.1: Sample based rarefaction curves for fauna collected during four phases at the Flying Fox study area.

5.3 Herpetofauna

5.3.1 The Assemblage

The Phase III and IV surveys yielded a combined total of 21 herpetofauna species from the study area (Table 5.3). The tally comprised two frogs (Myobatrachidae), five geckos (Gekkonidae), seven skinks (Scincidae), three dragons (Agamidae), one monitor (Varanidae), one blind snake (Typhlopidae) and two front-fanged snakes (Elapidae).

The most abundant species encountered during Phases III and IV was the Western Toadlet *Pseudophryne occidentalis* with 20 records representing 22% of all herpetofauna recorded during both survey phases. It should be noted however, that all 20 records were noted at a single site, on one day following rain. Additionally, *Cryptoblepharus plagiocephalus* and *Crenodactylus ocellatus* were relatively common, representing 15% and 11% respectively of all records during Phases III and IV.

Site FR04 (*Eucalyptus mallee*) exhibited the highest herpetofauna diversity within the study area, comprising nine species (43% of all herpetofauna species recorded in the study area during Phases III and IV). The most diverse herpetofauna family was the Scincidae, comprising 7 species (33% of all herpetofauna species recorded).

The herpetofauna species composition varied significantly between the Phase III and IV surveys, with only four recorded species in common. Ten species of herpetofauna were recorded during Phase III, compared to 15 species during Phase IV. Eleven additional species were recorded during Phase IV that appeared absent during Phase III. Similarly six species were recorded during Phase III that were not recorded during Phase IV (Table 5.4).

It should be noted that 28 herpetofauna species were recorded during previous sampling efforts in 2005 (Phases I and II), (Biota 2006a and Appendix 9). In total, 34 herpetofauna species were recorded within the Flying Fox study area during Phases I, II, III and IV combined.

The data for all herpetofauna recorded from each site during the Flying Fox Phases III and IV surveys are presented in Table 5.3. Each species is discussed individually in the annotated lists presented in Appendix 5 (common names after Wilson and Swan 2003). Specimens lodged with the WA Museum have been assigned numbers R1 66805 – R1 66806 (see Appendix 5).

Following four sampling phases, the herpetofauna rarefaction curve appears to be approaching an asymptote, indicating a reduced rate at which additional new species are likely to be recorded with continued trapping effort (Figure 5.1).

However, non-parametric estimators predict total Herpetofauna species richness within the Flying Fox study area could range from 41 to 53 species (mean $S_{\max}$ estimate of 46.0 ± 3.1 species; Table 5.3).

Table 5.3: Observed and estimated herpetofauna species richness at Flying Fox based on four non-parametric estimators (calculated using EstimateS (Colwell 2005)).

Actual Observed (Phases I to IV)	35
Species Richness Estimator	Estimated $S_{\max}$
Ice Mean	40.8
Ace Mean	53.2
Chao 2 Mean	42.5
Jackknife 2 Mean	51.3

5.3.2 Discussion

The number of herpetofauna species recorded during Phases III and IV combined ($n = 21$) comprises 37% of the total number of species recorded by the Western Australian Museum ($n=57$, Appendix 2). This superficially indicates that the study area supports a deficient subset of herpetofauna typically found in this region. However, examination of the combined results of all survey phases conducted to date (surveys I to IV) shows the total number of herpetofauna species recorded ($n=35$) comprises 61% of the total number of species recorded by the Western Australian Museum ($n=57$, Appendix 2).

Based on species richness estimates (Colwell 2005), the total number of herpetofauna species recorded represent between 66% and 86% (mean = 76%) of the total predicted assemblage. It should be noted that these figures are not definitive as different sampling outcomes can affect the estimator's expressions (Colwell and Coddington 1994; Thompson and Withers 2003). Despite this, it is likely that additional species would be recorded within the Flying Fox study area as a result of further additional surveys.

Seasonal and climactic effects remain a parsimonious explanation accounting for the observed disparity in species composition between the Forrestania survey and museum records and between Phases III and IV. However, conducting a four-phase seasonal survey over two years is clearly advantageous in that confounding seasonal and climactic effects are greatly reduced. Despite this, such confounding effects cannot be fully eliminated. For example, in the absence of heavy precipitation many amphibian species are commonly in a state of aestivation and as a result are likely to remain concealed during the short survey periods.

In addition, the different habitat types found within the study do not represent all the habitat types occurring within the Forrestania region. As a result certain species with strict habitat requirements will not be recorded if their required habitat does not occur within the study area.

During survey phases III and IV the *Eucalyptus* mallee site FR04 yielded the greatest species richness (9 species). During survey phases I and II, woodland sites FR05 and FR06 yielded high richness. Again climactic factors may be at play here. However, both woodland and mallee habitats contain an abundance of leaf litter providing microhabitats for several litter-inhabiting species such as *Diplodactylus* species, as well as providing habitat for arboreal species (e.g. *Gehyra variegata*).

It is likely that the more common and easily collected species have already been documented. The estimated 6 to 18 species that remain uncollected (up to 22 species taking museum records into account) are likely to be at naturally low density or less easily collectible with the methods utilised in this study. As a result, the law of diminishing returns suggests that considerable additional sampling effort would be required to add a small number of extra species to survey records.

Alternatively, it is possible that longer-term (greater than 2 years) cyclical shifts in species assemblage occur at Forrestania (Cowan and How 2004). If this is the case then future surveys are likely to detect additional species that reflect assemblage changes.

Table 5.4: Herpetofauna records from the Forrestania survey sites during Phase III (P3) and Phase IV (P4) of the study.

Family	FR03		FR04		FR05		FR06		FR07		FR08		FR09		FR10		FR11		FR12		FR13		FRC		Opp		Total		
Species name	P3	P4	P3	P4	P3	P4	P3	P4	P3	P4	P3	P4	P3	P4	P3	P4	P3	P4	P3	P4	P3	P4	P3	P4	P3	P4	P3	P4	
Myobatrachidae																													
Crinia pseudinsignifera	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	1	
Pseudophryne occidentalis	–	20	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	20
Gekkonidae																													
Crenadactylus ocellatus	–	2	–	1	3	–	–	–	–	–	–	–	–	4	–	–	–	–	–	–	–	–	–	–	–	–	–	3	7
Diplodactylus granariensis	–	–	1	–	–	1	–	–	–	1	–	1	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	2	3
Diplodactylus maini	–	–	–	1	–	–	–	1	–	–	–	–	–	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	4
Gehyra variegata	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1
Strophurus spinigerus	–	–	–	–	–	–	–	–	–	–	–	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2
Scincidae																													
Cryptoblepharus plagiocephalus	4	–	2	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	4	–	2	–	–	–	–	–	–	13	–
Ctenotus schomburgkii	–	3	–	–	–	–	–	4	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	7
Egernia multiscutata	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–
Lerista dorsalis	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	1
Morethia obscura	–	–	2	–	1	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	–	–	–	–	–	–	5	1
Tiliqua occipitalis	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1
Tiliqua rugosa	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	1
Agamidae																													
Ctenophorus cristatus	–	–	–	–	–	2	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3
Ctenophorus maculatus	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	1
Pogona minor	–	–	1	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	1	–	–	–	–	–	–	3	–
Varanidae																													
Varanus gouldii	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	1
Typhlopidae																													
Ramphotyphlops australis	–	–	–	1	–	–	–	–	–	1	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3
Elapidae																													
Parasuta gouldii	–	–	–	–	–	–	1	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	–
Pseudonaja affinis	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	1	–
Number of individuals	4	25	6	5	4	4	2	6	2	2	0	4	3	6	1	2	1	0	4	0	6	1	0	0	0	1	33	56	
Number of species	1	3	4	5	2	3	2	3	1	2	0	3	3	2	1	2	1	0	1	0	4	1	0	0	0	1	10	15	
Number of species both phases	4		9		4		5		3		3		5		3		1		1		5		0		1		21		

5.4 Avifauna

5.4.1 The Assemblage

Sixty-one bird species were recorded during the Phase III and IV surveys combined. The total species tally comprised 21 families including 20 non-passerine species and 41 passerine species (Table 5.6).

The most abundant species recorded was the Red Wattlebird (353 records), representing 22% of all recorded avifauna during both surveys combined. The most abundant and speciose family of birds was the Meliphagidae (honeyeaters), which comprised 854 records (53% of total records) across 12 species. Site FR05 (Salmon Gum woodland) exhibited the highest avifauna diversity within the study area, comprising 37 species (61% of bird species recorded in the study area during Phases III and IV). Site FR03 (*Eucalyptus mallee*) also displayed high diversity, with 28 species recorded (46% of total records).

The avifauna species composition varied significantly between the Phase III and IV surveys. Only 29 (48%) of total recorded species were observed during both phases, with the number of recorded species varying only slightly between phases. This indicates a marked change in avifauna species composition between surveys. Recorded avifauna abundance also varied significantly between Phases III and IV, with 1487 individuals recorded during Phase III and only 121 birds observed during Phase IV.

It should be noted that 60 avifauna species were recorded during previous sampling in 2005 (Phases I and II), (Biota 2006a and Appendix 10). In total, 71 avifauna species have been recorded within the Flying Fox study area during Phases I, II, III and IV combined

Table 5.6 presents data for all bird species recorded from each census site during Phases III and IV. Individual species are discussed further in the annotated list in Appendix 6 (for habitat descriptions of each site see Table 5.1).

Similar to the herpetofauna (Section 5.3), the avifauna rarefaction curve (Phases I to IV combined) also appears to be approaching an asymptote, indicating a reduced rate at which additional new species are likely to be recorded with continued trapping effort (Figure 5.1).

Non-parametric estimators predict total avifauna species richness within the Flying Fox study area could range from 75 to 84 species (mean $S_{\max}$ estimate of 79.5 ± 2.0 species; Table 5.5).

Table 5.5: Observed and estimated avifauna species richness at Flying Fox based on four non-parametric estimators (calculated using EstimateS (Colwell 2005)).

Actual Observed (Phases I to IV)	71
Species Richness Estimator	Estimated $S_{\max}$
Ice Mean	77.1
Ace Mean	80.9
Chao 2 Mean	75.5
Jackknife 2 Mean	84.7

5.4.2 Discussion

The Phase III and IV avifauna census yielded a total of 61 species from 21 families. This is comparable to Phases I and II in which 60 species from 24 families were recorded (Biota 2006a). The majority of avifauna species were recorded in Salmon Gum woodland and *Eucalyptus mallee* habitat. These habitats offer significant vertical stratification providing a variety of habitat niches required to support high avifauna diversity, a well documented trend (Wiens

1989; Halpern Glick Maunsell 1998). Conversely heath habitat typically displays low avifauna diversity due to limited habitat diversity. Furthermore, as previously discussed (Biota 2006a), *Eucalyptus* mallee site (FR04) has recently been subject to fire creating a more open habitat and increasing habitat heterogeneity.

Based on species richness estimates (Colwell 2005), the total number of avifauna species recorded represent between 84% and 94% (mean = 89%) of the total predicted assemblage. Again, these figures are not definitive as different sampling outcomes can affect the estimator's expressions (Colwell and Coddington 1994; Thompson and Withers 2003).

The estimated 5 to 14 species that remain uncollected are likely to be at naturally low density or cryptic species. As a result, it is likely that considerable additional sampling effort would be required to add a small number of extra species to survey records

The pronounced disparity of species diversity and abundance between Phase III and IV may be largely explained by seasonal climactic variation (Driscoll et al. 2000). Phase III was conducted in the wetter winter months when many avifauna species are active. Conversely, the summer period in which Phase IV was conducted is not conducive to avifauna activity, as in general food resources are scarce and temperatures are markedly hotter. A similar trend was also observed during survey phases I and II (Biota 2006a).

Table 5.6: Avifauna records from the Forrestania survey sites during Phase III (P3) and Phase IV (P4) of the study.

Family and species name	Common name	FR03		FR04		FR05		FR06		FR07		FR08		FR09		FR10		FR11		FR12		OPP		Total	
		P3	P4	P3	P4	P3	P4	P3	P4	P3	P4	P3	P4	P3	P4	P3	P4	P3	P4	P3	P4	P3	P4	P3	P4
Casuariidae																									
<i>Dromaius novaehollandiae</i>	Emu	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	0	1
Turnicidae																									
<i>Turnix velox</i>	Little Button-quail	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1	-	-	-	0	2
Accipitridae																									
<i>Hamirostra isura</i>	Square-tailed Kite	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	0	1
<i>Aquila audax</i>	Wedge-tailed Eagle	1	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1	1
<i>Accipiter cirrocephalus</i>	Collared Sparrowhawk	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0
Falconidae																									
<i>Falco cenchroides</i>	Australian Kestrel	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	0	1
<i>Falco peregrinus macropus</i>	Peregrine Falcon	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	1
<i>Falco berigora berigora</i>	Brown Falcon	-	-	2	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	0
Columbidae																									
<i>Phaps chalcoptera</i>	Common Bronzewing	-	-	-	-	-	-	1	-	-	1	-	-	1	-	1	-	-	-	-	-	-	-	1	3
<i>Phaps elegans</i>	Brush Bronzewing	-	-	-	-	-	-	-	1	-	-	-	-	1	-	1	1	-	-	-	-	-	-	1	3
Psittacidae																								0	0
<i>Glossopsitta</i>	Purple-crowned Lorikeet	10	-	12	-	58	-	31	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	11	2
<i>Neophema elegans</i>	Elegant Parrot	-	-	-	-	-	2	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	0	3
<i>Platycercus icterotis icterotis</i>	Western Rosella	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	1
<i>Polytelis anthopeplus</i>	Regent Parrot	-	-	-	-	-	-	2	-	-	-	-	-	1	-	-	-	-	-	-	-	1	-	0	4
<i>Platycercus zonarius</i>	Australian Ringneck	4	-	8	-	1	-	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	19	0
Cacatuidae																									
<i>Cacatua roseicapilla</i>	Galah	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	0	1
<i>Calyptrorhynchus latirostris</i>	Carnaby's Cockatoo	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	0	1
Cuculidae																									
<i>Cacomantis flabelliformis</i>	Fan-tailed Cuckoo	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0
<i>Chrysococcyx lucidus</i>	Shining Bronze Cuckoo	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0
Caprimulgidae																									
<i>Eurostopodus argus</i>	Spotted Nightjar	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1	0
Maluridae																									
<i>Stipiturus malachurus</i>	Southern Emu-wren	-	-	-	-	-	-	-	-	-	-	-	-	-	6	-	-	1	-	-	-	-	-	6	1
<i>Malurus pulcherimus</i>	Blue-breasted Fairy-wren	4	-	13	-	-	-	-	-	-	-	25	-	25	1	6	-	8	1	2	-	-	-	83	2
Acanthizidae																									
<i>Acanthiza chrysorrhoa</i>	Yellow-rumped Thornbill	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	1
<i>Acanthiza uropygialis</i>	Chestnut-rumped Thornbill	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	4	1
<i>Acanthiza apicalis</i>	Broad-tailed Thornbill	-	-	2	-	10	1	8	1	4	1	12	-	12	-	10	1	3	1	2	-	-	-	63	5

		FR03		FR04		FR05		FR06		FR07		FR08		FR09		FR10		FR11		FR12		OPP		Total	
<i>Hylacola cauta</i>	Shy Groundwren	4	–	3	–	–	–	3	–	–	1	3	–	–	–	2	–	3	–	2	–	–	–	20	1
<i>Pyrrholaemus brunneus</i>	Redthroat	–	–	–	–	4	1	–	–	–	1	1	–	3	–	–	–	–	–	–	–	–	–	8	2
<i>Gerygone fusca fusca</i>	Western Gerygone	–	1	–	–	3	–	1	–	–	1	–	–	–	–	–	–	–	–	1	–	–	–	4	3
<i>Pardalotus punctatus</i>	Spotted Pardalote	4	–	1	–	1	–	1	–	1	–	2	–	2	–	–	–	–	–	–	–	–	–	12	0
<i>Pardalotus striatus</i>	Striated Pardalote	8	–	17	–	5	–	13	–	4	–	5	–	5	–	3	–	–	–	3	–	–	–	63	0
<i>Calamanthus campestris</i>	Rufous Fieldwren	–	–	–	–	–	–	–	–	–	–	–	–	–	–	6	–	–	–	–	–	–	–	6	0
<i>Smicromis brevirostris</i>	Weebill	26	–	9	–	33	–	63	–	8	–	14	–	14	–	8	–	7	–	2	–	–	–	184	0
Meliphagidae																									
<i>Acanthagenys rufogularis</i>	Spiny-cheeked Honeyeater	4	–	2	–	–	–	2	1	–	–	–	1	–	1	1	–	2	1	–	1	–	–	11	5
<i>Anthochaera carunculata</i>	Red Wattlebird	59	1	25	2	110	–	145	2	2	–	1	–	1	1	–	–	–	1	2	–	–	–	345	7
<i>Lichenostomus cratitius</i>	Purple-gaped Honeyeater	3	–	–	–	–	–	–	–	3	–	3	–	3	1	–	–	–	–	–	–	–	–	12	1
<i>Lichenostomus leucotis</i>	White-eared Honeyeater	30	1	26	–	15	–	20	–	9	–	7	–	7	–	6	–	–	–	13	–	–	–	133	1
<i>Lichmera indistincta indistincta</i>	Brown Honeyeater	9	2	6	1	–	1	–	–	–	1	–	–	–	1	1	–	–	1	–	2	–	–	16	9
<i>Lichenostomus virescens</i>	Singing Honeyeater	1	–	–	–	88	–	24	–	–	–	–	–	–	–	–	–	4	1	1	–	–	–	118	1
<i>Lichenostomus plumulus</i>	Grey-fronted Honeyeater	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	0
<i>Lichenostomus ornatus</i>	Yellow-plumed Honeyeater	–	–	–	–	11	–	10	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	21	0
<i>Melithreptus brevirostris</i>	Brown-headed Honeyeater	–	–	–	–	–	–	12	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	12	0
<i>Phylidonyris albifrons</i>	White-fronted Honeyeater	–	1	–	–	18	–	–	–	–	–	–	1	–	1	–	–	–	–	–	–	–	–	18	3
<i>Phylidonyris melanops</i>	Tawny-crowned Honeyeater	12	–	4	–	19	–	17	–	1	–	6	2	6	–	21	2	14	2	11	–	–	–	111	6
<i>Phylidonyris nigra gouldii</i>	White-cheeked Honeyeater	–	8	–	2	–	–	–	–	–	1	–	8	–	–	3	–	–	–	–	1	–	–	3	20
Cinclosomatidae																									
<i>Cinclosoma castanotus</i>	Chestnut Quail-thrush	–	–	–	–	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	0
Pomatostomidae																									
<i>Pomatostomus superciliosus</i>	White-browed Babbler	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	1
Petroicidae																									
<i>Microeca fascians assimilis</i>	Jacky Winter	–	1	–	–	–	2	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	3
<i>Eopsaltria australis griseogularis</i>	Western Yellow Robin	1	–	–	–	–	1	2	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3	2
<i>Petroica cucullata</i>	Hooded Robin	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	–	–	–	–	–	2	0
<i>Drymodes brunneopygia</i>	Southern Scrub-robin	1	–	–	–	–	–	–	–	–	–	–	–	–	–	3	–	–	–	2	–	–	–	6	0
Pachycephalidae																									
<i>Oreocica gutturalis</i>	Crested Bellbird	1	1	1	2	4	1	–	1	–	1	1	–	–	–	–	1	–	1	–	–	–	–	9	6
<i>Pachycephala pectoralis</i>	Golden Whistler	–	–	–	–	1	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	1
<i>Colluricincla harmonica</i>	Grey Shrike-thrush	2	–	3	–	1	–	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	8	0
Dicruridae																									
<i>Rhipidura leucophrys</i>	Willie Wagtail	–	–	–	–	6	–	–	–	–	–	–	–	–	–	1	–	–	1	–	–	–	–	7	1
Campephagidae																									
<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike	1	–	1	–	3	–	4	–	–	3	4	1	4	–	–	–	–	1	–	–	–	–	17	5
Artamidae																									
<i>Artamus cinereus melanops</i>	Black-faced Woodswallow	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	1
Cracticidae																									

		FR03		FR04		FR05		FR06		FR07		FR08		FR09		FR10		FR11		FR12		OPP		Total	
<i>Cracticus torquatus torquatus</i>	Grey Butcherbird	5	–	–	–	1	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	6	1
<i>Cracticus nigrogularis</i>	Pied Butcherbird	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	0
<i>Cracticus tibicen</i>	Australian Magpie	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	1	0
<i>Strepera versicolor plumbea</i>	Grey Currawong	6	–	5	–	2	–	1	–	–	–	–	–	–	–	–	–	1	1	–	–	–	–	15	1
Corvidae																									
<i>Corvus coronoides perplexus</i>	Australian Raven	3	–	2	1	–	1	2	–	–	–	2	–	2	–	1	1	2	–	–	2	–	–	14	5
	Number of individuals	200	16	146	8	401	16	370	10	32	12	86	13	84	15	78	6	48	12	42	10	0	3	1487	121
	Number of species	24	8	20	5	27	14	22	8	8	10	14	5	12	15	15	5	12	11	12	8	0	3	48	42
	No. of species both phases	28		21		37		25		17		17		24		17		18		20		3		61	

5.5 Mammals

5.5.1 The Assemblage

A total of 18 mammal species (14 native and four introduced) were recorded from the study area during phases III and IV combined (Table 5.2). Twelve non-volant mammal species were recorded during the survey comprising three dasyurids (carnivorous marsupials), one burramyid (pygmy possum), one tarsiped (honey possum), two macropods (kangaroos and wallabies), one Canine (dogs), one feline (cats), one leporid (rabbits), and two murids (murid rodents), (Appendix 7).

The most commonly recorded mammal species were *Sminthopsis granulipes* (White-tailed Dunnart) and *Cercartetus concinnus* (Western Pygmy Possum), each recorded on 38 occasions (each comprising almost 26% of the non-volant mammal records during the survey). *Notomys mitchelli* (Mitchell's Hopping Mouse) was also abundant during Phase III (Table 5.8). As consistent with previous surveys the non-volant mammal diversity was low within the study area (Biota 2006a, Biota 2006b and Biota 2007), with each site displaying between one and four species.

It should be noted that 18 mammalian species were also recorded during previous sampling in 2005 (Phases I and II), (Biota 2006a and Appendix 11). The species composition between phases was similar and in total 20 mammalian species have been recorded within the Flying Fox study area to date (Phases I, II, III and IV combined).

Based on data from Phases I to IV, the rarefaction curve for non-volant mammals appears to be very close to asymptotic, indicating that no additional new species are likely to be recorded with continued trapping effort (Figure 5.1).

However, non-parametric estimators predict total non-volant mammalian species richness within the Flying Fox study area could range from 14 to 16 species (mean $S_{\max}$ estimate of 14.75 ± 0.3 species; Table 5.7).

Table 5.7: Observed and estimated mammal species richness at Flying Fox based on four non-parametric estimators (calculated using EstimateS (Colwell 2005)).

Actual Observed (Phases I to IV)	14
Species Richness Estimator	Estimated $S_{\max}$
Ice Mean	14.4
Ace Mean	15.0
Chao 2 Mean	14.2
Jackknife 2 Mean	15.5

Harp trapping during Phase IV resulted in nil captures. However, based on examination of recorded call sequences a total of six bat species were found to occur within the study area. These include four vespertilionids (evening bats) and two molossids (freetail bats):

- Vespertilionidae - *Chalinolobus gouldii* (Figure 5.1), *Chalinolobus morio* (Figure 5.2), *Vespadelus regulus* (Figure 5.3), and *Nyctophilus geoffroyi* (Appendix 8); and
- Molossidae - *Tadarida australis* (Figure 5.4) and *Mormopterus planiceps* (Figure 5.5).

5.5.2 Discussion

The number of mammalian species recorded during Phases III and IV combined ($n = 18$) comprises 95% of the total number of species recorded by the Western Australian Museum ($n=19$, Appendix 2). Superficially, this indicates that the study area supports the majority of

mammalian species typically found in this region. However, based on additional records from surveys conducted by Biota Environmental Sciences it is evident that the museum records are deficient.

When the museum records are combined with results from this study in addition to Phases I and II (Biota 2006a), it is evident that the number of species comprises 75% of the total number of mammalian species recorded in the area (n=24).

Based on species richness estimates (Colwell 2005), the total number of non-volant mammalian species recorded from Phases I to IV represent between 90% and 99% (mean = 95%) of the total predicted assemblage. It is therefore possible, but very unlikely that additional non-volant mammalian species would be recorded within the Flying Fox study area as a result of further additional surveys.

It appears that the vast majority of non-volant mammals have already been documented. The estimated maximum of two additional species that remain uncollected are likely to be at naturally low density or less easily collectible and observable with the methods utilised in this study.

Table 5.8: Mammal records from the Forrestania survey sites during Phase III (P3) and Phase IV (P4) of the study.

Family		FR03		FR04		FR05		FR06		FR07		FR08		FR09		FR10		FR11		FR12		FR13		FRC		FRbat		Total	
Species name	Common name	P3	P4	P3	P4	P3	P4	P3	P4	P3	P4	P3	P4	P3	P4	P3	P4	P3	P4	P3	P4	P3	P4	P3	P4	P3	P4	P3	P4
Dasyuridae																													
Dasyurus geoffroii	Western Quoll	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	2	–	–	–	–	1	2
Sminthopsis gilberti	Gilbert's Dunnart	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	1
Sminthopsis granulipes	White-tailed Dunnart	–	–	–	–	–	–	–	–	–	–	5	2	4	3	2	4	5	3	5	5	–	–	–	–	–	–	21	17
Burramyidae																													
Cercartetus concinnus	Western Pygmy Possum	3	1	2	9	1	–	3	3	–	3	1	1	6	2	2	–	–	1	–	–	–	–	–	–	–	–	18	20
Tarsipedidae																													
Tarsipes rostratus	Honey Possum	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	1	0
Macropodidae																													
Macropus fuliginosus	Western Grey Kangaroo	–	–	–	1	–	–	–	–	–	–	–	–	–	–	2	–	–	–	–	1	–	–	–	–	–	–	2	2
Macropus irma	Western Brush Wallaby	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1xT	–	1xT	–	–	–	–	–	–	–	–	–	2	0
Vespertilionidae																													
Chalinolobus gouldii	Gould's Wattled Bat	–	–	–	–	–	C	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	C	0	2
Chalinolobus morio	Chocolate Wattled Bat	–	–	–	–	–	C	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	C	0	2
Vespadelus regulus	Southern Forest Bat	–	–	–	–	–	C	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	C	0	2
Nyctophilus geoffroyi	Lesser Long-eared Bat	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	C	0	1
Molossidae																													
Tadarida australis	White striped Freetail Bat	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	C	0	1
Mormopterus planiceps	Inland Freetail Bat	–	–	–	–	–	C	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	C	0	2
Muridae																													
Mus musculus*	House Mouse	1	–	–	–	–	–	–	–	–	1	–	6	–	–	–	2	–	1	–	–	–	4	–	–	–	–	1	14
Notomys mitchelli	Mitchell's Hopping Mouse	–	–	–	–	–	–	–	–	4	2	3	1	3	–	–	–	–	–	6	–	13	2	2	–	–	–	31	5
Canidae																													
Canis lupis*	Dog	–	–	–	–	–	–	–	–	1xT	–	1xT	–	–	–	3xT	–	–	–	–	–	–	–	–	–	–	–	5	0
Felidae																													
Felis catus*	House Cat	1xS	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1xT	–	–	–	–	–	–	–	2	0
Leporidae																													
Oryctolagus cuniculus*	European Rabbit	–	–	–	–	–	–	–	–	1xT	–	–	–	–	–	–	–	1xD	–	–	–	1xS	1	–	–	–	–	3	1
	No. of individuals	5	1	2	11	1	4	3	3	6	6	10	10	13	5	11	6	7	5	12	6	15	9	2	0	0	6	87	72
	No. of species	3	1	1	3	1	4	1	1	3	3	4	4	3	2	6	2	4	3	3	2	3	4	1	0	0	6	11	14
	No. of species both phases	3		3		5		1		5		5		3		7		4		4		4		1		6		18	

* Denotes introduced species.

C Denotes calls.

T Denotes tracks

S Denotes scats

D Denotes diggings

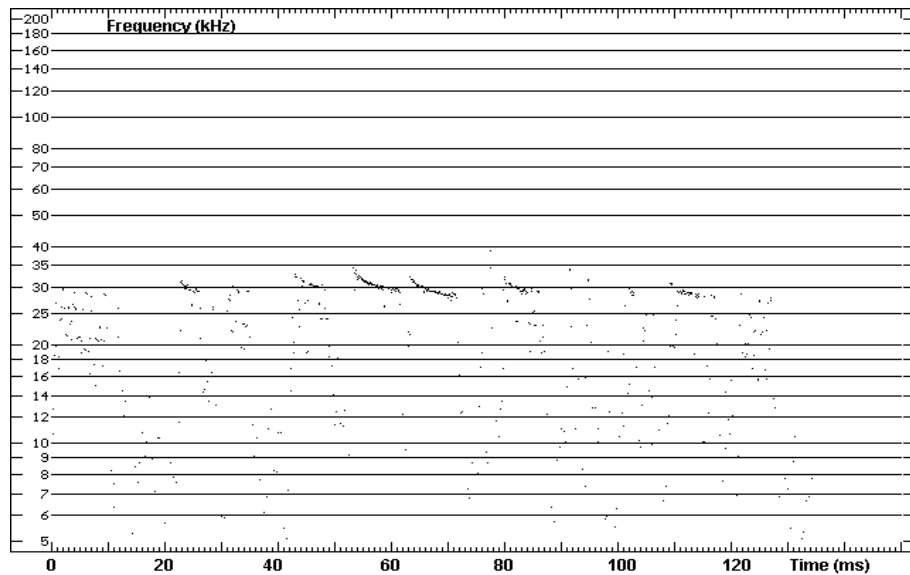


Figure 5.2: Example of call sequence identified as *Chalinolobus gouldii*.

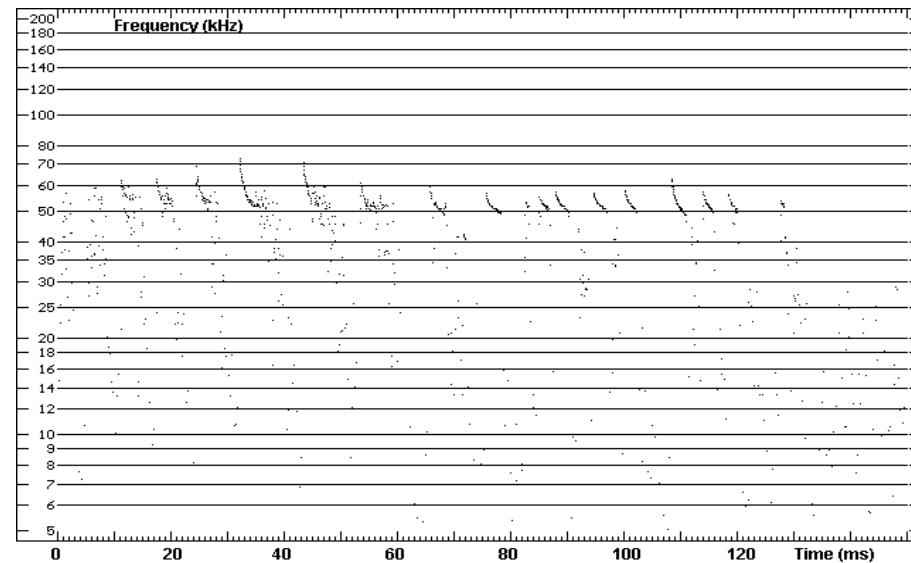


Figure 5.3: Example of call sequence identified as *Chalinolobus morio*.

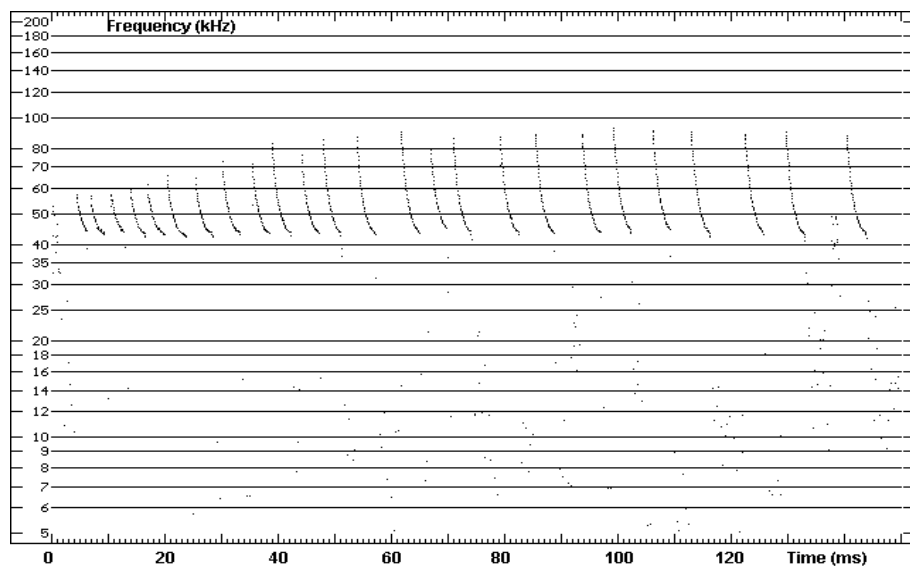


Figure 5.4: Example of call sequence identified as *Vespadelus regulus*.

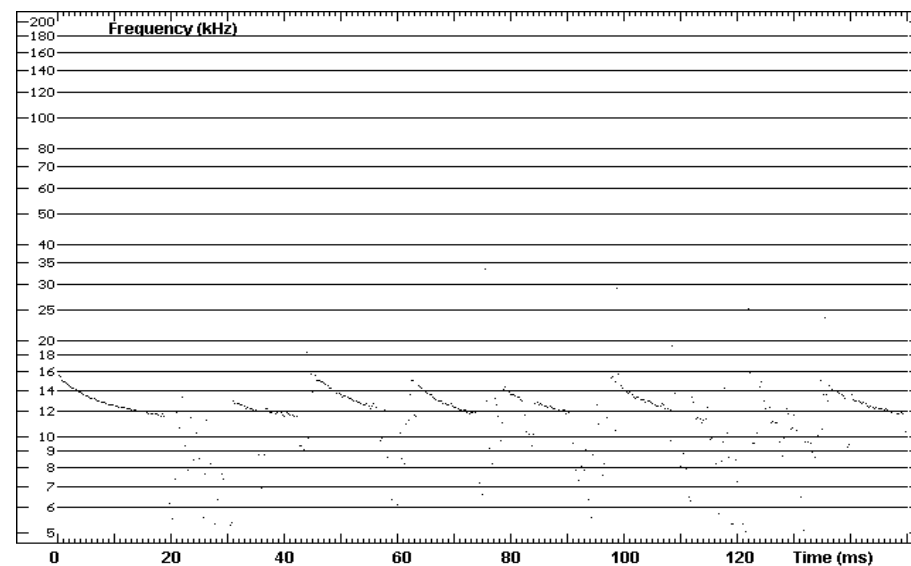


Figure 5.5: Example of call sequence identified as *Tadarida australis*.

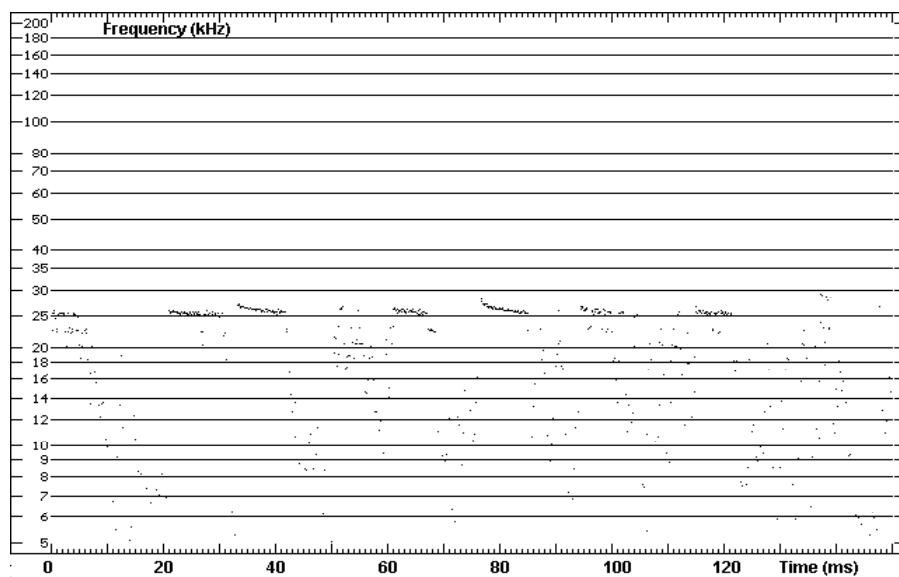


Figure 5.6: Call sequence identified as *Mormopterus planiceps*.

5.6 SRE Invertebrates

5.6.1 Overview

Taxonomic groups of invertebrates with naturally small distributions are described as short-range endemics and are in part characterised by poor dispersal capabilities, confinement to disjunct habitats and low fecundity (Harvey 2002, Ponder and Colgan 2002). Given the importance of short-range endemism to the conservation of biodiversity, the assessment of such invertebrate taxa is a potentially important component of impact assessment. Examples of taxonomic groups that show high levels of short-range endemism in this respect include mygalomorph spiders, millipedes, pseudoscorpions and freshwater and terrestrial molluscs.

Seven species of mygalomorph spider were recorded from the Forrestania study area (Table 5.9). These represent the Idiopidae, Barychelidae and Nemesiidae families (Plate 5.14 and Plate 5.15).



Plate 5.14: *Aname* sp. A (Nemesiidae)



Plate 5.15: *Aname* sp. B (Nemesiidae)

In addition, a single species pseudoscorpion represented by eleven specimens (family Chernetidae; genus *Haplochernes*) was recorded at site FR05 under the bark of salmon gums.



Plate 5.16: *Haplochernes* sp. (Chernetidae)

Table 5.9: Mygalomorph spiders recorded at the Flying Fox study area during survey Phase III (P3) and Phase IV (P4).

Species	FR03		FR04		FR05		FR06		FR07		FR08		FR09		FR10		FR11		FR12		FR13		Total	
	P 3	P 4	P 3	P 4	P 3	P 4	P 3	P 4	P 3	P 4	P 3	P 4	P 3	P 4	P 3	P 4	P 3	P 4	P 3	P 4	P 3	P 4	P 3	P 4
Idiopidae sp. A	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	0
Idiopidae sp. B	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	0
Idiopidae sp. C	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	0
Barychelidae sp. A	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	0
Barychelidae sp. B	–	–	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	0
Aname sp. A (Nemesiidae)	–	1	–	3	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	4
Aname sp. B (Nemesiidae)	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	0	1

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6.0 Conservation Significance

6.1 Threatened Fauna Statutory Framework

Native fauna species that are rare, threatened with extinction, or have high conservation value are specially protected by law under the *Western Australian Wildlife Conservation Act 1950-1979*. In addition, many of these species are listed under the *Federal Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act 1999)*.

6.1.1 *Wildlife Conservation Act 1950-1979*

Classification of rare and endangered fauna under the *Wildlife Conservation (Specially Protected Fauna) Notice 2006* recognises four distinct schedules of taxa:

- Schedule 1** Taxa that are rare or likely to become extinct and are declared to be fauna in need of special protection;
- Schedule 2** Taxa that are presumed to be extinct and are declared to be fauna in need of special protection;
- Schedule 3** Birds that are subject to an agreement between the governments of Australia and Japan relating to the protection of migratory birds and birds in danger of extinction, which are declared to be fauna in need of special protection; and
- Schedule 4** Taxa that are in need of special protection, otherwise than for the reasons mentioned in paragraphs (1), (2) and (3).

In addition to the above classification, fauna are also classified under five different Priority codes:

- Priority One** **Taxa with few, poorly known populations on threatened lands.**
Taxa that are known from a few specimens or sight records from one or a few localities on lands not managed for conservation. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.
- Priority Two** **Taxa with few, poorly known populations on conservation lands, or taxa with several, poorly known populations not on conservation lands.**
Taxa that are known from few specimens or sight records from one or a few localities on lands not under immediate threat of habitat destruction or degradation. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.
- Priority Three** **Taxa with several, poorly known populations, some on conservation lands.**
Taxa that are known from few specimens or sight records from several localities, some of which are on lands not under immediate threat of habitat destruction or degradation. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.
- Priority Four** **Taxa in need of monitoring.**
Taxa which are considered to have been adequately surveyed or for which sufficient knowledge is available and which are considered not currently threatened or in need of special protection, but could be if present circumstances change. These taxa are usually represented on conservation lands. Taxa which are declining significantly but are not yet threatened.
- Priority Five** **Taxa in need of monitoring.**
Taxa that are not considered threatened but are subject to a specific conservation program, the cessation of which would result in the species becoming threatened within five years.

6.1.2 ***EPBC Act 1999***

Fauna species of national conservation significance are listed under the *EPBC Act 1999*, and may be classified as 'critically endangered', 'endangered', 'vulnerable' or 'conservation dependent' (consistent with IUCN categories (see http://www.redlist.org/info/categories_criteria2001.html)). Migratory wader species are also protected under the *EPBC Act 1999*. The national List of Migratory Species consists of those species listed under the following International Conventions:

- Japan-Australia Migratory Bird Agreement (JAMBA);
- China-Australia Migratory Bird Agreement (CAMBA); and
- Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention).

6.2 **Schedule and Priority Fauna**

Nine species of Schedule and Priority fauna were recorded within the Flying Fox study area during survey III and IV.

- Short-billed (Carnaby's) Black Cockatoo - listed as Schedule 1 (Endangered) at State level and Endangered at the Federal level. Recorded opportunistically with the study area.
- Western Quoll (Chudich) - listed as Schedule 1 (Vulnerable) at State level and Vulnerable at the Federal level. Recorded at site FR13.
- Western Rosella (inland sub-species) - listed as Schedule 1 (Vulnerable) at State level. Recorded at sites FR05.
- Peregrine Falcon- listed as Schedule 4 at the state level. Recorded at site FR05.
- Shy Groundwren (western) - listed as Priority 4 at the State level. Recorded at sites FR03, FR04, FR06, FR07, FR08, FR10, FR11 and FR12.
- Rufous Fieldwren - listed as Priority 4 at the State level. Recorded at site FR10.
- Crested Bellbird - listed as Priority 4 at the State level. Recorded at site FR03, FR04, FR05, FR06, FR07, FR08, FR11 and FR12.
- White-browed Babbler (western Wheatbelt) - listed as Priority 4 at the State level. Recorded at site FR05.
- Western Brush Wallaby - listed as Priority 4 at the State level. Recorded at sites FR10 and FR11.

Based on habitats available and known distributions, a total of 20 Schedule or Priority species may potentially occur within the study area (Table 6.1, Appendices 1 and 2).

Table 6.1: Schedule and Priority fauna listed at State and Federal levels recorded or potentially occurring in the Flying Fox study area.

Species	State Wildlife Conservation Act 1950-1979	Federal Environment Protection and Biodiversity Conservation (EPBC) Act 1999
Carnaby's Cockatoo <i>Calyptorhynchus latirostris</i> *† Red-tailed Phascogale <i>Phascogale calura</i> Western Whipbird <i>Psophodes nigrogularis</i> Heath Mouse <i>Pseudomys shortridgei</i> Numbat <i>Myrmecobius fasciatus</i> Δ Malleefowl <i>Leipoa ocellata</i> †Δ Western Quoll (Chudich) <i>Dasyurus geoffroii</i> *†Δ Western Rosella <i>Platycercus icterotis zanthogenys</i> *†Δ	<u>Schedule 1</u> Endangered Endangered Endangered Vulnerable Vulnerable Vulnerable Vulnerable Vulnerable	Endangered Endangered Vulnerable Vulnerable Vulnerable Vulnerable Vulnerable Not listed
Peregrine Falcon <i>Falco peregrinus</i> *†Δ Carpet Python <i>Morelia spilota imbricata</i> †	Schedule 4 Schedule 4	
Bustard <i>Ardeotis australis</i> Shy Groundwren <i>Hylacola cauta whitlocki</i> *† Rufous Fieldwren <i>Calamanthus campestris montanellus</i> *† Western Shrike-tit <i>Falcunculus frontatus leucogaster</i> Crested Bellbird <i>Oreoica gutturalis gutturalis</i> *† White-browed Babbler <i>Pomatostomus superciliosus ashbyi</i> *†Δ Western Brush Wallaby <i>Macropus irma</i> *†Δ Western Mouse <i>Pseudomys occidentalis</i> Δ	Priority 4 Priority 4 Priority 4 Priority 4 Priority 4 Priority 4 Priority 4 Priority 4	
Fork-tailed Swift <i>Apus pacificus</i> Rainbow Bee-eater <i>Merops ornatus</i> †		Migratory Species Migratory Species

* Denotes species recorded in the study area during this survey.

† Denotes species recorded in the area during other surveys by Biota.

Δ Denotes species recorded in DEC's threatened and priority fauna database (see Appendix 1).

Accounts of the ecology, status and likelihood of occurrence of these threatened species follow.

6.2.1 Schedule One Species

• Short-billed (Carnaby's) Black-Cockatoo – *Calyptorhynchus latirostris*:

Endangered under the State Wildlife Conservation Act 1950-1979 and Endangered under the Federal EPBC Act 1999.

Distribution: This species has declined since the 1940s primarily due to widespread clearing of semiarid sandplains. It remains endemic to the south-west of Western Australia from Kalbarri to Esperance. Lake Cronin marks the easternmost distribution within the study area (Johnstone and Storr 1998).

Ecology: Postnuptial nomad, tending to move coastward after breeding (Johnstone and Storr 1998). Considered uncommon to common within most of its range, but scarce and patchily distributed in driest parts of its range. Salmon Gum comprises its principal nest tree within the Wheatbelt.

Likelihood of Occurrence: Recorded on one occasion opportunistically within the Flying Fox study area. Also recorded on past surveys at Forrestania (Biota 2006a and 2007). This species is also listed for the general region on the Birds Australia Atlas Database and the WA Museum FaunaBase. It is probably widespread throughout the study area on an occasional basis primarily in woodland, but also occurring in mallee. If the species breeds in the area, this would be confined to woodland where large trees provide hollows of a suitable size.

Potential Impacts: The conservation status of this species is unlikely to be affected by existing operations associated with the Flying Fox mine, however the potential exists to impact individuals if large trees containing nesting hollows are destroyed (Dr Peter Mawson pers. com.).

- **Chudich – *Dasyurus geoffroii*:**

Vulnerable under the *Wildlife Conservation Act 1950-1979* and Vulnerable under the *EPBC Act 1999*.

Distribution: Formerly present across semi-arid southern Australia from south-west Western Australia to Western Queensland and New South Wales. Now confined to sclerophyll and mallee remnants in south-west Western Australia (Menkhorst and Knight 2001).

Ecology: Solitary and mostly nocturnal. Creates dens in burrows or hollow logs. The Chudich is a generalist predator, mating in April to July (Menkhorst and Knight 2001).

Likelihood of Occurrence: Two individuals (three trapping events) were recorded at site FR13 during Phases III and IV combined. Also, recorded for the area on the WA Museum FaunaBase and DEC Threatened Fauna Database. The species has a large home range and only occurs at very low densities; it probably utilises all habitats.

Potential Impacts: The conservation status of this species is unlikely to be affected by the existing operations associated with the Flying Fox mine, however potential impacts include habitat loss, and predation and competition from foxes and cats.

- **Numbat – *Myrmecobius fasciatus*:**

Vulnerable under the *Wildlife Conservation Act 1950-1979* and Vulnerable under the *EPBC Act 1999*.

Distribution: Formerly widespread across southern semi-arid and arid Australia. Currently restricted to remnant forests in the south-west of Western Australia including Dryandra and Perup Forests (Menkhorst and Knight 2001).

Ecology: This species is adapted to a diet of termites. Numbats use hollow logs and burrows as refuges and den sites, and are strictly diurnal.

Likelihood of Occurrence: No individuals were recorded during the survey, however the DEC Threatened Fauna Database indicates that a single individual was recorded in the region in 1961. This species is unlikely to still occur in the Forrestania area.

Potential Impacts: Given the unlikely occurrence of numbats in the study area, the conservation status of this species is unlikely to be affected by the existing operations associated with the Flying Fox mine

- **Malleefowl – *Leipoa ocellata*:**

Vulnerable under the *Wildlife Conservation Act 1950-1979* and Vulnerable under the *EPBC Act 1999*.

Distribution: The Malleefowl was once broadly distributed across the southern half of the Australian continent, but has undergone significant range reduction over several decades. It is now restricted to the south west of Western Australia and southern areas of South Australia and New South Wales.

Ecology: Considered uncommon and sedentary, the species is omnivorous and typically has a large home range in woodlands or shrublands that have a deep layer of leaf litter, which the species uses to build nesting mounds. Mounds are up to 5 metres in diameter and 1.5 metres in height. Breeding occurs from September to April, with chicks emerging seven weeks after hatching.

Likelihood of Occurrence: Not recorded during the current survey. However, a disused nest mound at Diggers South and a recently active mound near the Flying Fox water disposal pipeline were recorded in 2006 during previous surveys (Biota 2007 and 2006b). This species is listed for the general region on the Birds Australia Atlas Database, the WA Museum FaunaBase and DEC Threatened Fauna Database. Staff at the Cosmic Boy camp report regular sightings of this species throughout the study area, and the lack of records during the this survey probably reflects the elusive nature and low density of the species. It is probably present in most habitats in the study area, except heath.

Potential Impacts: The conservation status of this species is unlikely to be affected by the existing operations associated with the Flying Fox mine, however vegetation clearing has the potential to destroy active nest mounds. Furthermore, increased vehicular traffic associated with the mine will increase the risk of mortality through collision.

- **Red-tailed Phascogale – *Phascogale calura*:**

Endangered under the *Wildlife Conservation Act 1950-1979* and Endangered under the *EPBC Act 1999*.

Distribution: Formerly widespread in woodland habitats in inland south and central Australia, this species is now restricted to mature remnant wandoo habitat in the south-west Wheatbelt (Menkhorst and Knight 2001).

Ecology: This species is arboreal, often moving to the ground to feed. They are opportunistic feeders, eating invertebrates, small birds and small mammals. Males die shortly after the mating period in July. This species occurs in eucalypt woodlands but is most abundant where Rock Oak (*Allocasuarina huegeliana*) grows over a shrub layer on rocky substrates (Strahan 1995, Menkhorst and Knight 2001).

Likelihood of Occurrence: Not recorded during this survey, but the species is very cryptic. Recorded for the general area on the WA Museum FaunaBase. This species is unlikely to occur in the study area but, if present, is probably confined to the eucalypt woodlands.

Potential Impacts: The conservation status of this species is unlikely to be affected by the existing operations associated with the Flying Fox mine

- **Heath Mouse – *Pseudomys shortridgei*:**

Vulnerable under the *Wildlife Conservation Act 1950-1979* and Vulnerable under the *EPBC Act 1999*.

Distribution: Occurs in widely separated populations. The Western Australian population occurs in the Ravensthorpe Range, Fitzgerald River National Park and Dragon Rocks and Lake Magenta Nature Reserves.

Ecology: The Heath Mouse is known to occupy variable habitats, preferring stands of scrub mallee and mixed scrub with *Banksia* on loamy soils. It feeds on flowers, seeds, berries, grass stems and fungi (Strahan 1995, Menkhorst and Knight 2001).

Likelihood of Occurrence: Not recorded during the fauna survey. The species has only been recorded as far north as Dragon Rocks Nature Reserve, about 60 km south-west of the study area (Menkhorst and Knight 2001), so it probably does not occur in the study area. However, the complete distribution of this species is not well known in Western Australia and the study area contains suitable habitat. The Heath Mouse is recorded from the general area on the WA Museum FaunaBase, and this record presumably refers to Dragon Rocks.

Potential Impacts: The conservation status of this species is unlikely to be affected by the existing operations associated with the Flying Fox mine.

Western Rosella – *Platycercus icterotis xanthogenys*:

Vulnerable under the *Wildlife Conservation Act 1950-1979*.

Distribution: Endemic to Western Australia, this species occurs in the semi-arid southern interior.

Ecology: Habitat and food consists mainly of eucalypt and casuarina woodlands and scrub including Salmon Gum (Johnstone and Storr 1998). This species nests in tree hollows with favoured nesting trees including Wandoo, Marri, Flooded Gum, York Gum and Salmon Gum. Nesting hollows are small, often a dry sprout leading into a green limb (Johnstone and Storr 1998).

Likelihood of Occurrence: Recorded on one occasions from site FR05. Also recorded on previous surveys (Biota 2006a, 2006b, and 2007) This species is also recorded from the general region on the Birds Australia Database and the WA Museum FaunaBase. The subspecies is probably widespread in the area in woodland and, to a lesser extent, mallee; it is likely that the locality supports a significant population.

Potential Impacts: Given the relatively small scale of proposed clearing and the breeding requirement of small tree hollows, the impact of the proposed works on the Western Rosella is likely to be negligible. The conservation status of this species is therefore unlikely to be altered by the existing operations associated with the Flying Fox mine.

- **Western Whipbird – *Psophodes nigrogularis*:**

Endangered under the *Wildlife Conservation Act 1950-1979* and Vulnerable under the *EPBC Act 1999*.

Distribution: Confined to the south of south-west Western Australia, mainly in the eastern semiarid and subhumid zones (Johnstone and Storr 2004).

Ecology: Inhabits mallee, *Banksia* and heath habitats. Eats mainly insects, also spiders and snails.

Likelihood of Occurrence: Not recorded during the survey. This species is listed on the Department of Environment and Water Resources (DEWR) database. It should be noted that DEWR refers to the sub-species *P. n. oberon*, while the DEC refers to the sub-species *P. n. nigrogularis*. Both databases are referring to the Western Mallee sub-species, but the discrepancy in sub-species names stems from taxonomic inconsistencies that are currently under review.

Potential Impacts: The conservation status of this species is unlikely to be affected by the existing operations associated with the Flying Fox mine.

6.2.2 Schedule Four Species

- **Peregrine Falcon – *Falco peregrinus*:**

Other Specially Protected Fauna under the *Wildlife Conservation Act 1950-1979*.

Distribution: The Peregrine Falcon has an almost cosmopolitan distribution. The only subspecies in Australia (*F. p. macropus*) is widespread throughout Australia and Tasmania (Marchant and Higgins 1993). The Australian population has been estimated at 3,000 to 5,000 pairs (Cade 1982).

Ecology: This species inhabits a wide range of habitats including forest, woodlands, wetlands and open country. The availability of prey is apparently more important than habitat in determining its distribution. Home ranges are probably defended year round and are variable in size, though not typically less than 480 ha (Marchant and Higgins 1993). This species typically nests on cliffs (81% of nests Australia-wide) but also on stick nests (11%) and in tree hollows (8%). Breeding typically occurs from August to November (Johnstone and Storr 1998). Food is almost exclusively birds such as pigeons, parrots and passerines, which are captured in flight (Johnstone

and Storr 1998). Mammals such as possums and rabbits have been recorded as rare prey items (Marchant and Higgins 1993).

Likelihood of Occurrence: This species was recorded on one occasion at site FR05. It has also been seen over woodland at Diggers South during a 2005 visit (Dr. Mike Craig, pers. obs.). The species is also listed for the general region on the Birds Australia Atlas Database, the WA Museum FaunaBase and DEC Threatened Fauna Database. Home ranges of this species are large (Marchant and Higgins 1993), and the species probably occurs periodically in all habitats throughout the study area at low densities.

Potential Impacts: Loss of potential nesting and foraging habitat. Given the mobility of the species, its conservation status is unlikely to be affected by the existing operations associated with the Flying Fox mine.

- **Carpet Python – *Morelia spilota imbricata*:**

Priority 4 under the *Wildlife Conservation Act 1950-1979*.

Distribution: This subspecies inhabits temperate climatic areas with winter rains and dry summers. Occurs in south-west Western Australia (Cogger 1992).

Ecology: Diet includes a variety of terrestrial invertebrates (lizards, birds and mammals). Females have a single ovulation in late spring to early summer, laying 14 to 35 eggs.

Likelihood of Occurrence: This species was not recorded during the current survey, however it was recorded near the Flying Fox mine during the site inspection in 2005. The lack of records during the fauna survey probably reflects the low densities at which this species occurs, combined with its cryptic behaviour. The species would be expected to occur at a low density in most if not all habitats within the study area.

Potential Impacts: Loss of habitat from land clearing has negatively impacted this sub-species. The role of predation by feral predators (foxes and cats) remains unknown. The proposed works have potential to impact individual carpet pythons, however, the conservation status of this species is unlikely to be altered by the existing operations associated with the Flying Fox mine.

6.2.3 Priority Four Species

- **Australian Bustard – *Ardeotis australis*:**

Priority 4 under the *Wildlife Conservation Act 1950-1979* and classified as Near-Threatened by Garnett and Crowley (2000).

Distribution: The Australian Bustard occurs over much of Western Australia, with the exception of the more heavily wooded southern portions of the state (Johnstone and Storr 1998). Its wider distribution includes eastern Australia and New Guinea.

Ecology: This species prefers open or lightly wooded grassland including *Triodia* sandplains (Johnstone and Storr 1998) and is considered scarce to common depending on season and habitat. It has an omnivorous diet and occurs in a relatively broad range of habitats, but appears to have some preference for grasshoppers and is often attracted to recently burnt areas (Marchant and Higgins 1993). This species breeds from March to September and the eggs are laid on bare, preferably stony, ground (Johnstone and Storr 1998). The species tends to be nomadic moving between good foraging areas such as mulga flats after good heavy rainfall (Johnstone and Storr 1998).

Likelihood of Occurrence: This species was not recorded during the current survey, but is likely to occur within the study area. It typically inhabits low shrublands and grasslands and is particularly attracted to burnt areas (Marchant and Higgins 1993). In the study area, it probably occurs in heaths and open areas with a sparse understorey.

Potential Impacts: Given its distribution and mobility, the conservation status of this species would not be affected by the existing operations associated with the Flying Fox mine.

- **Shy Groundwren – *Hylacola cauta whitlocki*:**

Priority 4 under the *Wildlife Conservation Act 1950-1979* and classified as Near-Threatened by Garnett and Crowley (2000).

Distribution: Restricted to the semi-arid interior of south-west Western Australia.

Ecology: Inhabits shrublands including understorey of eucalypt woodlands and scrubs (Johnstone and Storr 2004). Feeds predominantly on insects. Breeds from July to October.

Likelihood of Occurrence: Recorded on 21 occasions predominantly during Phase III, at sites FR03, FR04, FR06, FR07, FR08, FR10, FR11 and FR12. Also recorded during previous surveys at Forrestania (Biota 2006a, 2006b and 2007). This species was also recorded for the general region in the Birds Australia Atlas Database.

Potential Impacts: The conservation status of this species would not be affected by the existing operations associated with the Flying Fox mine.

- **Rufous Fieldwren – *Calamanthus campestris montanellus*:**

Priority 4 under the *Wildlife Conservation Act 1950-1979* and classified as Near-Threatened by Garnett and Crowley (2000).

Distribution: Occurs in low shrublands of the southern semiarid zone and also up the arid west coast to North West Cape (Johnstone and Storr 2004).

Ecology: This subspecies typically inhabits saltbush, samphire and heaths (Higgins and Peter 2002). It is common near the west and south coasts, and forages in low vegetation with the diet consisting predominantly of insects.

Likelihood of Occurrence: Recorded during the current survey within heath habitat at site FR10. listed for the general region in the Birds Australia Database and the WA Museum FaunaBase.

Potential Impacts: The conservation status of this species is unlikely to be affected by the existing operations associated with the Flying Fox mine.

- **Western Shrike-tit – *Falcunculus frontatus leucogaster*:**

Priority 4 under the *Wildlife Conservation Act 1950-1979* and classified as Near-Threatened by Garnett and Crowley (2000).

Distribution: Occurs mainly in the southern subhumid and semiarid interior of south-west Western Australia.

Ecology: Inhabits woodlands, scrubs and more open forests of *Eucalyptus* including Salmon Gum (Johnstone and Storr 2004, Higgins and Peter 2002). This sub-species is locally common, but generally scarce or rare. It has a mainly insectivorous diet.

Likelihood of Occurrence: Not recorded during this survey, but recorded for the region on the Western Australian Museum FaunaBase. The species typically occurs in eucalypt woodland (Higgins and Peter 2002), hence it is likely to be present in those habitats in the study area. It may also occur occasionally in stands of Gimlet, particularly where they are adjacent to woodlands.

Potential Impacts: The conservation status of this species is unlikely to be affected by the existing operations associated with the Flying Fox mine.

- **Crested Bellbird – *Oreoica gutturalis gutturalis*:**

Priority 4 under the *Wildlife Conservation Act 1950-1979* and classified as Near-Threatened by Garnett and Crowley (2000).

Distribution: Distributed across the greater part of Western Australia excluding the wettest regions.

Ecology: Inhabits most types of scrub and thicket. Moderately common in the arid zone, but scarce and patchily distributed in wetter country (Johnstone and Storr 2004). This is a mainly insectivorous species.

Likelihood of Occurrence: Recorded during Phases III and IV of the current survey. This species was also recorded during Phases I and II of the Flying Fox survey, conducted in 2005 (Biota 2006a). This species is also recorded from the area on the Birds Australia Atlas Database. The subspecies inhabits woodland, mallee and Acacia shrublands (Higgins and Peter 2002), hence it is probably widespread throughout the study area at low densities.

Potential Impacts: The conservation status of this species is unlikely to be affected by the existing operations associated with the Flying Fox mine.

- **White-browed Babbler (Western Wheatbelt) – *Pomatostomus superciliosus ashbyi*:**

Priority 4 under the *Wildlife Conservation Act 1950-1979*.

Distribution: Occurs in mainly the arid and semiarid zones south of the Tropic of Capricorn.

Ecology: Prefers edges of most types of thicket and scrub (Johnstone and Storr 2004), and is mainly insectivorous. The taxon is in decline due to extensive habitat clearing for agriculture, however persists in large patches of continuous older age habitat that surrounds the wheatbelt.

Likelihood of Occurrence: One individual was observed during the Phase IV survey. This species was also observed during Phase I and II of the Flying Fox survey, in addition to the Diggers South survey (Biota 2006a and Biota 2007). *P.s. ashbyi* is recorded for the area on the WA Museum FaunaBase, DEC Threatened Fauna Database and the Birds Australia Atlas Database. The sub-species is typically found in eucalyptus forests and woodlands, mallee and tree-lined inland watercourses.

Potential Impacts: This sub-species is unlikely to be affected by the existing operations associated with the Flying Fox minesite. However, it may be susceptible to displacement from preferred habitat by regular uncontrolled fires.

- **Western Brush Wallaby – *Macropus irma*:**

Priority 4 under the *Wildlife Conservation Act 1950-1979*.

Distribution: Distributed across the south-west of Western Australia from north of Kalbarri to Cape Arid (Strahan 1995).

Ecology: Inhabits predominantly open forest or woodland, but is also found in mallee and heath habitat. The Western Brush Wallaby is a grazer.

Likelihood of Occurrence: Tracks of this species were recorded during the current survey. *M irma* has been directly observed during previous surveys in the area (Biota 2006a, 2006b and 2007). It is also recorded for the area on the WA Museum FaunaBase and DEC Threatened Fauna Database. The species is typically recorded in open woodlands with grassy understorey for foraging and thickets of shrubs for resting (Strahan 1995, Menkhorst and Knight 2001).

Potential Impacts: A decline in numbers of Western Brush Wallaby since the 1970s has been attributed to increased fox numbers and predation. The conservation status of this species would not be affected by the existing operations associated with the Flying Fox mine.

- **Western Mouse – *Pseudomys occidentalis*:**

Priority 4 under the *Wildlife Conservation Act 1950-1979*.

Distribution: Formerly distributed in a narrow band across south-west Western Australia and the Nullarbor Plain. Now confined to the Ravensthorpe Range, Fitzgerald River National Park and small reserves in the southern Wheatbelt (Menkhorst and Knight 2001).

Ecology: The species inhabits shrublands on loam soils and all occupied areas are characterised by an extremely dense shrub layer between 0.5 and 2.5 m in height (Strahan 1995, Menkhorst and Knight 2001). Diet includes fibrous plant material and invertebrates. Young are born from mid to late spring.

Likelihood of Occurrence: Not recorded during the fauna survey but recorded for the region on the WA Museum FaunaBase and DEC Threatened Fauna Database. This species may be present in suitable habitat in the study area.

Potential Impacts: Habitat destruction and altered fire regimes that remove old growth habitat constitute the main threatening processes for this species. However, the conservation status of this species is unlikely to be affected by the existing operations associated with the Flying Fox mine.

6.2.4 Migratory Species

The Fork-tailed Swift *Apus pacificus* and **Rainbow Bee-eater *Merops ornatus*** are listed as migratory species under the *EPBC Act 1999*. The Fork-tailed Swift is also listed under the China-Australia Migratory Bird Agreement (CAMBA) and the Japan-Australia Migratory Bird Agreement (JAMBA), and the Rainbow Bee-eater is listed under JAMBA. The Fork-tailed Swift was not recorded during the current survey (or past surveys conducted by Biota) and is not listed for the general region on any of the avifauna databases. However, the occurrence of this species is extremely patchy on both a temporal and spatial basis; it probably occurs in the study area at irregular intervals, and would be likely over all habitats.

Similarly, the Rainbow Bee-eater was not recorded during the current survey, however it has been recorded during earlier survey phases within the Flying Fox study area (Biota 2006a). This species is also listed for the general region on the Birds Australia Atlas Database. The Rainbow Bee-eater forages on aerial insects and nests in burrows in the ground (Higgins 1999). It probably occurs in most habitats in the study area that provide suitable soil for nesting and a tall stratum of vegetation for perching. Given the mobility of these species, there would be no alteration of the conservation status of either species from the existing operations.

7.0 Potential Impacts and Management

7.1 Generic Impacts and Management

Below is a list of generic impacts that are typically associated with mining and associated infrastructure proposals of a similar scale to the Flying Fox project.

Direct fauna habitat disturbance and modification

The principal impacts arising from the proposed development are associated with the clearing of fauna habitat associated with establishment of:

- a box cut; and
- associated mine infrastructure (eg. water disposal pipeline, waste dumps, roads).

Indirect fauna habitat disturbance and modification

A number of indirect modifications may also occur to fauna habitat as a result of the construction and operation of the mine and associated roads. These include changes to noise levels, weed introduction or spread, and feral animal spread.

7.1.1 Direct Loss of Habitat

Habitat supporting at least three Schedule 1 taxa may potentially be impacted by development associated with the Flying Fox mine. It is considered unlikely that mine infrastructure expansion will affect the conservation status of the Western Rosella, Carnaby's Cockatoo, Western Quoll or other Schedule 1 taxa potentially occurring in the area (e.g. Malleefowl).

7.1.2 Direct Loss of Individual Fauna

It is inevitable that there will be some localised loss of fauna due to direct mortality arising from construction activities, including that which may occur during the clearing of habitat. Ongoing impacts may also arise from more frequent vehicle movements, haulage movements and machinery operation. For all vertebrate and the majority of invertebrate taxa, it is unlikely that the loss of individuals associated with such direct mortalities would be significant enough to affect the overall conservation status of any of the species recorded from the study area.

We have not fully established the distribution of the potential short range taxa (mygalomorph spiders) recorded from the study area to determine whether impacts may be significant. However, studies indicate that the habitat type in which mygalomorph spiders occur is widespread (Biota 2006a).

In relation to both habitat loss and direct loss of fauna, it is noted that cumulative effects of a variety of disturbances (eg. mining proposals, road construction and maintenance, wildfires, increased road usage, and feral animals) in the region may impact negatively on some species.

7.1.3 Noise

Noise from mining activities including blasting, haulage and general mining operations may impact on fauna. However, we did not record any particularly sensitive habitats or communities within the study area that may be at particular risk (eg. there were no recorded significant bat roosts or breeding populations of birds).

7.1.4 Weed Spread

Ground disturbance associated with construction and operation of the mine provides an opportunity for the infiltration and spread of weeds. The consequences of weed infiltration on

the biodiversity of fauna are not well documented, however precautions should be taken to prevent the introduction or spread of weeds.

7.1.5 Feral Animal Spread

Ground disturbance and construction of roads or tracks offer opportunities for the spread of feral animals that use these disturbances as pathways for travel. Feral animals may be predators or competitors of native fauna, and their spread should be kept to a minimum. A Feral animal control program was undertaken in December 2006 at Flying Fox, Cosmic Boy and New Morning/Daybreak. A further control program will be implemented in December 2007 to ensure feral animals are kept at reduced numbers.

7.2 Existing Commitments

Based on recommendations outlined in previous studies at Forrestania (Biota 2006a and 2006b), the following commitments are currently being implemented or will soon be implemented within the Flying Fox study area:

7.2.1 Generic

1. The proponent has agreed to utilise existing cleared and disturbed areas for proposed new disturbances where practicable. The use of these disturbed areas should be maximised as part of project design.
2. All members of the work force on site are provided with an environmental induction to ensure they are familiarised with the presence of Schedule 1 fauna. This includes driving speed restrictions, ensuring that off-road driving is minimised, in addition to fire risk minimisation.
3. Western Areas NL has implemented a feral animal trapping and baiting program targeting areas around the Cosmic Boy camp, Flying Fox mine and the New Morning drillers camp (Biota 2006a and 2006b). The program will aid in keeping predatory feral animal numbers to a minimum, with the aim of reducing predation on native fauna.

Trapping and baiting was first undertaken in December 2006. Following assessment of the outcome of the initial program, WSA decided that baiting and trapping on an annual basis would provide adequate control of feral animals at the target sites. In addition, Western Areas NL, where possible will help to maintain the existing wild dog control program currently undertaken in the area by the Department of Agriculture and the Department of Environment and Conservation.

7.2.2 Malleefowl - *Leipoa ocellata*

4. Signs creating awareness of Malleefowl in the area and bearing instruction to slow down should be erected on mine site access roads.
5. A search should be undertaken within 100m of any new project disturbance footprint (once it is finalised) to determine if active Malleefowl mounds are present. The Malleefowl Preservation Group may assist with this. If any active mounds are located, measures should be taken to avoid their disturbance.

7.2.3 Chudich- *Dasyurus geoffroii*

6. In the camp waste disposal area, waste is covered with a layer of soil to minimum depth of 100 mm, at least monthly. In addition, the waste disposal area is enclosed with chain-wire fencing (Cyclone® fencing). This will limit the availability of edible waste to both native and

feral animals and will help reduce the likelihood of the western quoll being attracted to the area.

7.2.4 Short-billed (Carnaby's) Black Cockatoo - *Calyptorhynchus latirostris*

8. Clearing of large hollow bearing trees should be avoided. It should be noted that Salmon Gum (*Eucalyptus salmonophloia*) woodlands comprise the preferred nesting habitat for Carnaby's Cockatoo.

7.3 Future monitoring

The survey phases completed to date at Flying Fox have illustrated the value of medium to long-term fauna studies in respect of both more comprehensive community descriptions and documenting changes in community structure and species representation over time. Most fauna studies conducted for impact assessment purposes are short-term in nature and generally conducted over short timeframes. Even in research organizations, there are limited examples of systematic long-term studies of terrestrial fauna over longer timeframes. There would therefore be value in continuing the terrestrial fauna trapping at the established sites, perhaps with consideration to reducing the frequency of data collection. This would yield a publication standard data set that could be submitted to a refereed journal, recognising the support provided by Western Areas.

In addition to this broader value, future fauna surveys (associated with ongoing monitoring commitments) will continue targeting the Western Quoll with individuals being marked to aid in identification of new individuals. Uncertainty also exists in resolving the conservation significance of mygalomorph spiders. Future fauna surveys should further target mygalomorph species with a view to utilising molecular techniques as a means of inferring levels of reproductive isolation in these spiders.

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Appendix 1

DEC Threatened Fauna Search

Threatened and Priority Fauna Database

Page 1 of 2

31.6361 °S 120.2642 °E / 32.8866 °S 119.1458 °E

Forrestania area east of Hyden

* Date Certainty Seen Location Name Method

Schedule 1 - Fauna that is rare or is likely to become extinct

Dasyurus geoffroii **Chuditch** *1 records*

This carnivorous marsupial occupies large home ranges, is highly mobile and appears able to utilise bush remnants and corridors.

Date	Certainty	Seen	Location Name	Method
1985	1	2	HYDEN	Dead

Myrmecobius fasciatus **Numbat** *1 records*

This diurnal marsupial feeds almost exclusively on termites and is very vulnerable to predation by foxes and cats. It occurs in a variety of habitats including woodland and shrubland where it shelters in hollow logs, tree hollows and burrows.

Date	Certainty	Seen	Location Name
1961	1	1	Norseman

Leipoa ocellata **Malleefowl** *1 records*

This species was once widely distributed across southern Australia. It prefers woodland or shrubland with an abundant litter layer that provides essential material for the construction of its nest mound.

Date	Certainty	Seen	Location Name	Method
1995	1	16	Varley/Mount Sheridan	Day sighting

Platycercus icterotis xanthogenys **Western Rosella (inland ssp)** *3 records*

This subspecies of the Western Rosella occurs in eucalypt and casuarina woodlands and scrubs, especially of Salmon Gum and tall mallees.

Date	Certainty	Seen	Location Name	Method
1969	1	1	Lake Varley Nature Reserve	Day sighting
1991	1	2	Lake Cronin Nature Reserve	Day sighting
1991	1	3	Lake Cronin Nature Reserve	Day sighting

Schedule 4 - Other specially protected fauna

Falco peregrinus **Peregrine Falcon** *1 records*

This species is uncommon and prefers areas with rocky ledges, cliffs, watercourses, open woodland or margins with cleared land.

Date	Certainty	Seen	Location Name	Method
1991	1	1	Lake Cronin Nature Reserve	Day sighting

Priority Four: Taxa in need of monitoring

Macropus irma **Western Brush Wallaby** *3 records*

This species occurs in areas of forest and woodland supporting a dense shrub layer.

Date	Certainty	Seen	Location Name	Method
1969	1	3	Lake Varley Nature Reserve	Day sighting
1998	1	5	Mount Sheridan	Day sighting
1999	2	2	Jilbadji NR	Day sighting

Pseudomys occidentalis **Western Mouse** *1 records*This species occurs most frequently in areas of long-unburnt vegetation on sandy clay or loam with a matrix of gravel. It is known to feed on the seeds of quandong (*Santalum acuminatum*) and various sedge species.

Date	Certainty	Seen	Location Name
1			Hatter Hill

Pomatostomus superciliosus ashbyi **White-browed Babbler (western wheatb)** *1 records*

This species of bird lives in eucalypt forests and woodlands, and forages on or near the ground for insects and seeds.

Date	Certainty	Seen	Location Name	Method
1982	1		Tapper Road Nature Reserve	Day sighting

Friday, 20 January 2006

Department of Conservation and Land Management



Appendix 2

Western Australian Museum Faunabase Search

Amphibians collected between 31.6361°S, 120.2642°E and 32.8866°S, 119.1458°E.**Hylidae***Litoria cyclorhyncha***Myobatrachidae***Crinia pseudinsignifera**Crinia sp**Heleioporus albopunctatus**Limnodynastes dorsalis**Myobatrachus gouldii**Neobatrachus albipes**Neobatrachus kunapalari**Neobatrachus pelobatooides**Neobatrachus sp**Neobatrachus sutor**Pseudophryne guentheri**Pseudophryne occidentalis***Reptiles collected between 31.6361°S, 120.2642°E and 32.8866°S, 119.1458°E.****Agamidae***Ctenophorus cristatus**Ctenophorus maculatus**Ctenophorus maculatus griseus**Ctenophorus ornatus**Ctenophorus salinarum**Moloch horridus**Pogona minor**Pogona minor minor**Rankinia adelaidensis chapmani***Elapidae***Echiopsis curta**Neelaps bimaculatus**Notechis curtus**Parasuta gouldii**Paroplocephalus atriceps**Pseudonaja affinis affinis**Pseudonaja nuchalis**Simoselaps bertholdi***Gekkonidae***Crenadactylus ocellatus**Crenadactylus ocellatus ocellatus**Diplodactylus granariensis granariensis**Diplodactylus maini**Diplodactylus pulcher**Gehyra variegata**Heteronotia binoei**Nephurus stellatus**Oedura reticulata**Strophurus spinigerus inornatus**Underwoodisaurus milii***Pygopodidae***Delma australis**Delma butleri**Delma fraseri fraseri**Gehyra variegata**Lialis burtonis**Pygopus lepidopodus***Scincidae***Cryptoblepharus plagiocephalus**Ctenotus atlas**Ctenotus impar**Ctenotus schomburgkii**Ctenotus sp**Ctenotus uber uber**Cyclodomorphus melanops elongatus**Egernia inornata**Egernia multiscutata bos**Egernia richardi**Hemiergis initialis**Hemiergis initialis initialis**Hemiergis peronii peronii**Lerista distinguenda**Menetia greyii**Morethia butleri**Morethia obscura**Tiliqua occipitalis***Typhlopidae***Ramphotyphlops australis**Ramphotyphlops waitii***Varanidae***Varanus gouldii**Varanus rosenbergi***Birds collected between 31.6361°S, 120.2642°E and 32.8866°S, 119.1458°E.****Acanthizidae***Acanthiza apicalis**Calamanthus campestris**Hylacola cauta**Pyrholaemus brunneus***Accipitridae***Hamirostra isura***Cinclosomatidae***Cinclosoma castanotus***Columbidae***Phaps elegans***Dicruridae***Rhipidura albicauda***Halcyonidae***Dacelo novaeguineae***Maluridae***Malurus pulcherrimus**Stipiturus malachurus westernensis***Megapodiidae***Leipoa ocellata***Meliphagidae***Anthochaera carunculata**Lichenostomus cratitius**Lichenostomus leucotis**Lichenostomus leucotis novaenorcae**Lichenostomus ornatus**Manorina flavigula***Motacillidae***Anthus australis australis*

Pachycephalidae

Falcunculus frontatus
Oreoica gutturalis
Pachycephala inornata

Pardalotidae

Pardalotus punctatus punctatus
Pardalotus striatus

Petroicidae

Drymodes brunneopygia
Eopsaltria australis griseogularis
Microeca fascinans assimilis
Petroica goodenovii

Pomatostomidae

Pomatostomus superciliosus

Psittacidae

Neophema elegans
Platycercus icterotis
Platycercus zonarius
Platycercus zonarius zonarius
Polytelis anthopeplus anthopeplus

Scolopacidae

Calidris acuminata

Strigidae

Ninox novaeseelandiae

Tytonidae

Tyto alba

Zosteropidae

Zosterops lateralis gouldi

Mammals collected between 31.6361°S, 120.2642°E and 32.8866°S, 119.1458°E.**Burramyidae**

Cercartetus concinnus

Dasyuridae

Ningauia yvonneae
Sminthopsis dolichura
Sminthopsis gilberti
Sminthopsis granulipes

Leporidae

Oryctolagus cuniculus

Macropodidae

Macropus fuliginosus

Molossidae

Mormopterus planiceps
Tadarida australis

Muridae

Mus musculus
Notomys mitchellii
Pseudomys albocinereus
Pseudomys occidentalis
Pseudomys shortridgei

Tachyglossidae

Tachyglossus aculeatus

Tarsipedidae

Tarsipes rostratus

Vespertilionidae

Chalinolobus gouldii
Nyctophilus geoffroyi
Vespertilio regulus

Appendix 3

EPBC Act Protected Matters Report

The following tables denote species or species habitat likely to occur within the search area.

Threatened Species

Species Name	Common name	Status
Birds		
<i>Acanthiza iredalei iredalei</i>	Slender-billed Thornbill (western)	Vulnerable
<i>Calyptrorhynchus latirostris</i>	Carnaby's Black-Cockatoo	Endangered
<i>Leipoa ocellata</i>	Malleefowl	Vulnerable
Mammals		
<i>Dasyurus geoffroii</i> *	Chuditch, Western Quoll	Vulnerable
<i>Phascogale calura</i> *	Red-tailed Phascogale	Endangered

Migratory Terrestrial Species

Species Name	Common name	Status
Birds		
<i>Leipoa ocellata</i>	Malleefowl	Migratory
<i>Merops ornatus</i>	Rainbow Bee-eater	Migratory

Migratory Wetland Species

Species Name	Common name	Status
Birds		
<i>Ardea alba</i>	Great Egret, White Egret	Migratory
<i>Ardea ibis</i>	Cattle Egret	Migratory

Migratory Marine Species

Species Name	Common name	International Convention
Birds		
<i>Apus pacificus</i>	Fork-tailed Swift	CAMBA, JAMBA
<i>Ardea alba</i>	Great Egret, White Egret	CAMBA, JAMBA
<i>Ardea ibis</i>	Cattle Egret	CAMBA, JAMBA

Appendix 4

DEC Regulation 17 Permit

		DEPARTMENT OF CONSERVATION AND LAND MANAGEMENT	
Enquiries: 17 DICK PERRY AVE, KENSINGTON, WESTERN AUSTRALIA Telephone: 08 9334 0333 Facsimile: 08 9334 0242		Correspondence: Locked Bag 30 Bentley Delivery Centre WA 6983	
		PAGE 1 NO. SF005285	RECEIPT NO. AMOUNT \$0.00
WILDLIFE CONSERVATION ACT 1950 REGULATION 17			
LICENCE TO TAKE FAUNA FOR SCIENTIFIC PURPOSES			
THE UNDERMENTIONED PERSON MAY TAKE FAUNA FOR RESEARCH OR OTHER SCIENTIFIC PURPOSES AND WHERE AUTHORISED, KEEP IT IN CAPTIVITY, SUBJECT TO THE FOLLOWING AND ATTACHED CONDITIONS, WHICH MAY BE ADDED TO, SUSPENDED OR OTHERWISE VARIED AS CONSIDERED FIT.			
EXECUTIVE DIRECTOR			
CONDITIONS			
1 THE LICENSEE SHALL COMPLY WITH THE PROVISIONS OF THE WILDLIFE CONSERVATION ACT AND REGULATIONS AND ANY NOTICES IN FORCE UNDER THIS ACT AND REGULATIONS. 2 UNLESS SPECIFICALLY AUTHORISED IN THE CONDITIONS OF THIS LICENCE OR OTHERWISE IN WRITING BY THE EXECUTIVE DIRECTOR, SPECIES OF FAUNA DECLARED AS LIKELY TO BECOME EXTINCT, RARE OR OTHERWISE IN NEED OF SPECIAL PROTECTION SHALL NOT BE CAPTURED OR OTHERWISE TAKEN. 3 NO FAUNA SHALL BE TAKEN FROM ANY NATURE RESERVE, WILDLIFE SANCTUARY, NATIONAL PARK, MARINE PARK, TIMBER RESERVE OR STATE FOREST WITHOUT PRIOR WRITTEN APPROVAL OF THE EXECUTIVE DIRECTOR. NO FAUNA SHALL BE TAKEN FROM ANY OTHER PUBLIC LAND WITHOUT THE WRITTEN APPROVAL OF THE GOVERNMENT AUTHORITY MANAGING THAT LAND. 4 NO ENTRY OR COLLECTION OF FAUNA TO BE UNDERTAKEN ON ANY PRIVATE PROPERTY OR PASTORAL LEASE WITHOUT THE CONSENT IN WRITING OF THE OWNER OR OCCUPIER, OR FROM ANY ABORIGINAL RESERVE WITHOUT THE WRITTEN APPROVAL OF THE DEPARTMENT OF INDIGENOUS AFFAIRS. 5 NO FAUNA OR THEIR PROGENY SHALL BE RELEASED IN ANY AREA WHERE IT DOES NOT NATURALLY OCCUR, NOR HANDED OVER TO ANY OTHER PERSON OR AUTHORITY UNLESS APPROVED BY THE EXECUTIVE DIRECTOR, NOR SHALL THE REMAINS OF SUCH FAUNA BE DISPOSED OF IN SUCH MANNER AS TO CONFUSE THE NATURAL OR PRESENT DAY DISTRIBUTION OF THE SPECIES. 6 THIS LICENCE AND THE WRITTEN PERMISSION REFERRED TO AT CONDITIONS 3 & 4 MUST BE CARRIED BY THE LICENSEE OR AUTHORISED AGENT AT ALL TIMES FOR THE PURPOSE OF PROVING THEIR AUTHORITY TO TAKE FAUNA WHEN QUESTIONED AS TO THEIR RIGHT TO DO SO BY A WILDLIFE OFFICER, ANY OTHER STATE OR LOCAL GOVERNMENT EMPLOYEE OR ANY MEMBER OF THE PUBLIC. 7 *****ANY INTERACTION INVOLVING GAZETTED THREATENED FAUNA THAT MAY BE HARMFUL AND/OR INVASIVE MAY REQUIRE APPROVAL FROM THE COMMONWEALTH DEPARTMENT OF THE ENVIRONMENT AND HERITAGE, PHONE 02 6274 1900. INTERACTION WITH SUCH SPECIES IS CONTROLLED BY THE COMMONWEALTH GOVERNMENT'S "ENVIRONMENT PROTECTION AND BIODIVERSITY CONSERVATION ACT 1999" & "ENVIRONMENT PROTECTION AND BIODIVERSITY CONSERVATION REGULATIONS 2000" AS WELL AS CALM'S WILDLIFE CONSERVATION ACT & REGULATIONS ***** 8 NO BIOPROSPECTING INVOLVING THE REMOVAL OF SAMPLE AQUATIC AND TERRESTRIAL ORGANISMS (BOTH FLORA AND FAUNA) FOR CHEMICAL EXTRACTION AND BIOACTIVITY SCREENING IS PERMITTED TO BE CONDUCTED WITHOUT SPECIFIC WRITTEN APPROVAL BY THE EXECUTIVE DIRECTOR OF C.A.L.M. 9 FURTHER CONDITIONS (NUMBERED 1 TO 10) ARE ATTACHED.			
PURPOSE		FORESTANNIA FAUNA SURVEY FOR PROPOSED FLYING FOX NICKEL PROJECT.	
AUTHORISED PERSONS		GARTH HUMPHRIES, MIKE GREENHAM, ZOE HAMILTON, GREG HAROLD, DANIEL KAMIEN, ANGELA SANDERS.	

WILDLIFE CONSERVATION ACT 1950 WILDLIFE CONSERVATION REGULATIONS

Regulation 17:- Licence to Take Fauna for Scientific Purposes

FURTHER CONDITIONS (OF LICENCE NUMBER SF 5285)

1. The licensee shall ensure that all due care is taken in the capture and handling of fauna to prevent injury or mortality resulting from that capture or handling. Where traps or other mechanical means or devices are used to capture fauna these shall be inspected at regular intervals throughout each day of their use. At the conclusion of research all markers etc and signs erected by the licensee and all traps shall be removed, all pitfalls shall be refilled or capped and the study area returned to the condition it was in prior to the research/capture program. During any break in research, cage traps should be removed and pitfalls either removed, capped or filled with sand.
2. No collecting is to be undertaken in areas where it would impinge on pre-existing scientific research programs.
3. Any form of colour marking of birds or bats to be coordinated by the Australian Bird and Bat Banding Schemes.
4. Any inadvertently captured specimens of fauna which is declared as likely to become extinct, rare or otherwise in need of special protection is to be released immediately at the point of capture. Where such a specimen is injured or deceased, the licensee shall contact CALM licensing staff at Kensington (08 9334 0434) for advice on disposal. Records are to be kept of any fauna so captured and details included in the report required under further condition 6 below.
5. Prior to any renewal of this research licence the licensee shall submit a summary report outlining work conducted under this licence and work proposed for the next research period.
6. Within one month of the expiration of this licence (or at such other time or times as the Executive Director may determine) the holder shall furnish to the Executive Director [ATTENTION: WILDLIFE CLERK] a return setting out in full detail the number of each species of fauna taken during the currency of the licence, the localities where the species was/were taken and the method of handling of such fauna and disposal of specimens. A copy of any paper or report resulting from this research should be lodged in due course with the Executive Director. In the case of consultants, a list of the fauna handled, the localities involved and a copy of the interpretive data prepared should be lodged.
7. As a general rule not more than ten specimens of any one protected species shall be permanently taken from any location less than 20km apart. Where exceptional circumstances make it necessary to take large series in order to obtain adequate statistical data the collector will proceed with circumspection and justify their actions to the Executive Director in advance.
8. No fauna, whether dead or alive, may be taken out of Western Australia without the necessary export permit issued under the *Wildlife Conservation Act 1950*. It should be noted that the permit will not be issued unless the State to which the fauna is going has approved that fauna entering that State. In addition to the requirements of the Australian States, the Commonwealth controls exports overseas through Commonwealth legislation administered by the Australian Nature Conservation Agency.
9. All holotypes and syntypes and a half share of paratypes of species or subspecies permitted to be permanently taken under this licence shall be donated to the Western Australian Museum. Duplicates (one pair in each case) of any species collected which represents a significant extension of geographic range shall be donated on request to the Western Australian Museum.
10. To prevent any unnecessary collecting in this state, all specimens and material collected under the authority of this licence shall, on request, be loaned to the Western Australian Museum. Also, the unused portion or portions of any specimen collected under the authority of this licence shall be offered for donation to the Western Australian Museum or made available to other scientific workers if so required.

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Appendix 5

Annotated List – Herpetofauna Phases III and IV

MYOBATRACHIDAE**Bleating Froglet- *Crinia pseudinsignifera***

This species was recorded on one occasion during survey Phase III in heathland from pit-traps at site FR11.

Western Toadlet- *Pseudophryne occidentalis*

Recorded on 20 occasions from pit-traps at site FR03 during Phase IV. One specimen was lodged with the Western Australian Museum (lodgement number R166805).



Western Toadlet- *Pseudophryne occidentalis*

GEKKONIDAE**Clawless Gecko- *Crenodactylus ocellatus ocellatus***

Phase III – Recorded on three occasions at site FR05 in Salmon gum woodland.

Phase IV – Recorded on seven occasions across sites FR03, FR04 and FR09.

Western Stone Gecko- *Diplodactylus granieriensis*

Phase III – Recorded on two occasions from pit traps and opportunistically at sites FR04 and FR13.

Phase IV – Recorded on three occasions from a range of different habitats at sites FR05, FR07 and FR08.

Diplodactylus maini

Recorded solely during Phase IV on four occasions at sites FR04, FR06 and FR09.

Gehyra variegata

Recorded on a single occasion during Phase IV at Mallee site FR04.

Soft Spiny-tailed Gecko- *Strophurus spinigerus*

Recorded on two occasions during Phase III in Heath habitat at site FR08.

SCINCIDAE***Cryptoblepharus pagiocephalus***

Recorded on 13 occasions across five sites during Phase III only. This included captures in pit-traps in addition to opportunistic records at sites FR03, FR04, FR06 FR12 and FR13.

Ctenotus Schomburgkii

Phase III- Recorded two occasions from *Melaleuca* shrubland at site FR07.

Phase IV- Recorded on seven occasions in pit-traps at sites FR03 and FR06.

Bull Skink- *Egernia multiscutata*

Recorded on one occasion during Phase III at heath site FR09.

Lerista dorsalis

Recorded on a single occasion in heath habitat at site FR10.

Morethia obscura

Phase III- Recorded on five occasions in pit-traps and opportunistic sightings across three sites (FR04, FR05 and FR13).

Phase IV- Recorded once during Phase IV at site FR05.

Western Blue-tongue- *Tiliqua occipitalis*

Recorded on a single occasion in an Elliott trap during Phase IV at site FR04.

Bobtail Lizard- *Tiliqua rugosa*

Recorded during Phase IV on one occasion in an Elliott trap at site FR13.

AGAMIDAE**Crested Dragon- *Ctenophorus cristatus***

Recorded on three occasions from pit-traps and opportunistic sightings solely during Phase IV. This species was recorded in woodland habitat only (FR05 and FR06).

Spotted Military Dragon- *Ctenophorus maculatus*

Sited on a single occasion in heath habitat (FR10) during Phase IV.

Dwarf Bearded Dragon- *Pogona minor*

Recorded on three occasions during Phase III from pit-traps and Elliott traps at sites FR04, FR09 and FR13.

VARANIDAE**Gould's Goanna- *Varanus gouldii***

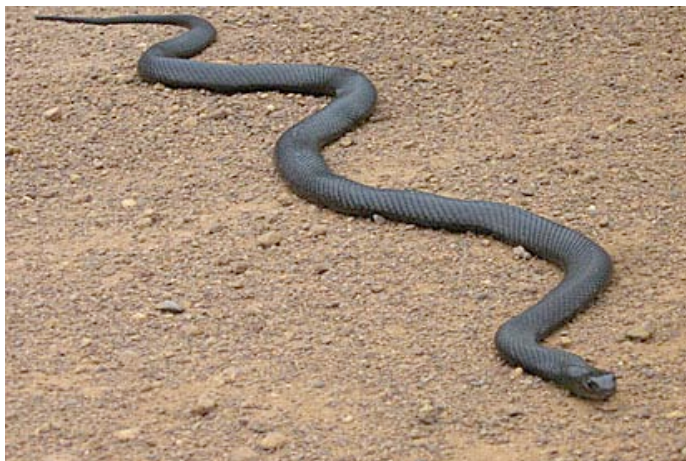
Recorded opportunistically on a single occasion during Phase IV only.

TYPHLOPIDAE**Southern Blind Snake- *Ramphotyphlops australis***

Recorded during Phase IV on three occasions from pit-traps at sites FR04, FR07 and FR08. One specimens were lodged with the Western Australian Museum (lodgement number R166806)

ELAPIDAE**Dugite- *Pseudonaja affinis***

Sighted on one occasion in heath habitat at site FR10 during Phase III only.



Dugite- *Pseudonaja affinis*

Gould's Hooded Snake- *Parasuta gouldii*

Recorded from pit-traps on two occasions during Phase III at sites FR06 and FR09.

Appendix 6

Annotated List – Avifauna Phases III and IV

CASUARIIDAE**Emu- *Dromaius novaehollandiae***

One individual was observed in tall heath habitat at site FR12 during survey Phase IV.

TURNICIDAE

Recorded on two occasions during Phase IV in heath habitat at sites FR09 and FR12.

ACCIPITRIDAE**Square-tailed Kite- *Hamirostra isura***

Recorded opportunistically on a single occasion during Phase IV.

Wedge-tailed Eagle- *Aquila audax*

Single birds were recorded in both Phases III and IV at site FR03 and FR09 respectively.

Collared Sparrowhawk- *Accipiter cirrocephalus*

One individual was recorded during Phase III only at woodland site FR05.

FALCONIDAE**Australian Kestrel- *Falco cenchroides***

Recorded on one occasion during Phase IV over heath habitat at site FR09.

Peregrine Falcon- *Falco peregrinus macropus*

Recorded on one occasion during Phase IV within woodland habitat at site FR05.

Brown Falcon- *Falco berigora*

Recorded on three occasions solely during Phase III at sites FR04 and FR05.

PSITTACIDAE**Purple-crowned Lorikeet- *Glossopsitta porphyrocephala***

Phase III- Recorded on 113 occasions within mallee and woodland habitat (FR03, FR04, FR05 and FR06).

Phase IV- Recorded on two occasions from shrubland and heath habitat at sites FR07 and FR09 respectively.

Elegant Parrot- *Neophema elegans*

Recorded on three occasions solely during the Phase IV survey (FR05 and FR09).

Western Rosella- *Platycercus icterotis xanthogeny*

Recorded on a single occasion during Phase IV at site FR05. This is a Schedule one species and is considered Vulnerable under the *Wildlife Conservation Act 1950-1979*.

Regent Parrot- *Polytelis anthopeplus*

Recorded on four occasions during Phase IV only at sites FR06, FR09 and opportunistically within the study area.

Australian Ringneck- *Platycercus zonarius*

Recorded 19 occasions solely during Phase III from mallee and woodland habitats (sites FR03, FR04, FR05 and FR06).

CACATUIDAE**Short-billed (Carnaby's) Black Cockatoo- *Calyptorhynchus latirostris***

Recorded on a single occasion opportunistically within the study area. This species is considered Endangered (Schedule 1) under the *Wildlife Conservation Act 1950-1979* and Endangered under the EPBC Act 1999.

COLUMBIDAE**Common Bronzewing- *Phaps chalcoptera***

Phase III- Recorded on a single occasion at site FR06.

Phase IV- Recorded on three occasions across three sites (FR07, FR09 and FR10).

Brush Bronzewing- *Phaps elegans*

Phase III- Recorded on one occasion during Phase III at site FR11.

Phase IV- Recorded on three occasions (sites FR06, FR09 and FR10).

CUCULIDAE

Fan-tailed Cuckoo- *Cacomantis flabelliformis*

Recorded on one occasion during Phase III at mallee site FR03.

Shining Bronze Cuckoo- *Chrysococcyx lucidus*

One individual was recorded during Phase III in woodland site FR05.

CAPRIMULGIDAE

Spotted Nightjar- *Eurostopodus argus*

Recorded on one occasion during Phase III at site FR11.

MALURIDAE

Blue-breasted Fairy-wren- *Malurus pulcherrimus*

Phase III- Recorded on 83 occasions across seven sites (FR03, FR04, FR08, FR09, FR10, FR11 and FR12).

Phase IV- Recorded on two occasions from sites FR09 and FR11.

Southern Emu-wren- *Stipiturus malachurus*

Phase III- Six individuals were recorded from heath habitat at site FR10.

Phase IV- a single recorded was noted from heath habitat at site FR11.

ACANTHIZIDAE

Broad-tailed Thornbill- *Acanthiza apicalis*

Phase III- this species was very abundant during Phase III with 63 recorded sighting across nine sites (FR04, FR05, FR06, FR07, FR08, FR09, FR10, FR11 and FR12).

Phase IV- Recorded on only five occasions across five sites (FR05, FR06, FR07, FR10 and FR11).

Yellow-rumped Thornbill- *Acanthiza chrysorrhoa*

Recorded on one occasion during Phase IV at woodland site FR05.

Chestnut-rumped Thornbill- *Acanthiza uropygialis*

Phase III- Four individuals were recorded from Mallee habitat at site FR04.

Phase IV- Recorded one a single occasion at site FR12.

Shy Groundwren- *Hylacola cauta*

.This species is listed as Priority 4 under the *Wildlife Conservation Act 1950-1979*.

Phase III- Recorded on 20 occasions from seven sites throughout the study area (FR03, FR04, FR06, FR08, FR10, FR11 and FR12).

Phase IV- Recorded on one occasion at site FR07.

Redthroat- *Pyrholaemus brunneus*

Phase III- Recorded on eight occasions across three sites within woodland and heath habitat (FR05, FR08 and FR09).

Phase IV- Recorded on two occasions from two sites (FR05 and FR08).

Western Gerygone- *Gerygone fusca fusca*

Phase III- Recorded on four occasions from woodland habitat at sites FR05 and FR06.

Phase IV- Recorded on three occasions from heath and mallee at sites FR03

Spotted pardalote- *Pardalotus punctatus*

Recorded on 12 occasions solely during Phase III in a variety of habitats at seven sites (FR03, FR04, FR05, FR06, FR07, FR08 and FR09).

Striated Pardalote- *Pardalotus striatus*

Recorded on 63 occasions solely during Phase III across a number of different habitats (FR03, FR04, FR05, FR06, FR07, FR08, FR09 and FR10).

Rufous Fieldwren- *Calamanthus campestris*

Recorded on six occasions solely during Phase III at heath site FR10.

Weebill- *Smicrornis brevirostris*

Very common species recorded during Phase III, but absent during the Phase IV survey.

Recorded on 184 occasions across all fauna sites (FR03 to FR12) during Phase III.

MELPHAGIDAE

Spiny-cheeked Honeyeater- *Acanthagenys rufogularis*

Phase III- Recorded on 11 occasions within heath, mallee and woodland habitat at sites FR03, FR04, FR06, FR10 and FR11.

Phase IV- Recorded on five occasions across five sites (FR06, FR08, FR09, FR11 and FR12).

Red Wattlebird- *Anthochaera carunculata*

Phase III- The most abundant bird species recorded during Phase III. Recorded on 345 occasions across eight sites within the study area (FR03, FR04, FR05, FR06, FR07, FR08, FR09 and FR12).

Phase IV- Recorded on seven occasions at sites FR03, FR04, FR06, FR09 and FR11).

Purple-gaped Honeyeater- *Lichenostomus cratitius*

Phase III- Recorded on 12 occasions across four sites (FR03, FR07, FR08, and FR09).

Phase IV- Recorded on a single occasion within heath habitat at site FR09.

White-eared Honeyeater- *Lichenostomus leucotis*

Phase III- Very abundant during Phase III with a total of 133 records across nine sites (FR03, FR04, FR05, FR06, FR07, FR08, FR09, FR10, and FR12).

Phase IV- Recorded on a single occasion from site FR03.

Singing Honeyeater- *Lichenostomus virescens*

Phase III- Abundant during Phase III, recorded on 118 occasions predominantly in woodland habitat (FR05 and FR06), but also at sites FR03, FR11 and FR12.

Phase IV- Recorded on one occasion at site FR11.

Grey-fronted Honeyeater- *Lichenostomus plumulus*

Recorded on a single occasions during Phase III at woodland site FR05.

Yellow-plumed Honeyeater- *Lichenostomus ornatus*

Recorded on 21 occasions solely during Phase III within woodland habitat (FR05 and FR06).

Brown Honeyeater- *Lichmera indistincta*

Phase I- Recorded on 16 occasions across three sites within the study area (FR03, FR04 and FR10).

Phase IV- Recorded on nine occasions from seven sites within the study area (FR03, FR04, FR05, FR07, FR09, FR11 and FR12).

Brown-headed Honeyeater- *Melithreptus brevirostris*

Recorded on 12 occasions solely from woodland site FR06 during Phase III.

White-fronted Honeyeater- *Phylidonyris albigularis*

Phase III- Recorded on 18 occasions from woodland habitat at site FR05.

Phase IV- Recorded on three occasions at sites FR03, FR08 and FR09.

Tawny-crowned Honeyeater- *Phylidonyris melanops*

Phase III- Abundant during Phase III with 111 records from all sites within the study area.

Phase IV- Recorded on six occasions from heath habitat at sites FR08, FR10 and FR12.

White-cheeked Honeyeater *Phylidonyris nigra*

Phase III- Recorded on three occasions from heath habitat at site FR10.

Phase IV- Recorded on 20 occasions at sites FR03, FR04, FR07, FR08 and FR12.

CINCLOSOMATIDAE**Chestnut Quail-thrush- *Cinclosoma castanotus***

Recorded on two occasions solely during Phase III at woodland site FR05.

POMATOSTOMIDAE**White-browed Babbler- *Pomatostomus superciliosus***

Recorded on one occasion during Phase IV in woodland habitat at site DR05. Listed as Priority 4 under the *Wildlife Conservation Act 1950-1979*.

PETROICIDAE**Jacky Winter- *Microeca fascians assimilis***

Phase III- Recorded on two occasions in woodland habitat at site FR06.

Phase IV- Recorded on three occasions in mallee and woodland habitat at sites FR03 and FR05 respectively.

Western Yellow Robin- *Eopsaltria australis*

Phase III- Recorded on three occasions at site FR03 and FR06.

Phase IV- Recorded on two occasions at woodland sites FR05 and FR06.

Hooded Robin- *Petroica cucullata*

Recorded on two occasions solely from Phase III within heath habitat at site FR11.

Southern Scrub-robin- *Drymodes brunneopygia*

Recorded on six occasions during Phase III only (sites FR03, FR10 and FR12).

PACHYCEPHALIDAE**Crested Bellbird- *Oreoica gutturalis gutturalis***

Phase III- Recorded on nine occasions at sites FR03, FR04, FR05, FR08, FR11 and FR12.

Phase IV- Recorded on six occasions at sites FR03, FR04, FR05, FR08, FR11 and FR12.

Oreoica gutturalis gutturalis (southern sub-species) is listed as Priority 4 under the *Wildlife Conservation Act 1950-1979*.

Golden Whistler- *Pachycephala pectoralis*

Phase III- Recorded on a single occasion within woodland habitat at site FR05.

Phase IV- Recorded on a single occasion within woodland habitat at site FR05.

Grey Shrike-thrush- *Colluricincla harmonica*

Recorded solely during Phase III on eight occasions from sites FR03, FR04, FR05 and FR06.

DICRURIDAE

Willie Wagtail- *Rhipidura leucophrys*

Phase III- Recorded on seven occasions at sites FR05 and FR10.

Phase IV- Recorded on one occasion at site FR10.

CAMPEPHAGIDAE

Black-faced Cuckoo-shrike- *Coracina novaehollandiae*

Phase III- Recorded on 17 occasions across six sites representing heath, mallee and woodland habitats (FR03, FR04, FR05, FR06, FR08 and FR09).

Phase IV- Recorded on five occasions from heath habitat at sites (FR07, FR08 and FR11).

ARTAMIDAE

Black-faced Woodswallow- *Artamus cinereus melanops*

Recorded on a single occasion within woodland habitat at site FR05.

CRACTICIDAE

Grey Butcherbird- *Cracticus torquatus*

Phase III- Recorded on six occasions from site FR03 and FR05.

Phase IV- Recorded on a single occasion from site FR06.

Pied Butcherbird- *Cracticus nigrogularis*

Recorded on a single occasion during Phase III from woodland habitat at site FR05.

Australian Magpie- *Cracticus tibicen*

Recorded on a single occasion during Phase III from heath habitat at site FR09.

Grey Currawong- *Strepera versicolor plumbea*

Phase III- Recorded on 15 occasions from sites FR03, FR04, FR05, FR06 and FR12.

Phase IV- Recorded on one occasion at site FR11.

CORVIDAE

Australian Raven- *Corvus coronoides*

Phase III- Recorded on 14 occasions across seven sites (FR03, FR04, FR06, FR08, FR09, FR10 and FR11).

Phase IV- Recorded on five occasions at sites FR04, FR05, FR10 and FR12.

Appendix 7

Annotated List – Mammals Phases III and IV

DASYURIDAE

Western Quoll (Chudich)- *Dasyurus geoffroii*

Federally listed as 'Vulnerable' under the EPBC Act. It is also listed as a Schedule 1 taxon under the state *Wildlife Conservation Act* (i.e. fauna that is rare or likely to become extinct).

Phase III- A single adult female was recorded in a cage trap at site FR13.

Phase IV- A single sub-adult female was captured twice in cage traps at site FR13. Examination of the pouch revealed that this individual had not mated and is likely to be less than one year old. Given this fact it likely that the quoll recorded during Phase IV is a different individual to that recorded during Phase III.

Gilbert's Dunnart- *Sminthopsis gilberti*

Recorded solely during Phase IV on one occasion from pit-traps within mallee habitat at site FR04.

White-tailed Dunnart- *Sminthopsis granulipes*

Phase III- Very abundant during Phase III. Recorded from pit-traps on 21 occasions solely from heath habitat at sites FR08, FR09, FR10, FR11 and FR12.

Phase IV- Also abundant during Phase IV. Recorded on 17 occasions from pit-traps solely from heath habitat at sites FR08, FR09, FR10, FR11 and FR12.

BURRAMYIDAE

Western Pygmy possum- *Cercartetus concinnus*

Phase III- Abundant during Phase III. Recorded on 18 occasions in pit-traps from a variety of habitats (FR03, FR04, FR05, FR06, FR08, FR09 and FR10).

Phase IV- Also abundant during Phase IV. Recorded on 20 occasions in pit-traps from a variety of habitats (FR03, FR04, FR06, FR07, FR08, FR09 and FR11).



Western Pygmy Possum- *Cercartetus concinnus*

TARSIPEDIDAE

Honey Possum- *Tarsipes rostratus*

Recorded on one occasion solely during Phase III from pit-traps at heath site FR10.

MACROPIDAE

Western Grey Kangaroo- *Macropus fuliginosus*

Phase III- observed on two occasions at sites FR04 and FR12.

Phase IV- observed on two occasions at site FR10.

Western Brush Wallaby- *Macropus irma*

Tracks were observed during Phase III at sites FR10 and FR11. This species is listed as Priority 4 under the State Wildlife Conservation Act 1950-1979.

VESPERTILIONIDAE**Gould's Wattled Bat- *Chalinolobus gouldii***

Identified during Phase IV solely by call characteristics within woodland habitat at site FR05 and FRbat.

Chocolate Wattled Bat- *Chalinolobus morio*

Identified during Phase IV solely by call characteristics at woodland site FR05 and FRbat.

Southern Forest Bat- *Vespadelus regulus*

Identified during Phase IV solely by call characteristics within woodland habitat at site FR05 and FRbat.

Lesser Long-eared Bat- *Nyctophilus geoffroyi*

Identified during Phase IV solely by call characteristics at site FR05 and FRbat.

MOLOSSIDAE**Inland Freetail Bat- *Mormopterus planiceps***

Identified during Phase IV solely by call characteristics within woodland habitat at site FR05 and FRbat.

White-striped Freetail Bat- *Tadarida australis*

Identified during Phase IV solely by call characteristics at site FR05 and FRbat.

MURIDAE**House Mouse- *Mus musculus***

Phase III- Recorded on a single occasion from pit-traps within mallee habitat at site FR03.

Phase IV- Recorded on 14 occasions from pit-traps at sites FR07, FR08, FR10, FR11 and from Elliott traps at FR13.

Mitchell's Hopping Mouse- *Notomys mitchelli*

Phase III- Recorded on 31 occasions from pit-traps, Elliott traps and cage traps within heath habitat at sites (FR07, FR08, FR09, FR12, FR13 and FRC)

Phase IV- Recorded on five occasions from pit-traps and Elliott traps within heath habitat at sites FR07, FR08 and FR13.

CANIDAE**Dog- *Canis Lupis***

Recorded on five occasions within heath habitat via identification of tracks during Phase III (sites FR07, FR08 and FR10).

FELIDAE**House Cat- *Felis Catus***

Recorded on two occasions during Phase III from tracks and scats at sites FR03 and FR12

LEPORIDAE**European Rabbit- *Oryctolagus cuniculus***

Phase III- Recorded on three occasions from scats, tracks and diggings at sites FR07, FR11 and FR13 respectively.

Phase IV- Recorded on one occasions from a cage trap at site FR13.

Appendix 8

Bat Call Identification-
Dr Kyle Armstrong

MOLHAR PTY LTD
Applying DNA technology

Kyle Armstrong PhD
MOLHAR PTY LTD ABN 46 117 824 629
WA State Agricultural Biotechnology Centre (SABC),
Murdoch University. Send post to:
46A Cale Street, Como, Western Australia 6152.
Mobile: 0404-423-264, Home off. 08 9450 6852
EMAIL kyle.n.armstrong@gmail.com

6/3/07, 3 pages, via email

Dan Kamien
Biota Environmental Sciences Pty Ltd
PO Box 176,
North Perth, WA 6906.

Bat call identification verification from the Forrestiana survey

Thank you for seeking my advice concerning your bat call identifications from Forrestiana, near Hyden. This letter provides verification of bat species identification from Anabat echolocation call recordings.

As discussed, I have examined your IDs as provided in the six TIFF files, and have gone through the folder of Anabat sequences provided by email to check that all species recorded have been noted. The details are provided next page.

Yours sincerely,
Via email
Kyle Armstrong PhD
Director, Zoologist

Methods. Anabat sequences were examined in AnalookW for Windows (URL: <http://www.hoarybat.com>). One additional species was identified, and representative call sequences were imported into the software Analyze (Jolly 1997) where three call variables were measured: pulse duration, maximum frequency and end frequency.

Results. The five species you identified were all correct. Notes are provided in Table 1. In addition to these were several examples from a long-eared bat *Nyctophilus* sp. The species in this genus are unable to be identified with certainty from Anabat sequences, however it is most likely to be the lesser long-eared bat *Nyctophilus geoffroyi*. Measurements from 11 representative call sequences are provided in Table 2. Two examples are given in Figure 1. These calls are very similar to attack and pre-capture pulses produced by *Vespadelus regulus*, but can be distinguished in some cases by call shape.

TABLE 1. Identification verifications from the provided TIFF files.

Filename	Comment
GB252205 V.regulus.TIF	Correct ID
GB262229 M. planiceps.TIF	Correct ID, note that the name should be south-western free-tailed bat <i>Mormopterus</i> sp. 4 (<i>sensu</i> Armstrong and Reardon 2006).
GB262230 C.gouldii.TIF	Correct ID
GB270022 T.australis.TIF	Correct ID
GB270222 C.morio.TIF	Correct ID
GB270308 C.gouldii.TIF	Ambiguous sequence, might also be <i>Mormopterus</i> sp. 4. Use file GB262230 C.gouldii.TIF as a representative sequence.

TABLE 2. Variables from 11 representative call sequences (each cell the mean of several pulses).

File	Duration (ms)	Max Frequency (kHz)	End frequency (kHz)
GB270108.56#	2.3	74.7	51.8
GB270109.12#	0.9	81.1	55.5
GB270318.03#	2.0	69.6	51.9
GB270325.58#	2.2	71.5	45.5
GB270326.10#	2.1	66.9	45.4
GB270349.35#	2.0	71.5	46.2
GB270409.23#	2.0	67.0	45.6
GB270446.28#	1.8	68.6	46.4
GB270451.20#	1.8	67.0	42.7
GB270509.00#	1.8	71.9	50.9
GB270516.05#	1.9	70.4	45.8
Mean $\pm$ SD	1.9 $\pm$ 0.4	70.9 $\pm$ 4.2	48.0 $\pm$ 3.9
Minimum – Maximum	0.9 – 2.3	66.9 – 81.1	42.7 – 55.5

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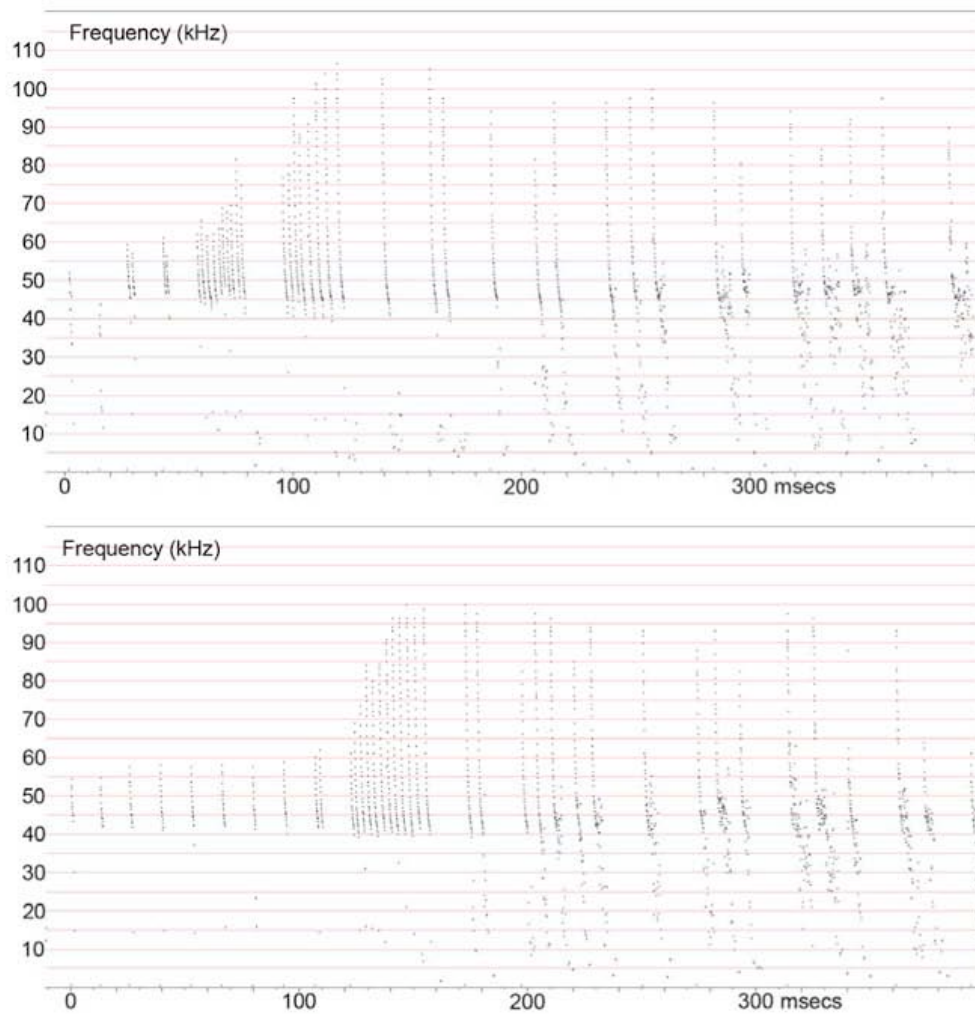


FIGURE 1. Two representative call sequences attributed to a species of long-eared bat, *Nyctophilus* sp.

REFERENCES

Jolly, S. 1997. Analysis of Anabat files. *The Australasian Bat Society Newsletter* 9: 25–27.

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Appendix 9

Herpetofauna Records Phases I and II, 2005

Family	FR03		FR04		FR05		FR06		FR07		FR08		FR09		FR10		FR11		FR12		FR13		FR14		FRC		Total	
Species name	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2
Scincidae																												
<i>Cryptoblepharus plagiocephalus</i>	-	-	-	1	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	2	2
<i>Ctenotus impar</i>	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	4	-
<i>Ctenotus schomburgkii</i>	-	1	-	-	-	-	-	-	3	-	1	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	4	2
<i>Egernia richardi</i>	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	2	2
<i>Hemiergis initialis</i>	-	-	-	-	4	1	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-	-	-	-	-	5	2
<i>Lerista picturata</i>	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Morethia obscura</i>	-	-	-	1	2	4	1	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1	-	-	-	5	5
<i>Tiliqua rugosa</i>	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
Agamidae																												
<i>Ctenophorus cristatus</i>	-	-	-	-	2	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	4	2
<i>Ctenophorus maculatus</i>	-	-	-	1	-	-	1	-	1	-	-	1	1	2	-	-	-	-	1	-	-	-	-	1	-	1	4	6
<i>Moloch horridus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	1	1	-	-	-	-	-	-	-	2	2
<i>Pogona minor</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	1	-	-	-	1	-	-	-	-	-	4
<i>Rankinia adelaidensis</i>	-	1	-	-	-	-	-	-	-	-	-	1	-	-	-	4	-	3	-	-	-	-	-	-	-	-	-	9
Gekkonidae																												
<i>Crenadactylus ocellatus</i>	4	2	-	-	6	1	-	2	1	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	11	6
<i>Diplodactylus granariensis</i>	-	1	-	-	1	2	1	5	1	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	3	9
<i>Diplodactylus maini</i>	-	-	-	-	1	8	4	11	-	-	-	1	1	2	-	5	-	-	-	-	-	-	-	-	-	-	6	27
<i>Diplodactylus pulcher</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	2
<i>Gehyra variegata</i>	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
<i>Oedura reticulata</i>	-	-	-	-	1	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	1
Pygopodidae																												
<i>Delma australis</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1	-
<i>Delma fraseri</i>	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1	1
<i>Lialis burtonis</i>	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	2
<i>Pygopus lepidopodus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1
Lacertidae																												
<i>Parasuta gouldii</i>	1	-	-	-	2	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	-
<i>Parasuta nigriceps</i>	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
<i>Pseudonaja affinis</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	1	-	-	-	-	-	-	3	-
<i>Simoselaps bertholdi</i>	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
Typhlopidae																												
<i>Ramphotyphlops australis</i>	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Number of individuals	7	6	1	3	19	21	10	24	8	0	2	3	2	8	2	11	4	7	4	3	1	1	4	3	0	1	66	91
Number of species	4	5	1	3	8	9	6	7	6	0	2	3	2	5	2	4	2	5	3	3	1	1	4	3	0	1	19	22
Number of species both phases	8		4		10		12		6		5		5		7		6		5		2		6		1		28	

Appendix 10

Avifauna Records Phases I and
II, 2005

Family		FR03		FR04		FR05		FR06		FR07		FR08		FR09		FR10		FR11		FR12		opp		Total	
Species name	Common name	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2
Acanthizidae																									
<i>Acanthiza apicalis</i>	Broad-tailed Thornbill	3	1	6	1	6	–	3	–	14	2	8	2	8	–	7	–	12	–	1	–	–	–	68	6
<i>Pyrrholaemus brunneus</i>	Redthroat	3	2	–	–	2	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	6	2
<i>Hylacola cauta</i>	Shy Groundwren	–	–	4	2	–	–	–	–	–	3	2	–	–	–	–	–	–	2	–	–	–	–	6	7
<i>Smicromis brevirostris</i>	Weebill	25	–	4	–	6	–	27	–	15	2	15	–	1	–	4	–	13	–	4	–	–	–	123	2
<i>Acanthiza chrysorrhoa</i>	Yellow-rumped Thornbill	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–
Accipitridae																									
<i>Hamirostra isura</i>	Square-tailed Kite	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	1
<i>Accipiter cirrhocephalus</i>	Collared Sparrowhawk	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–
<i>Aquila audax</i>	Wedge-tailed Eagle	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–
Aegothelidae																									
<i>Aegotheles cristatus</i>	Australian Owlet-Nightjar	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–
Artamidae																									
<i>Artamus cinereus</i>	Black-faced Woodswallow	–	–	–	1	–	–	–	–	4	–	–	–	–	–	–	–	–	–	–	–	–	–	4	1
<i>Artamus cyanopterus</i>	Dusky Woodswallow	–	–	32	–	3	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	35	1
Campephagidae																									
<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-Shrike	–	–	2	–	–	–	–	–	–	2	–	–	–	–	–	–	1	–	–	–	–	1	3	3
<i>Lalage suerii</i>	White-winged Triller	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	1
Casuariidae																									
<i>Dromaius novaehollandiae</i>	Emu	–	–	–	1	–	–	–	–	–	–	–	–	1	–	–	–	–	–	1	–	–	–	2	1
Cinclosomatidae																									
<i>Cinclosoma castanotus</i>	Chestnut Quail-Thrush	–	–	1	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	–
Climacteridae																									
<i>Climacteris rufa</i>	Rufous Treecreeper	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	1
Columbidae																									
<i>Phaps chalcoptera</i>	Common Bronzewing	–	1	1	–	–	3	–	1	–	–	–	2	–	1	–	1	–	1	–	–	–	–	1	10
<i>Phaps elegans</i>	Brush Bronzewing	–	–	–	–	2	–	–	–	–	–	–	–	3	–	–	–	1	–	1	–	–	–	7	–
Corvidae																									
<i>Corvus coronoides</i>	Australian Raven	–	–	–	–	–	–	1	–	–	1	–	–	–	–	1	1	–	–	–	–	–	1	2	3
Cracticidae																									
<i>Gymnorhina tibicen</i>	Australian Magpie	2	–	2	–	–	1	–	–	–	–	–	–	2	–	–	–	–	–	–	–	–	–	6	1
<i>Cracticus torquatus</i>	Grey Butcherbird	5	1	2	–	1	–	2	2	1	1	1	–	1	2	–	–	1	–	2	–	–	–	16	6
<i>Strepera versicolor</i>	Grey Currawong	–	–	–	1	–	–	3	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	4	1
<i>Cracticus nigrogularis</i>	Pied Butcherbird	–	–	–	–	–	–	–	1	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	2
Dicruridae																									
<i>Rhipidura leucophrys</i>	Willie Wagtail	–	–	1	–	2	1	2	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	6	1
<i>Rhipidura fuliginosa</i>	Grey Fantail	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–
Falconidae																									

Family		FR03		FR04		FR05		FR06		FR07		FR08		FR09		FR10		FR11		FR12		opp		Total	
Species name	Common name	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2
<i>Falco cenchroides</i>	Australian Kestrel	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1
<i>Falco berigora</i>	Brown Falcon	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
Hirundinidae																									
<i>Hirundo nigricans</i>	Tree Martin	2	-	-	-	60	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	50	62	50
Maluridae																									
<i>Malurus pulcherimus</i>	Blue-breasted Fairy-wren	-	1	5	-	1	-	2	-	-	-	-	-	3	1	-	-	7	-	6	-	-	-	33	2
<i>Stipiturus malachurus</i>	Southern Emu-Wren	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	8	-	2	-	-	-	13	-
Meliphagidae																									
<i>Lichmera indistincta</i>	Brown Honeyeater	2	-	6	-	18	1	4	-	5	14	1	-	-	6	-	7	31	2	1	1	-	-	68	49
<i>Anthochaera carunculata</i>	Red Wattlebird	8	5	6	5	1	22	1	11	3	7	-	7	1	3	-	-	-	3	-	-	-	-	29	63
<i>Lichenostomus virescens</i>	Singing Honeyeater	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	1	-	-	2	1
<i>Acanthagenys rufogularis</i>	Spiny-cheeked Honeyeater	-	-	-	-	1	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	2
<i>Phylidonyris melanops</i>	Tawny-crowned Honeyeater	4	-	1	-	-	4	-	-	1	-	-	2	-	2	2	6	8	14	2	1	-	-	18	29
<i>Lichenostomus leucotis</i>	White-eared Honeyeater	1	1	12	2	5	-	9	1	6	-	6	-	4	1	5	-	6	-	6	-	-	-	69	5
<i>Phylidonyris albifrons</i>	White-fronted Honeyeater	1	-	1	-	-	1	-	-	1	-	-	-	-	-	-	-	1	-	-	-	-	-	4	1
<i>Lichenostomus ornatus</i>	Yellow-plumed Honeyeater	1	-	2	-	25	4	2	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	31	4
<i>Lichenostomus cratitius</i>	Purple-gaped Honeyeater	-	-	4	-	2	-	-	-	2	-	3	-	-	-	-	-	-	-	-	-	-	-	11	-
<i>Melithreptus brevirostris</i>	Brown-headed Honeyeater	-	-	-	-	15	-	23	-	11	-	-	-	-	-	-	-	-	-	-	-	-	-	49	-
<i>Manorina flavigula</i>	Yellow-throated Miner	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-
Meropidae																									
<i>Merops ornatus</i>	Rainbow Bee-eater	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	2
Pachycephalidae																									
<i>Oreoica gutturalis</i>	Crested Bellbird	1	-	1	-	-	1	1	-	-	-	-	-	1	2	-	-	-	-	-	-	-	-	4	3
<i>Pachycephala pectoralis</i>	Golden Whistler	-	-	-	-	3	-	1	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	5	1
<i>Colluricincla harmonica</i>	Grey Shrike-Thrush	2	-	2	-	2	-	-	-	1	-	-	-	-	-	-	-	-	-	1	-	-	-	8	-
Pardalotidae																									
<i>Pardalotus punctatus</i>	Spotted Pardalote	9	-	5	-	4	-	1	-	1	-	-	-	-	-	-	3	-	-	-	-	-	-	29	3
<i>Pardalotus striatus</i>	Striated Pardalote	6	2	5	3	15	5	7	2	1	-	-	-	-	-	-	-	2	-	-	-	-	-	36	12
Petroicidae																									
<i>Microeca fascians</i>	Jacky Winter	-	-	-	-	-	1	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	1
<i>Eopsaltria griseogularis</i>	Western Yellow Robin	-	-	-	-	1	-	4	-	2	-	1	-	-	-	-	-	-	-	-	-	-	-	8	-
<i>Drymodes brunneopygia</i>	Southern Scrub-Robin	-	-	-	-	-	-	-	-	2	-	1	-	-	-	1	-	1	-	-	-	-	-	5	-
Podargidae																									
<i>Podargus strigoides</i>	Tawny Frogmouth	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1
Pomatostomidae																									
<i>Pomatostomus superciliosus</i>	White-browed Babbler	-	-	-	-	6	6	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	10	6
Psittacidae																									
<i>Platycercus zonarius</i>	Australian Ringneck	3	-	3	-	2	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9	3
<i>Calyptrorhynchus latirostris</i>	Carnaby's Cockatoo	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	-	-	-	-	6

Family		FR03		FR04		FR05		FR06		FR07		FR08		FR09		FR10		FR11		FR12		opp		Total	
Species name	Common name	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2
<i>Neophema elegans</i>	Elegant Parrot	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Cacatua roseicapilla</i>	Galah	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Polytelis anthopeplus</i>	Regent Parrot	-	-	-	-	-	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8
<i>Platycercus icterotis</i>	Western Rosella	-	-	-	-	7	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	8	1
<i>Glossopsitta porphyrocephala</i>	Purple crowned Lorikeet	27	-	48	-	47	-	1	-	6	-	19	-	43	-	149	-	2	-	72	-	-	-	414	-
Zosteropidae																									
<i>Zosterops lateralis</i>	Silveryeye	-	-	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Number of individuals	115	14	157	16	264	74	111	22	84	32	57	13	78	20	172	18	94	23	104	19	0	107	1224	368
	Number of species	19	9	25	8	29	18	22	9	22	8	10	4	11	10	8	5	14	6	12	5	0	6	48	44
	Number of species both	21		27		33		26		25		13		16		11		18		17		7		60	

Appendix 11

Mammal Records Phases I and II, 2005

Family		FR03		FR04		FR05		FR06		FR07		FR08		FR09		FR10		FR11		FR12		FR13		FRC		Opp		Total		
Species name	Common name	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P1	P2	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	
Burramyidae																														
Cercartetus concinnus	Western Pygmy Possum	1	1	5	7	–	2	4	2	–	2	–	–	4	–	3	–	–	2	–	2	–	–	–	–	–	–	–	17	18
Dasyuridae																														
Dasyurus geoffroii	Western Quoll	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	1	
Sminthopsis gilberti	Gilbert's Dunnart	1	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	1	
Sminthopsis granulipes	White-tailed Dunnart	–	–	–	3	–	–	–	3	–	4	1	10	4	6	9	18	3	8	1	3	–	1	–	–	–	–	18	53	
Sminthopsis griseoventer	Grey-bellied Dunnart	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	
Felidae																														
Felis catus*	House Cat	1	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	1	
Leporidae																														
Oryctolagus cuniculus*	European Rabbit	–	–	–	–	–	1	1	–	–	–	–	1	–	–	–	–	–	–	1	–	–	–	–	–	–	–	2	2	
Macropodidae																														
Macropus fuliginosus	Western Grey Kangaroo	–	–	–	–	–	–	–	1	2	–	–	2	2		–	4	1	–	3	1	–	–	–	–	–	–	8	8	
Macropus irma	Western Brush Wallaby	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	1	
Muridae																														
Mus musculus*	House Mouse	3	–	3	–	2	–	–	2	1	1	4	–	2	–	3	–	3	1	3	2	8	–	3	–	–	–	35	6	
Notomys mitchellii	Mitchell's Hopping Mouse	–	1	–	–	–	–	–	–	–	2	–	2	–	–		1	–	2	–	2	–	7	–	–	–	–	–	17	
Pseudomys albocinereus	Ash-grey Mouse	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	1	–	–	–	–	–	–	–	–	–	2	1		
Tarsipedidae																														
Tarsipes rostratus	Honey Possum	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	–	–	–	–	–	–	–	–	–	–	–	2	–	
Vespertilionidae																														
Chalinolobus gouldii	Gould's Wattled Bat	–	–	–	–	–	C	–	C	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	3	
Chalinolobus morio	Chocolate Wattled Bat	–	–	–	–	–	C	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	
Vespadelus sp.	Forest Bat sp.	–	–	–	–	–	C	–	C	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	
Molossidae																														
Tadarida australis	White striped Freetail Bat	–	–	–	–	–	C	C	C	–	–	–	–	–	–	–	–	–	C	–	–	–	–	–	–	–	–	2	2	
Mormopterus planiceps	Inland Freetail Bat	–	–	–	–	–	C	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	
	Number of individuals	6	2	8	11	2	8	6	12	3	9	5	16	12	7	19	24	7	13	8	10	8	9	3	–	–	1	88	111	
	Number of species	4	2	2	3	1	7	3	8	2	4	2	5	4	2	5	4	3	4	5	5	1	3	1	–	–	1	10	17	

* Denotes introduced species.

C Denotes calls.

T Denotes tracks