239000.000000 240000.000000 241000.000000 242000.000000

6272000.000000 6271000.000000 6270000.000000 6269000.000000 6268000.000000

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Figure 4-4: Low Woodland Mallee and Heath Fauna Habitat

Legend

- Other habitat
- Low woodland and mallee heath habitat
- *Ravensthorpe Gold/Copper Project Tenements*

Date: 12/12/2016

Scale: 1:10,000

N

0 0.45 0.9

Kilometres

ACH

APM ANIMAL PLANT MINERAL

ems@animalplantmineral.com.au

GDA 1994 MGA Zone 51

\\MAINSERVER-PC\server-storage\APM GIS and Mapping\03_Client\ACH\02_GIS Maps\20161212_ACH_Kundip Gold Project_Fig 4-4 Bio Report.mxd

5 DISCUSSION AND CONCLUSION

The RGCP is not a new proposal. Originally proposed as the Phillips River Gold Project (PRGP), the Project was referred to the Federal Department of Environment (DoE) for assessment in 2005 where it was determined to be "Not a Controlled Action". The Project was also assessed by the Minister for Environment who approved the Project (Ministerial Statement (MS) 0716) under the EP Act 1986.

The Kundip Project impact footprint is located within mining leases on crown land within what is known as the Ravensthorpe-Kundip copper-gold belt. This belt stretches 20 km in a north-south direction from just north of Ravensthorpe to south of the historic town of Kundip. The Kundip Project area is at the southern end of the belt where there is significant historical disturbance legacy from small operations that commenced in the early 1900s. The number of mine shafts around the Kundip Project area is beyond count and all but a few are of concern having been left open without safety exclusion fencing by the previous tenement holders. Conversely, Myamba represents a uniform area of cleared pasture with little, if any, flora and fauna habitat value.

In the early 1900s much of the original vegetation at the Kundip Mine Site was cleared, with larger trees being felled and used for bracing mine shafts and the construction of gantries. Tall hollow bearing eucalypt and Corymbia species, which would have provided essential nesting and roosting habitat for a number of arboreal and semi arboreal non-volant (non-flying) species and a number of predatory volant species, are all but absent. The current over-story vegetation does not accurately reflect the vegetation that would have been present had these small scale mining operations not proliferated. There is little doubt that this major shift in vegetation attributes would have had a major impact on the faunal assemblages. In addition to the changes in vegetation structure, the small scale mines of the early and mid-1900s and the subsequent larger scale activities in more recent times has resulted in the clearing of approximately 30 ha within the Kundip Project area.

Nevertheless, the area still has intrinsic value to both vegetation and its associated fauna assemblages and is a significant area of remnant vegetation. The current survey showed that the small patch (<1 ha) of remnant vegetation between Kaolin Pit, Western Gem Pit and the Tailings Storage Facility continues to support a diverse array of mammals and reptiles. The innumerable mine shafts distributed across the site provide refuge for species such as the Chuditch and small Microchiropteran bats which would, under normal circumstances, take refuge in standing and fallen hollow limbs (or refugia offered by granite inselbergs).

Refugia are priority habitats for biodiversity conservation, due to their unique ecological and biological attributes (Keppel et al. 2012). They have led to development of unique evolutionary units, function to preserve habitats and potentially lend themselves as mode of protection to biota under periods of stress, to survive in, and to spread out under more benign conditions (Keppel et al. 2012). It is recommended, whilst not occurring in disturbance areas, that these refugial vegetation types are identified and surveyed over the life of the mine for both flora and fauna. These provide a good opportunity as research and preservation units under long term mining activities.

Current local and regional environmental values

The Kundip Mine Site is situated in the foothills of the Ravensthorpe Range approximately 0.4-1 km north of the Kundip Nature Reserve (Reserve No. 31128). Large tracts of uncleared remnant bush surround the Kundip Mine Site and these are targeted for incorporation into the proposed Ravensthorpe Range Nature Reserve.

The site occurs on the periphery of the Fitzgerald Biosphere and one of 15 biodiversity hotspots in Australia, where the most valuable ecological attributes are protected within the Fitzgerald River National Park (FRNP). Radiating out from the FRNP, the peripheral areas of the biosphere are zones of co-operation, where development can take place in an ecologically sensitive manner. The intent is that development does not

constrain or inhibit the radiation or movement of local fauna species many of which have become threatened by fragmentation, land clearing, increased feral predation and competition from non-native species.

There is no capacity for the Kundip Mine Site to impact on local and regional flora and fauna values beyond the direct impacts of clearing for construction and operation. The activities forecast for Kundip will not constrain or inhibit the movement or radiation of species around the project area where they are free to radiate in large tracts of undisturbed vegetation.

The Myamba Mine Site is situated approximately 1.5 km south of the Kundip Nature Reserve and is located on land cleared for agricultural use. Consequently, there are no flora or fauna assemblages proposed for disturbance.

The RGCP Project will not degrade the local and regional fauna conservation values.

Future local environmental values

The Kundip Project is not likely to have significant impact on site specific flora, vegetation and fauna values and the proposal to recommence mining presents a unique opportunity to improve conservation and land management through the implementation of mining and mine site related environmental management practices, such as feral fauna, fire and weed management and the management of land access to the proposed conservation reserve to the east of the Project area.

To date, very limited resources have been invested in fauna conservation by government and non-government entities, as evidenced by the number of key threatened species known to occur but not recently recorded and reported. For instance, records of the Chuditch *Dasyurus geoffroii* are sporadic across the region and most are more than two decades old, however, the species is known to occur at Kundip and was recorded during the most recent fauna survey of the Project area which was undertaken as part of this environmental assessment.

Local environmental values will be improved through collaboration between ACH Minerals and Edith Cowan University. ACH Minerals has already instigated a process to increase the amount of zoological research at the site by providing some financial and a large amount of in-kind support to two Masters students with studies focussed on the habitat requirements of the Chuditch and the Malleefowl.

ACH Minerals has, in the first instance, identified an area of some 50 ha in the north east of the Project area to be partitioned off as a conservation area. This area contained all records of the Heath Rat, H. *decipiens* and the majority of the records of *M. mollis*, providing a strong foundation for conservation in association with mining

The level of site specific localised impact from clearing and construction has the potential to be rapidly offset by the longer term net positive impacts of proactive mine site environmental management.

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7 APPENDICES

APPENDIX 1: CONSERVATION CODES FOR WESTERN AUSTRALIA FLORA AND FAUNA

CONSERVATION CODES FOR WESTERN AUSTRALIAN FLORA AND FAUNA

Schedule 1 - Threatened (T)
Schedule 1 of the Wildlife Conservation (Specially Protected Fauna) Notice and Wildlife Conservation (Rare Flora) Notice under the *Wildlife Conservation Act 1950*.

- **Threatened Fauna** (Fauna that is rare or is likely to become extinct)
- **Threatened Flora** (Declared Rare Flora - Extant)

Taxa that have been adequately searched for and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection, and have been gazetted as such.

Schedule 2 – Extinct (X)
Schedule 2 of the Wildlife Conservation (Specially Protected Fauna) Notice and Wildlife Conservation (Rare Flora) Notice under the *Wildlife Conservation Act 1950*.

- **Presumed Extinct Fauna**
- **Presumed Extinct Flora** (Declared Rare Flora – Extinct)

Taxa which have been adequately searched for and there is no reasonable doubt that the last individual has died, and have been gazetted as such.

Schedule 3 – International Agreement (IA)
Schedule 3 of the Wildlife Conservation (Specially Protected Fauna) Notice under the *Wildlife Conservation Act 1950*.

- **Birds protected under an international agreement**
  Birds that are subject to an agreement between governments of Australia and Japan relating to the protection of migratory birds and birds in danger of extinction.

Schedule 4 – Other specially protected Fauna (S)
Schedule 4 of the Wildlife Conservation (Specially Protected Fauna) Notice under the *Wildlife Conservation Act 1950*.

- **Other specially protected fauna**
  Fauna that is in need of special protection, otherwise than for the reasons mentioned in the above schedules.

Threatened fauna and flora (Schedule 1) are further ranked by the Department according to their level of threat using IUCN Red List criteria:
CR: Critically Endangered - considered to be facing an extremely high risk of extinction in the wild.
EN: Endangered - considered to be facing a very high risk of extinction in the wild.
VU: Vulnerable - considered to be facing a high risk of extinction in the wild.

1: Priority One: Poorly-known taxa
Taxa that are known from one or a few collections or sight records (generally less than five), all on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, Shire, Westrail and Main Roads WA road, gravel and soil reserves, and active mineral leases and under threat of habitat destruction or degradation. Taxa may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes.

2: Priority Two: Poorly-known taxa
Taxa that are known from one or a few collections or sight records, some of which are on lands not under imminent threat of habitat destruction or degradation, e.g. national parks, conservation parks, nature reserves, State forest, vacant Crown land, water reserves, etc. Taxa may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes.

3: Priority Three: Poorly-known taxa
Taxa that are known from collections or sight records from several localities not under imminent threat, or from few but widespread localities with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Taxa may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and known threatening processes exist that could affect them.

4: Priority Four: Rare, Near Threatened and other taxa in need of monitoring
(a) **Rare.** Taxa that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that 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.
(b) **Near Threatened**. Taxa that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable.
(c) Taxa that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

5: Priority Five: Conservation Dependent taxa
Taxa that are not threatened but are subject to a specific conservation program, the cessation of which would result in the taxa becoming threatened within five years.

APPENDIX 2: 2004 BIOTA BIOLOGICAL SURVEY REPORT

BIOta | Biota Environmental Sciences

Fauna and Fauna Assemblages of the Kundip and Trilogy Study Sites

Fauna and Fauna Assemblages Report

Prepared for:

Tectonic Resources NL

Prepared by:

Biota Environmental Sciences Pty Ltd

May 2004

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Project No.: 250

Prepared by: R. Teale

Checked by: G. Humphreys M. Maier

Front cover photographs - Honey Possum, Pygmy Possum, typical habitat and the trapdoor spider *Aname mainae* overlaid on aerial photography of the study site.

Fauna and Fauna Assemblage Survey Report of the Kundip and Trilogy Study Sites

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Summary

Introduction
Tectonic Resources NL as owners of the Phillips River Gold Project aim to develop the gold/copper resource at the Kundip site and the polymetallic resource at the Trilogy site, located 16 and 26 kilometres southeast of Ravensthorpe respectively. An open cut pit is planned for the Trilogy deposit, whilst underground mining and an open cut are planned for the deposits at Kundip.

Aims and Methods
A field survey was conducted over a 10-day period between the 5/1/2004 and 14/1/2004, following a 12-month period of slightly above average rainfall, though this was preceded by an extended dry period.

The primary aims of the survey were to:
- Collect information on the presence of vertebrate fauna and selected invertebrate taxa (short range endemics);
- Document the relative abundance of species;
- Document the components of the physical environment (ie. the fauna habitat); and
- Document existing levels of disturbance.

Systematic censusing focused on the Kundip study site, as the Trilogy site comprised cleared farmland. The central component of the systematic censusing consisted of seven trapping grids, each located within a defined habitat. Each trapping grid consisted of two rows of six pitfall traps. The rows were set approximately 50m apart, and the pits (alternating 20 litre buckets and pvc tubes) within rows were spaced at approximately 8m intervals and connected with a single length of 30 cm high flywire fence. At each site, a medium size Elliott trap was placed adjacent to each pit and a row of eight Elliott traps was positioned such that it bisected the two pit lines. In addition to these sites, a single transect of 25 cage traps was established through the *Eucalyptus clivicola* woodland.

Twenty-three 40 minute and two 60 minute avifauna censuses were conducted across nine sites during the survey. Censuses were typically made from 6 a.m. through to midday.

Targeted invertebrate groups were sampled through systematic and opportunistic collections during the survey and included:
- Araneae (Spiders, in particular Trapdoor and Wolf Spiders);
- Pseudoscorpionida (Pseudoscorpions);
- Scorpionida (Scorpions);
- Diplopoda (Millipedes); and
- Pulmonata (Land snails).

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.

Results
The field survey recorded a combined total of 99 vertebrate species including 62 species of bird, 11 native mammals, two introduced mammals, 21 reptiles and three frogs.

The total of 62 species of birds comprised 30 families and included 24 non-passerine and 38 passerine species. The tally from the Kundip site comprised 18 non-passerines and 35 passerines from a total of 27 families. The tally from the Trilogy site comprised six non-passerines from three families and four passerines from four families.

The survey recorded 13 species of mammals, comprising one tachyglossid (Echidna), one dasyurid (carnivorous marsupial), two macropods (kangaroos and wallabies), one

burramyid (Pygmy Possum), one tarsipedid (Honey Possum), three vespertilionids (vespertilionid bats), one molossid (sheathtail bat), one native and one introduced murid (murid rodents) and one canid (Fox).

The reptiles comprised four geckos, three pygopodids, one agamid, one varanid, 10 skinks and two elapid snakes. All were recorded from the Kundip site.

Over 30 invertebrate taxa were recorded from the Kundip study site, many of which were not identified beyond family level. The only taxa identified to genus or species level were those belonging to groups known to include short-range endemics (Mygalomorphs, Pulmonate land snails), that were otherwise of conservation significance (Buprestidae), or for which expertise was readily available at the WA Museum (eg. wolf spiders and other spider groups).

Two species of mygalomorph spiders from the family Nemesiidae were recorded from the Kundip project area; *Aname mainae* and *Chenistonia tepperi*. Both species (as they are currently recognised) have broad distributions through the South-west of WA. A single *Bothriembryon* that was not known to Ms Shirley Slack-Smith (WA Museum) was collected during the survey from leaf litter at KU8. The conservation status of this taxon is unknown.

A search of the CALM Schedule and Priority Fauna database for species potentially occurring in the area yielded five Schedule 1 species, one Schedule 4 species and five Priority species. An additional Schedule 1, Schedule 4 and Priority taxon may occur in the area based on other information. The 14 conservation significant species potentially occurring in the area are discussed briefly below.

Schedule 1 Fauna

- Carnaby's Cockatoo *Calyptorhynchus latirostris* (Endangered under *EPBC Act 1999*)

Recorded on three occasions as flocks of between two and seven individuals flying over the project area.

- Western Ground Parrot *Pezoporus wallicus flaviventris* (Endangered under *EPBC Act 1999*)

It is possible, but not probable that the species occurs in the study area. Factors in favour of its occurrence are that the study area lies between known populations and the habitat appears suitable. Factors against its occurrence are that the distribution of the subspecies is well known, and that although the area is relatively frequently visited by birders, this taxon has not been recorded.

- Malleefowl *Leipoa ocellata* (Vulnerable under *EPBC Act 1999*)

A single record from the project area. This species appears to be relatively common in the Ravensthorpe district compared to elsewhere in its range, and has been recorded throughout mallee-heath habitat in the Fitzgerald Biosphere Reserve (Teale et al. in prep.).

- Chuditch *Dasyurus geoffroyii* (Vulnerable under *EPBC Act 1999*)

Single record of this species from the Kundip townsite during 1992.

- Dibbler *Parantechinus apicalis* (Endangered under *EPBC Act 1999*)

Record from Kundip in 1986.

- Heath Rat *Pseudomys shortridgei* (Vulnerable under *EPBC Act 1999*)

This species was not recorded during the current survey, however suitable habitat occurs across much of the lease. Within the Fitzgerald Biosphere Reserve, this species appears to be largely confined to habitats with a mallee overstorey on variable soils, including loamy-sands and sandy-loams with a laterite component, stony clays and sandy light clay on greenstone (Cooper et al. 2003; Teale et al. in prep.).

Schedule 4 Fauna

- Peregrine Falcon *Falco peregrinus*

This widespread species, although common in parts of WA, would be rare or scarce in the project area according to Johnstone and Storr (1998). It primarily inhabits wooded watercourses and lakes, coastal cliffs, rivers and ranges, none of which are prevalent in the project area.

- Carpet Python *Morethia spilota imbricata*

This sub-species is broadly distributed across much of the South-west, but has been given its protected status due to the fact that it is not common anywhere in its range. Teale et al. (in prep.) collated just three records from two sites for the Fitzgerald Biosphere Reserve.

Priority Taxa

- *Lerista viduata* (Priority 1)

Single individual recorded from a pit trap at KU2.

- Quenda *Isoodon obesulus fusciventer* (Conservation Dependent, Priority 4)

No convincing evidence of this species was recorded from the project area, although old diggings that may indicate the presence of this species were recorded along the Steere River. This species has been recorded from the Fitzgerald Biosphere Reserve as far east as Bandalup Hill (Teale et al. in prep.).

- Tammar *Macropus eugenii derbianus* (Conservation Dependent, Priority 4)

Not recorded during the survey but there are two recent records of road kills from just south of the old Kundip townsite on the Ravensthorpe to Hopetoun Road.

- Western Whipbird (southern WA subspecies) *Psophodes nigrogularis oberon* (Priority 4) (Vulnerable under *EPBC Act* 1999)

Identified on six occasions from calls given in mallee associations (sites KU1, KU2 and KU3). Johnstone (pers. comm. 2004) considered this species to be common throughout the Ravensthorpe district in suitable habitat.

- Western Mouse *Pseudomys occidentalis* (Priority 4)

Habitat for this species is described as shrublands on clay loams, usually with a laterite component, that have not been burnt for 15-30 years (Lee 1995). Though not recorded during the current survey, this species may occur in the Kundip area.

- Western Brush Wallaby *Macropus irma* (Priority 4)

During the current survey this species was recorded from a single carcass on the Ravensthorpe to Hopetoun Road, just to the north of the mine entrance.

Recommendations

The following recommendations arise from the fauna survey of the Kundip study area:

1. The opportunity exists, should the project proceed, to utilise existing cleared and disturbed areas for proposed new disturbances. The use of these disturbed areas should be maximised as part of project design.

2. Within the Kundip lease area, mature woodland habitat is restricted in distribution and supports both an abundant and species rich fauna assemblage. This is evident in the very high number of captures of species such as the Western Pygmy Possum *Cercartetus concinnus* and *Diplodactylus granariensis granariensis*. Clearing of mature woodland should be minimised wherever possible.

3. The proponent should undertake an additional seasonal survey of the project area to more fully document the faunal assemblage and identify any additional constraints. This study could usefully target threatened fauna taxa not well represented during the current survey including Schedule listed rodent and bird species.

1.0 Introduction

1.1 Project Background

Tectonic Resources NL as owners of the Phillips River Gold Project aim to develop the gold/copper resource at the Kundip site and the polymetallic resource at the Trilogy site, located 16 and 26 kilometres southeast of Ravensthorpe respectively (Figure 1.1). An open cut pit is planned for the Trilogy deposit, whilst underground mining and an open cut are planned for the deposits at Kundip. A final proposed footprint of the project area was not finalised at the time of preparing this report.

The Trilogy deposit is situated on freehold land that is currently an operating wheat/sheep farm (mining lease M74/176), whilst the Kundip deposits are encompassed by granted mining leases M74/41, 51, 53 and 135, and P74/153. M74/51 encompasses much of the historic mining area of Kundip with existing pits, numerous shafts, abandoned buildings and infrastructure, including tracks.

Given that the Trilogy site comprises farmland, the trapping effort focussed on the remnant vegetation within the Kundip study site. An assessment of the Trilogy site was made during a brief two-hour site visit.

1.2 Regional Setting

The project areas are situated entirely within the Esperance Plains Bioregion (Thackway and Cresswell 1995, Environment Australia 2000) of the South-west of Western Australia, a region recognised as one of the world's biodiversity hotspots (Myers et al. 2000). Furthermore, Kundip and Trilogy are situated within the zone of cooperation of the Fitzgerald Biosphere Reserve, an area established to help manage conservation efforts within the Fitzgerald River National Park.

The Ravensthorpe Range is the most significant inland topographic feature in the Fitzgerald Biosphere Reserve, and part of an important vegetation corridor. It also comprises the upper catchment of the Steere River, and some of the catchment of the Jerdacuttup River.

1.2.1 Fauna Habitats

Fauna habitats align closely with the major vegetation communities, which reflect changes in slope, aspect and soil type. A vegetation survey of the Kundip study site recognised 18 vegetation types (Craig 2004). These fall within three broad habitat types based on those recognised by Teale et al. (in prep.) in their review of the fauna of the Fitzgerald Biosphere Reserve:

- Mallee-heath –various species of mallee eucalypts over an understorey ranging from scrub to heath from 0.5-2.0 m tall on variable soil types;
- Woodland – Moort *Eucalyptus platypus* and mallet of various species with a shrubland or heath understorey over very sparse herbs on loamy to clayey soils; and
- Shrubland –shrub lifeforms over 2 m, with or without a lower shrub storey.

In addition the Trilogy site comprised a fourth broad habitat type:

- Farmland – habitat includes open paddocks, farm dams, buildings and shelter belts.

1.2.2 Previous Surveys

Teale et al. (in prep.) summarise a variety of biological surveys that have been carried out in the Fitzgerald Biosphere Reserve, and include data from the collection at the Western

Australian Museum. Whilst none of these surveys have trapped for vertebrate fauna within either the Kundip or Trilogy Project areas, Sanders (1996) established a number of survey sites in the area surrounding Kundip and data from these sites are included in this document. Information has also been obtained from data collected by Craig and Chapman (1998), Chapman (2000) and Biota (2000) for the Bandalup Hill proposal. All data presented in Teale et al. (in prep.) and used for regional context herein were collected by the authors (including R. Teale and G. Harold), are supported by specimen based collections, or were sourced from the collection at the Western Australian Museum.

Teale et al. (in prep.) summarise data collected from over 20,000 Elliott trap nights, 2,000 cage trap nights and 9,000 pit trap nights, in addition to opportunistic sightings from over 200 sites throughout the Fitzgerald Biosphere Reserve. These data provide a valuable tool for placing the fauna assemblages recorded from Kundip in regional context. This is particularly the case for rare and uncommon fauna.

1.3 Aims

This report documents the results of a 10 day fauna and fauna assemblage survey of the Kundip study site, and a brief reconnaissance survey (over 2 hours) of the Trilogy site. In general, the discussion on aims and methodology that follows is largely focussed on the work undertaken in the Kundip study area.

The primary aims of the surveys were to:

- Collect information on the presence of vertebrate fauna and selected invertebrate taxa (short range endemics after Harvey (2002));
- Document the relative abundance of species;
- Document the components of the physical environment (ie. the fauna habitat); and
- Document existing levels of disturbance.

These data have been collected to permit the Environmental Protection Authority (EPA) to apply the overarching principles for Environmental Impact Assessment of Biodiversity outlined in Position Statement No. 3 *Terrestrial Biological Surveys as an Element of Biodiversity Protection* (EPA 2002) and draft Guidance for the Assessment of Environmental Factors for Fauna Surveys (EPA 2003).

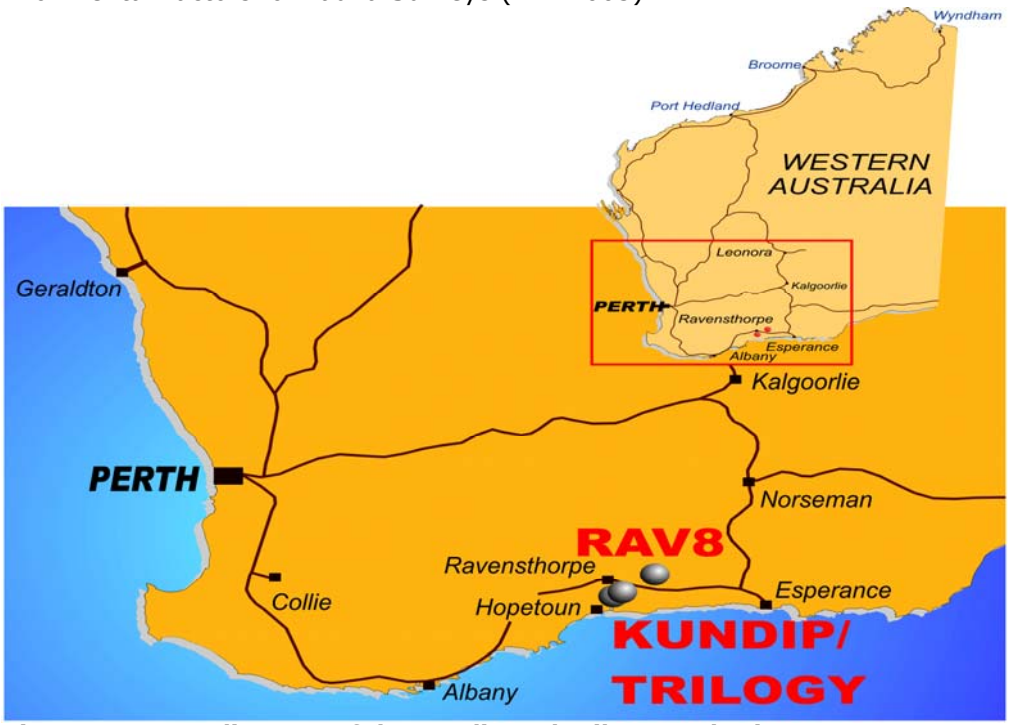

Figure 1.1: Locality map of the Kundip and Trilogy study sites.

2.0 Survey Methodology

2.1 Survey Timing and Weather

The survey was conducted over a 10-day period between the 5/1/2004 and 14/1/2004, following a 12-month period of slightly above average rainfall (Tables 2.1 and 2.2). Maximum temperatures taken at Ravensthorpe for the duration of the survey ranged between 17.8°C and 39.5°C (Table 2.3). Minimum temperatures recorded from the same station during the same period ranged between 12.2°C and 18.6°C. Ravensthorpe received 40.7 mm of rainfall during the survey, all falling in the first four days, with most rainfall (20.3 mm) falling on the 6/1/04.

2.2 Survey Team

The vertebrate fauna sampling for this survey was conducted under "Licence To Take Fauna For Scientific Purposes" No. SF004121 issued to RJ Teale and also covering Mr Greg Harold. Ethics approval was granted under the Western Australian Museum (WAM) application to the Department of Conservation and Land Management (DCLM) Animal Ethics Committee, which covers Mr. Roy Teale as a Research Associate with the WAM. The Fauna survey team comprised Mr. Roy Teale (Biota Environmental Sciences) and Mr. Greg Harold (consultant). Ms. Kim Bennett (Tectonic Resources NL) assisted with site orientation and Mr. Ian Field, Mr. Tim Nolan and Mr. Cliff Clarke (Tectonic Resources NL) assisted with set-up and coordination of logistics. Dr. Gillian Craig (consultant) kindly provided descriptions and mapping of vegetation types, description of soils, and an invaluable introduction to the project area.

Analysis of bat recordings was completed by Dr. Kyle Armstrong (Biota Environmental Scientists).

Invertebrate identification was undertaken by Ms. Karen Edward (Biota Environmental Sciences) using the resources of the WA Museum. Dr. Volker Fromenau, Dr. Mark Harvey, Ms. Julianne Waldock and Ms. Shirley Slack-Smith (all of the WA Museum) provided assistance with invertebrate identification and information.

Also acknowledged are Ms. Norah Cooper, Mr. Brad Maryan and Ms. Rachael O'Shea (WAM) who assisted with confirmation of herpetofauna and mammal identifications.

2.3 Systematic Censusing

Sampling was targeted within the lease area (as indicated by Tectonic Resources NL at the time of survey), with additional unusual habitat types outside of this area being sampled wherever possible.

The central component of the systematic censusing consisted of seven trapping grids (Table 2.4; Figures 2.1 and 2.2), each located within a defined habitat. In selecting survey sites equal weight was also given to accessibility of sites such that pitfall traps, Elliotts and cage traps could be regularly checked.

Systematic fauna sampling, the primary component of the study, was completed on the basis of grid installation in habitats considered to be representative of the range of units apparent within the project area. Not all areas within the project area were ground-truthed or sampled for fauna.

Trapping design replicates that used by the authors (and originally A. Chapman) at the Bandalup Hill locality (Craig and Chapman 1998). This was undertaken with the intention of using the two datasets (Bandalup Hill and Kundip) to provide some regional context.

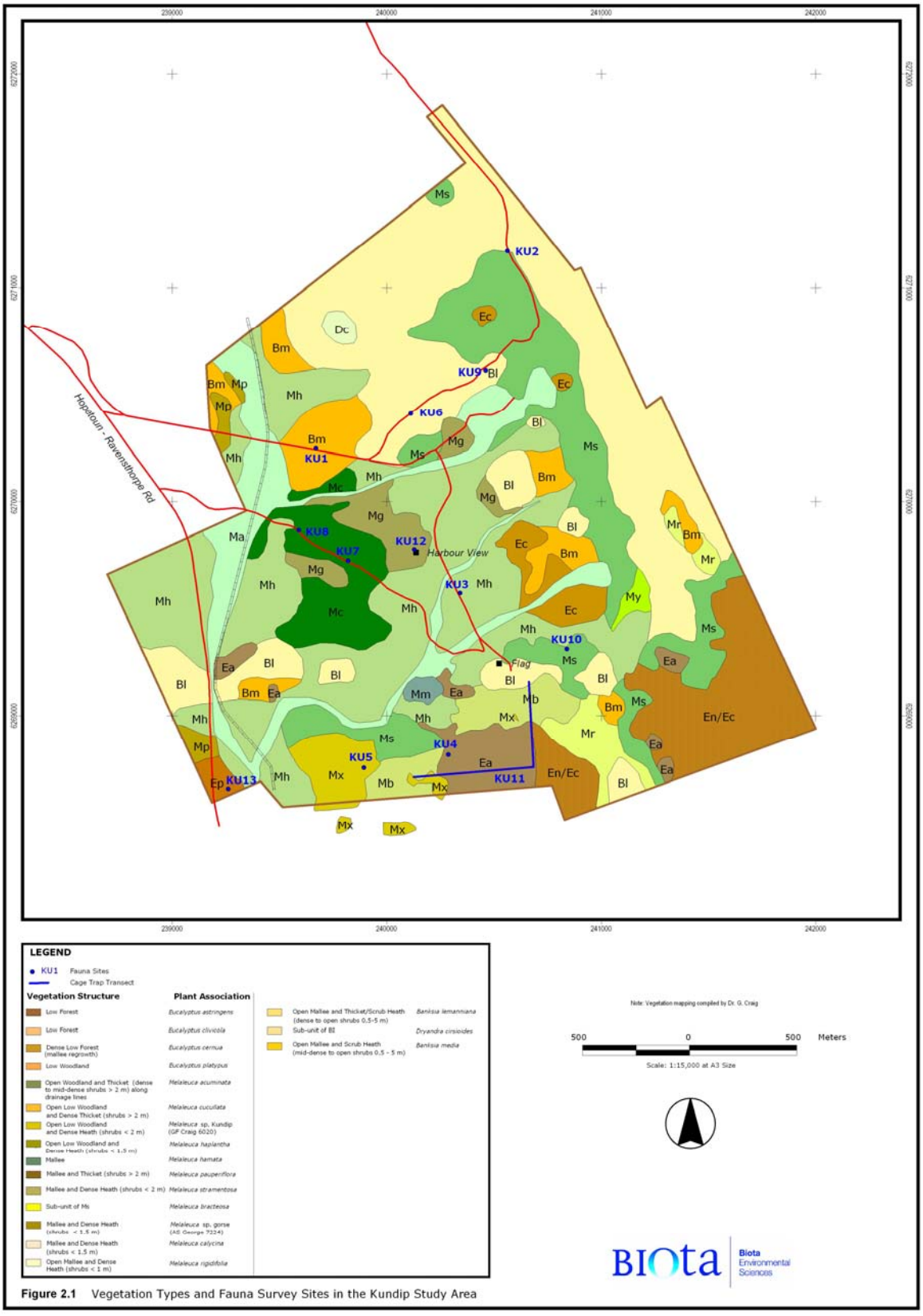

Figure 2.1 Vegetation Types and Fauna Survey Sites in the Kundip Study Area

Table 2.1: Climatological summary for Hopetoun North using data from 1996 to 2003 (data provided by the Western Australian Bureau of Meteorology).

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Mean Daily Maximum Temperature	25.6	25.4	24.7	23.5	21.7	19.4	18.2	18.8	20.5	21.1	23.1	23.9	
Mean Daily Minimum Temperature	15.0	15.6	14.3	12.8	10.5	8.6	7.6	7.8	8.9	9.8	12.1	14.1	
Mean Monthly Rainfall (mm)	42.9	24.5	29.7	29.0	30.2	35.3	65.2	55.5	53.9	38.4	36.6	24.7	465.7
Monthly Rainfall 2003	4.8	25.4	31.6	31.6	50.2	33.2	72.6	66.6	54.0	65.8	74.4	5.0	515.2

Table 2.2: Climatological summary for Ravensthorpe using data from 1901 to 2003 (data provided by the Western Australian Bureau of Meteorology).

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Mean Daily Maximum Temperature	29.2	28.4	26.6	23.7	20.0	17.2	16.2	17.1	19.5	22.3	24.8	27.3	
Mean Daily Minimum Temperature	14.0	14.5	13.5	11.8	9.6	7.9	6.8	6.6	7.5	8.9	10.9	12.7	
Mean Monthly Rainfall (mm)	22.8	25.3	31.2	32.8	45.0	44.0	47.1	44.9	41.5	38.1	29.6	22.3	427.7
Monthly Rainfall 2003	5.8	34.8	70.9	37.5	33.0	18.2	55.1	56.0	33.7	29.2	45.9	20.8	440.9

Table 2.3: Daily Meteorological Observations for Ravensthorpe for 4/1/04 – 15/1/04 (data provided by the Western Australian Bureau of Meteorology).

Day	Maximum	Minimum	Temperature at 9am	Temperature at 3pm	Rainfall 24 hours to 9am
5/1/04	17.8	15.2	16.0	16.2	15.2
6/1/04	21.9	13.7	16.4	20.4	20.3
7/1/04	19.2	13.2	16.0	18.2	3.4
8/1/04	21.0	12.2	15.9	19.5	1.8
9/1/04	25.2	14.0	16.4	22.4	0
10/1/04	27.2	13.4	21.0	25.7	0
11/1/04	33.4	12.4	24.5	31.2	0
12/1/04	39.5	18.6	32.5	30.5	0
13/1/04	22.6	15.2	16.0	-	0
14/1/04	26.9	15.4	18.5	-	0
15/1/04	26.0	14.4	21.9	20.0	0

Table 2.4: Trapping grid location and trap effort (WGS84 datum, Zone 51).

Site #	Location (AMG)	Trap Type	Date Opened	Date Closed	Nights Open	# of traps	Total effort (trap nights)
KU1	239670mE 6270247mN	Elliott Pit	7/1/2004 6/1/2004	12/1/2004 12/1/2004	5 6	20 12	100 72
KU2	240563mE 6271172mN	Elliott Pit	7/1/2004 6/1/2004	12/1/2004 12/1/2004	5 6	20 12	100 72
KU3	240342mE 6269570mN	Elliott Pit	7/1/2004 6/1/2004	12/1/2004 12/1/2004	5 6	20 12	100 72
KU4	240288mE 6268814mN	Elliott Pit	7/1/2004 7/1/2004	14/1/2004 14/1/2004	7 7	20 12	140 84
KU5	239894mE 6268754mN	Elliott Pit	7/1/2004 7/1/2004	13/1/2004 13/1/2004	6 6	20 12	120 72
KU6	240113mE 6270410mN	Elliott Pit	7/1/2004 7/1/2004	13/1/2004 13/1/2004	6 6	20 12	120 72
KU7	239820mE 6269724mN	Elliott Pit	8/1/2004 8/1/2004	14/1/2004 14/1/2004	6 5	20 12	120 72
KU8	239591mE 6269866mN	Opp.			-	-	-
KU9	240462mE 6270613mN	Opp.			-	-	-
KU10	240840mE 6269310mN	Opp.			-	-	-
KU11	Transect	Cage	9/1/2004	14/1/2004	5	25	125
KU12	240121mE 6269778mN	Opp.			-	-	-
KU13	239262mE 6268655mN	Opp.			-	-	-
					Total	**Elliott Pit Cage**	**800 516 125**

Opp – designates opportunistic hand foraging, head-torching and raking only.

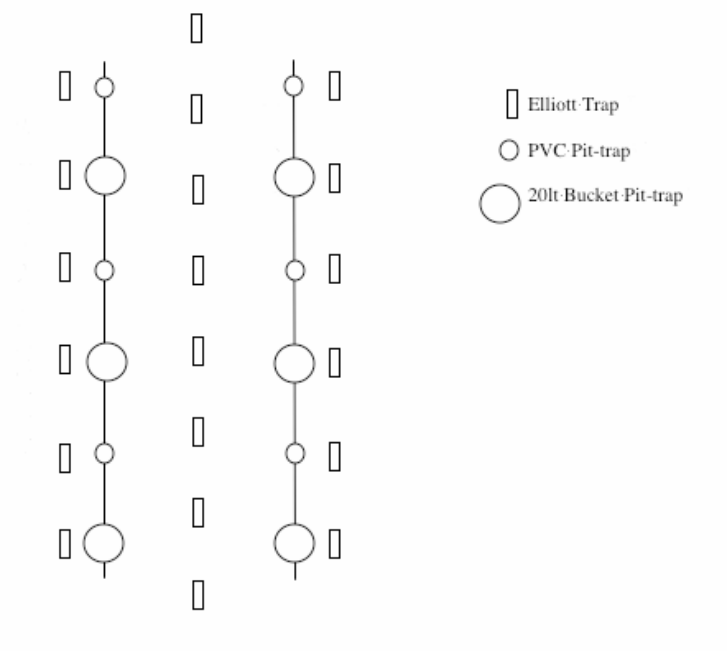

Figure 2.2: Trapping grid layout used at the Kundip site (nb. distance between the two lines of pits varied between 30m and 50m).

Each trapping grid consisted of two rows of six pitfall traps. The rows were set approximately 50m apart, and the pits (alternating 20 litre buckets and pvc tubes) within rows were spaced at approximately 8m intervals and connected with a single length of 30 cm high flywire fence (Figure 2.2). At each site, a medium size Elliott trap was placed adjacent to each pit and a row of eight Elliott traps was positioned such that it bisected the two pit lines (Figure 2.2). In addition to these sites, a single transect of 25 cage traps was established through the *Eucalyptus clivicola* woodland (KU11 in Table 2.4).

2.3.1 Avifauna Sampling

Twenty-three 40 minute and two 60 minute avifauna censuses were conducted across nine sites during the survey (Table 2.5). Censuses were typically made from 6am through to midday (except KU13) (Table 2.5). Individual censuses were confined to discrete habitat types typically corresponding to vegetation types. In addition, opportunistic records were made of species that were either not recorded during censuses or that were uncommon.

Table 2.5: Systematic avifauna censuses undertaken at each of the fauna sites.

Date	Site KU1	Site KU2	Site KU3	Site KU4	Site KU5	Site KU6	Site KU7	KU8	KU13
9/1/04		11:05 – 11:45	9:35 – 10:15	8:40 – 9:20	7:30 – 8:10	10:20 – 11:00	6:35 – 7:15		
10/1/04	6:05 – 6:45	7:05 – 7:45		11:00 – 11:40	10:15 – 10:55	8:06 – 8:46	9:20 – 10:00		
11/1/04	-	-	-	-	-	-	-	-	
12/1/04	9:07 – 9:47	7:42 – 8:22	6:13 – 6:53			10:30 – 11:10			
13/1/04	10:45 – 11:25		11:45 – 12:25	7:45 – 8:25	6:15 – 6:55	9:23 – 10:03	8:37 – 9:17		13:15 – 14:15
14/1/04				6:05 – 6:45				7:30 – 8:30	

2.3.2 Bats

Bats were sampled by recording echolocation calls only. A comprehensive survey of bats, which would include trapping to determine the presence of bats not readily recorded by microphones, was not undertaken during the survey. Echolocation calls were recorded with an Anabat II bat detector, which detects and transforms the ultrasonic echolocation that bats emit whilst foraging. Sampling was undertaken on two nights (12/1/2004 and 13/1/2004) at two sites (KU4 and KU12). On both occasions a delay switch was connected to the detector to maximise the time that calls could be collected. Calls were recorded onto TDK C90 audio cassette tapes using an Optimus CTR116 cassette recorder. Calls were then transformed with a ZCAIM V and analysed using Anabat 6 software. Variables measured from call sequences were compared with those in Fullard et al. (1991) to aid identification.

2.3.3 Invertebrate Sampling

Targeted invertebrate groups were sampled through opportunistic and systematic collections during the survey. Prior to field work, WAM staff were consulted to confirm invertebrate groups of interest and to identify any specific curation methods (eg. the preservation of Wolf Spiders for DNA analyses).

Invertebrate groups targeted during the survey included:

- Araneae (Spiders, in particular Trapdoor and Wolf Spiders);
- Pseudoscorpionida (Pseudoscorpions);

- Scorpionida (Scorpions);
- Diplopoda (Millipedes); and
- Pulmonata (Land snails).

Wolf Spiders were collected whilst head-torching at night at three locations; KU2, KU4, and KU12. These specimens were supplemented by those collected from pit traps at all systematic trapping sites (KU1 – KU7). Trapdoor spiders were targeted using pit-traps supplemented with burrow excavation at KU13. Trapdoor and wolf spiders were preserved in 70% ethanol, with one or two legs removed and placed in 100% ethanol for future molecular studies.

Hand foraging was undertaken for pseudoscorpions, involving peeling bark and lifting rocks. The latter technique was also used to search for scorpions, with additional specimens collected from pit traps. The remaining two groups (millipedes and land snails) were searched for whilst raking leaf litter and other debris. Representative samples of other invertebrates from pit traps were collected, placed in 70% ethanol and lodged with the WA Museum.

2.3.4 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.

2.4 Vegetation Types and Fauna Habitat Classification at each Survey Site

The descriptions of vegetation and soils presented below are based on those collated by Craig (2004). These have been amalgamated into the broad fauna habitats outlined in Teale et al. (in prep.).

The majority of the project area comprised mallee-heath habitat, with the heath component being dominated by proteaceous and/or myrtaceous species. *Banksia* species were a dominant component of the vegetation in the northern portion of the study area whilst *Melaleuca* species formed a common component of the understorey in the middle and southern sections. The Steere River runs in a north-south direction along the western edge of the project area, and was fed by a number of small tributaries extending to the east and exits into the Culham Inlet. Neither the Steere River nor its tributaries held water during the survey, although a number of small dams did. Areas of woodland habitat occurred along the southern boundary.

2.5 Survey Limitations

The survey was appropriately resourced by the proponent given the scale and nature of the proposed operation. Survey timing was appropriate for recording reptiles, whilst unseasonal rainfall increased the probability of detecting some frog species. Timing may not have been ideal for mammal species given the dry conditions over the 12 – 18 months

prior to last winter. In respect of key invertebrate groups (including short-range endemics), the rainfall encouraged activity in many groups including mygalomorph spiders and land snails. Timing was appropriate for wolf spiders as populations tend to support mostly adults during late summer. However the time of the year was not suitable for recording millipedes.

Table 2.6: Habitat, vegetation and soil descriptions for each of the sites at Kundip (vegetation and soils descriptions provided by Craig 2004) and Trilogy.

Site	Habitat	Vegetation Description	Soils Description
KU1	Mallee – heath.	Very open mallee and low proteaceous and myrtaceous heath (< 1 m) with *Banksia media* a characteristic species	Grey to yellow sand of varying depth over mottled clay loams.
KU2	Mallee – heath.	Open mallee and very dense proteaceous thicket where *Banksia lemanniana* is typical.	Skeletal pale grey to orange loamy sands with lateritic gravel.
KU3	Mallee – heath.	Dense to mid-dense shrub mallee (1-4 m tall) and myrtaceous heath.	Grey-brown to red-brown loamy clay sand with lateritic gravel.
KU4	Woodland	Mid-dense low forest of Brown Mallet *Eucalyptus astringens over Melaleuca rigidifolia*	Grey, calcareous clay loam.
KU5	Mallee – heath.	Very open mallee and dense shrub heath (1-1.5 m) dominated by *Melaleuca* sp. Kundip	Pale grey sandy loams with quartzite rubble.
KU6	Mallee – heath.	Open mallee and very dense proteaceous thicket where *Banksia lemanniana* is typical.	Skeletal pale grey to orange loamy sands with lateritic gravel.
KU7	Shrubland	Dense thicket of *Melaleuca cucullata.*	Poorly drained, orange-brown clay loams.
KU8	Debris	Disturbed area with abandoned buildings, sheets of tin and other debris.	Poorly drained, orange-brown clay loams.
KU9	Debris	Disturbed area with abandoned buildings, sheets of tin and other debris.	Skeletal pale grey to orange loamy sands with lateritic gravel.
KU10	Mallee – heath.	Mid-dense to open mallee and dense heath communities dominated by *Melaleuca stramentosa*	Orange-brown mottled clay loams with ironstone rubble.
KU11	Mixed	*Eucalyptus astringens* low forest and mid-dense mallee with dense heath.	Grey, calcareous clay loam and orange-brown mottled clay loams with ironstone rubble.
KU12	Mallee – heath.	Mid-dense to open mallee and dense heath communities dominated by *Melaleuca stramentosa*	Orange-brown mottled clay loams with ironstone rubble.
KU13	Woodland	*Eucalyptus platypus* Moort low woodland.	White clay or loamy clays with quartz rubble, 'moort clays'.
TR1	Farmland	Paddock grasses and weeds.	Not recorded

Plate 2.1: Cleared farmland at the Trilogy site.

Plates 2.2 – 2.7: Habitats at each of the trapping sites.

Plate 2.2: Habitat at KU1.

Plate 2.3: Habitat at KU2.

Plate 2.4: Habitat at KU3.

Plate 2.5: Habitat at KU4.

Plate 2.6: Habitat at KU5.

Plate 2.7: Habitat at KU7.

3.0 Vertebrate Fauna Inventory Survey

3.1 Background

The survey of the Kundip and Trilogy sites recorded a combined total of 99 vertebrate species. Table 3.1 provides a summary of the number of species recorded from each major vertebrate group during the survey.

Table 3.1: Number of species recorded during the survey of the Kundip and Trilogy study sites.

Fauna Group	Total
Avifauna	62
Native Mammals	11
Introduced Mammals	2
Reptiles	21
Amphibians	3
Total	**99**

3.2 Birds

Introduction

The regional (south-west) avifauna has been summarised by Storr (1991), who provides an annotated list of 379 species of birds. The majority of these would not be expected to occur in the project area due to habitat considerations, in particular the lack of tall woodlands, heaths, wetlands etc. Of more relevance would be small surveys carried out locally, including those by Chapman and Newbey (1995), Sanders (1996), Craig and Chapman (1998), Chapman (2000), Biota (2000) and Buchanan (2004). Several of these are summarised in Teale et al. (in prep.) and discussed further below.

The Assemblage

A total of 62 species of birds was recorded during the current survey. This total comprised 30 families and included 24 non-passerine and 38 passerine species (Table 3.2). The tally from Kundip comprised 18 non-passerines and 35 passerines from a total of 27 families. The tally from the Trilogy site comprised six non-passerines from three families and four passerines from four families.

Of the 62 species, nine were recorded only from the Trilogy site (Table 3.3). These included all the waterfowl, and several species typical of farms and open habitat in the South-west such as the Australian Kestrel, Black-shouldered Kite, Yellow-throated Miner, Magpie-lark and Australian Pipit. Habitat at the Trilogy site comprised open paddocks, farm dams, farm buildings and shelter-belts of *Eucalyptus* spp with little or no understorey.

Breeding

Breeding records were obtained for two species:

- A male Emu was recorded with four chicks; and
- A Dusky Woodswallow was seen feeding two chicks.

Annotated List

Table 3.2 presents data for all bird species recorded from each fauna habitat unit. Each species is discussed individually in the following annotated list (†Recorded from the Kundip site; ø Recorded from the Trilogy site).

CASUARIIDAE

Emu - *Dromaius novaehollandiae*[†]
Typically recorded from scats in open habitats including the *Eucalyptus astringens* low forest (KU4) and from access track in the *Melaleuca* sp Kundip (KU5). A male was recorded with four young at the Flag mine.

MEGAPODIIDAE

Malleefowl – *Leipoa ocellata* [†]
Dr. Gillian Graig and Ms. Kim Bennett recorded a single individual on the 5/1/2004 from the main access track where it crosses the *Melaleuca acuminata* drainage near the Railway Heritage Trail.

PHASIANIDAE

Brown Quail – *Coturnix ypsilophora* [†]
Recorded on eight occasions from its call given typically late in the evening or early in the morning. Recorded from mallee (KU3 and KU12) and open mallee scrub heath (KU6).

ANATIDAE

Australian Shelduck - *Tardorna tadornoides* [ø]
Two birds recorded from a farm dam in the vicinity of the proposed Trilogy Mine.

Australian Wood Duck - *Chenonetta jubata* [ø]
Ten individuals recorded from a farm dam in the vicinity of the proposed Trilogy Mine.

Grey Teal - *Anas gracilis* [ø]
Ten individuals recorded from a farm dam in the vicinity of the proposed Trilogy Mine.

Pacific Black Duck - *Anas superciliosa* [ø]
Only recorded (n=16) from from a farm dam in the vicinity of the proposed Trilogy Mine.

ACCIPITRIDAE

Black-shouldered Kite – *Elanus caeruleus axillaris* [ø]
Single individual seen foraging over farmland in the vicinity of the proposed Trilogy Mine.

Square-tailed Kite – *Hamirostra isura* [†]
Single bird recorded over *Eucalyptus astringens* (KU4) on the 10/1/04 and again on the 13/1/04. Another single individual, possibly the same bird, recorded over mallee (KU3) on the 13/1/04.

Brown Goshawk – *Accipiter c. cirrocephalus* [†]
Recorded on one occasion. Single bird recorded over mallee (KU3).

FALCONIDAE

Nankeen Kestrel - *Falco cenchroides* [ø]
Single bird seen over farmland in the vicinity of the proposed Trilogy Mine.

TURNICIDAE

Painted Button-quail - *Turnix varia* [†]
Single bird recorded from a pit trap at KU3.

COLUMBIDAE

Common Bronzewing – *Phaps chalcoptera* [†]
Single bird recorded from edge of access track at KU1. Noted to be moderately common on highway between Ravensthorpe and the Kundip project area.

Brush Bronzewing – *Phaps elegans* [†]
Single individual recorded at access to project area. Also observed on the road verge between Ravensthorpe and Kundip, although less often than the Common Bronzewing.

PSITTACIDAE

Carnaby's Cockatoo – *Calyptorhynchus latirostris* †
Recorded on three occasions as flocks of between two and seven individuals flying over the project area. These birds were not positively identified as *C. latirostris,* rather the identification is based on the current distribution of the two White-tailed Black Cockatoos in WA as given by Johnstone and Storr (1998).

Purple-crowned Lorikeet – *Glossopsitta porphyrocephala* †
Small flocks regularly flying over the project area. Recorded feeding in the *Eucalyptus astringens*.

Australian Ringneck - *Platycercus zonarius* †
Uncommon within the project area but common on the road verge between Ravensthorpe and Kundip. Recorded from most sites with trees including KU1, KU2, KU4, KU6, KU7 and KU13. Commonly seen foraging on the road verge between Ravensthorpe and Kundip particularly adjacent to taller Mallee Woodland. Often in mixed company with Red-capped Parrots *Platycercus spurius*.

Red-capped Parrot – *Platycercus spurius* †
Rare within the project area although apparently more common near tall woodlands closer to Ravensthorpe. Single bird recorded from open low woodland at (KU5) and two birds from mallee over dense heath at KU2.

Numerous birds were seen on the road between Ravensthorpe and Kundip particularly in the Salmon Gums woodland. Often in mixed company with Australian Ringnecks *Platycercus zonarius*.

CUCULIDAE

Fan-tailed Cuckoo – *Cacomantis flabelliformis* †
Single individual recorded from the dense shrub mallee near KU3.

Shining Bronze-cuckoo - *Chrysococcyx lucidus* †
Recorded from calls at KU1, KU6 and KU8.

STRIGIDAE

Boobook Owl – *Ninox novaeseelandiae* †
Single bird recorded as a road kill near the entrance to the Kundip project area.

TYTONIDAE

Barn Owl – *Tyto alba* †
Rare. Two records of this species, each of single birds detected whilst head-torching. A single animal recorded from near a shaft adjacent to KU2 and another single bird recorded from the Flag Mine area.

PODARGIDAE

Tawny Frogmouth - *Podargus strigoides* †
Single bird recorded as a road kill near the entrance to the Kundip project area.

CAPRIMULGIDAE

Spotted Nightjar – *Eurostopodus argus* †
Single bird observed on main access track adjacent to KU1.

MALURIDAE

Blue-breasted Fairy-wren – *Malurus pulcherrimus* †
Recorded on four occasions as either singles or small family groups of between two and four individuals. Habitats include dense to mid-dense shrub mallee (KU3), open mallee over dense shrub heath (KU5) and dense *Melaleuca cucullata* thicket (KU7).

PARDALOTIDAE

Spotted Pardalote (Yellow-rumped Pardalote) – *Pardalotus punctatus xanthopyge* †
Moderately common in the open mallee at KU5 and from scattered mallee at KU7. Recorded predominantly from its call.

Striated Pardalote - *Pardalotus striatus* †
Recorded from all systematic census sites, though apparently less common than the Spotted Pardalote. Like its cogener, recorded predominantly from call.

ACANTHIZIDAE

White-browed Scrubwren – *Sericornis frontalis maculatus* †
Moderately common, recorded on 13 occasions; mainly ones and twos, but also as a group of three. Mostly in low dense shrubs. Recorded from all main census sites with the exception of KU1, though most records from the dense shrub heath of *Melaleuca* sp Kundip at KU5.

Shy Groundwren – *Hylacola cauta* †
Sightings probably underestimate the relative abundance of this species as it was often seen crossing or flying in front of the vehicle but was not always recorded. Mainly recorded from the heaths and mallee on lateritic and gritty surfaces. Recorded from Sites KU2, KU5 and KU6.

Weebill – *Smicrornis brevirostris* †
Very common; third most commonly recorded species. Recorded on 56 occasions, mostly from calls but also as singles, twos and a group of three. Most commonly recorded from the canopy of eucalypts particularly in the *Eucalyptus astringens* low forest at KU4 (seven records), but also from mallees at all other sites.

Broad-tailed Thornbill (Inland Thornbill) – *Acanthiza apicalis* †
Recorded on five occasions, typically as pairs. Often seen in dense mid-height shrubs and *Banksia* spp. Not recorded from KU2, KU3 and KU5.

MELIPHAGIDAE

Brown Honeyeater – *Lichmera indistincta* †
The sixth most commonly recorded species (n=36). Typically recorded from calls, but also as singles and occasionally in twos. Recorded from all sites though most records (n=23) from the *Melaleuca cucullata* thicket at KU7.

Purple-gaped Honeyeater – *Lichenostomus cratitius* †
Recorded on nine occasions, most records from the *Melaleuca cucullata* thicket at KU7 (n=8) and a single record from KU5.

White-eared Honeyeater – *Lichenostomus leucotis novaenorciae* †
Recorded on just three occasions. Single birds recorded from KU1, KU5 and KU7.

Brown-headed Honeyeater – *Melithreptus brevirostris leucogenys* †
Two birds recorded from the open mallee over dense proteaceous thickets including *Banksia lemanniana* at KU2.

Western White-naped Honeyeater – *Melithreptus chloropsis* †
Most records (n=12) from the *Eucalyptus astringens* low forest at KU4, but also from the *Melaleuca cucullata* thickets at KU7 (n=3) and *E. platypus* at KU13 (n=1).

New Holland Honeyeater – *Phylidonyris novaehollandiae* †
The most abundant (301 individuals) and frequently recorded (145 records) species from the project area. Common across the seven main census sites with the exception of the mallee at KU3 from which just a single individual was noted.

Tawny-crowned Honeyeater – *Phylidonyris melanops* †
Recorded on 30 occasions, mostly as single birds or from calls but also as twos and small loose groups. Most commonly recorded from the low dense heath of *Melaleuca* sp. Kundip at KU5 (n=37) but also noted from KU1 (n=1), the proteaceous thickets at KU2 (n=9) and the *Melaleuca cucullata* thickets at KU7 (n=2).

Yellow-throated Miner - *Manorina flavigula* ø
Only recorded from the mallee shelter-belts within the open farmland of the Trilogy project area.

Western Little Wattlebird – *Anthochaera lunulata* †
Moderately common (17 records), particularly in vegetation associations supporting *Banksia* spp., eg. KU1, KU2 and KU6. Usually recorded as singles or from calls and occasionally in twos.

Red Wattlebird – *Anthochaera carunculata* †
Recorded from all sites with the exception of KU2. Most records from taller trees in the area including within the *Eucalyptus astringens* low forest at KU4 and emergent eucalypts at KU7 where it was typically recorded from calls.

PETROICIDAE

Western Yellow Robin - *Eopsaltria australis griseogularis* †
Just two records of this species from the project area. One from dense mallee at KU1 and another from *Melaleuca* thickets in the drainage line at KU8.

Southern Scrub-robin – *Drymodes brunneopygia* †
Calls from this species were heard at all sites within the project area.

POMATOSTOMIDAE

White-browed Babbler - *Pomatostomus superciliosus* †
Detected from calls at KU2 and KU6.

CINCLOSOMATIDAE

Western Whipbird – *Psophodes nigrogularis oberon* †
Uncommon. Recorded on six occasions from its call. All calls were from mallee associations including KU1, KU2 and KU3. A complete account of recordings of this species is given in Section 5.1.

PACHYCEPHALIDAE

Crested Bellbird - *Oreoica gutturalis* †
Recorded from calls on nine occasions including from Sites KU1, KU3, KU6, KU7 and KU8.

Golden Whistler - *Pachycephala pectoralis fuliginosa* †
Recorded from its call, as single birds or in pairs. Recorded from open mallee at KU1, KU2 and KU5 and from the dense *Melaleuca cucullata* thicket at KU5.

Grey Shrike-thrush – *Colluricincla harmonica rufiventris* †
Recorded on four occasions including a single bird from the *Eucalyptus astringens* low forest at KU4 and three from the open mallee at KU5.

DICRURIDAE

Restless Flycatcher - *Myiagra inquieta inquieta* †
This species was only recorded from the Steere River within the lease boundary.

Magpie-lark - *Grallina cyanoleuca* ø
Single bird recorded from a farm dam in the vicinity of the proposed Trilogy Mine.

Willie Wagtail - *Rhipidura l. leucophrys* †
Recorded on just four occasions; twice from a small dam near KU3, once from a clearing along Steere River near KU8 and once from a small dam in the vicinity of KU7.

CAMPEPHAGIDAE

Black-faced Cuckoo-shrike - *Coracina n. novaehollandiae* †
Three records. Two records from the *Eucalyptus astringens* low woodland at KU4 and a single bird seen flying over mid-dense shrub mallee at KU3.

ARTAMIDAE

Dusky Woodswallow - *Artamus cyanopterus* †
Adults were regularly seen feeding two chicks at KU5, also seen over KU4 and KU7.

CRACTICIDAE

Grey Butcherbird - *Cracticus t. torquatus* †
Recorded from just two calls; one bird heard at KU5, another heard calling at KU6.

Australian Magpie - *Cracticus tibicen dorsalis* † ø
Single bird seen on track adjacent to KU7.

CORVIDAE

Australian Raven - *Corvus coronoides* † ø
Often recorded as birds flying overhead or from its call, this species was observed on 10 occasions including singles, twos and a group of three.

Grey Currawong - *Strepera versicolor* †
Recorded on 28 occasions across most sites but particularly in the disturbed areas.

HIRUNDINIDAE

Welcome Swallow - *Hirundo neoxena* †
Common, particularly around the abandoned sheds and buildings associated with previous mining operations. Often observed foraging along the access tracks.

Tree Martin - *Hirundo nigricans* †
Flocks of up to 12 birds seeing hawking for insects over several sites.

ZOSTEROPIDAE

Grey-breasted White-eye - *Zosterops lateralis gouldi* †
Recorded on 61 occasions with between one and three individuals seen at most sites within the study area. However, 46 records from the *Melaleuca cucullata* thickets at KU7.

MOTACILLIDAE

Australian Pipit - *Anthus a. australis* ø
Moderately common though restricted to the cleared paddocks at the proposed Trilogy mine.

Discussion

The 53 species at Kundip were represented by 1153 records, 26% of which were contributed by a single species, the New Holland Honeyeater (Table 3.2). Thirty-four species were recorded from ten or fewer individuals, with 13 being recorded from just one individual (Table 3.2).

The honeyeaters (Meliphagidae) were both the most abundant and specious family of birds within the Kundip project area. The nine species of honeyeaters comprised 17% of the total number of species and represented 42% of all records. The numerical dominance of the New Holland Honeyeater at Kundip compares favourably with the findings at Bandalup Hill during the 2000 October survey where this species comprised 26% of all records (Biota 2000).

The data collected from Trilogy was of an opportunistic nature and largely focussed on a small dam adjacent to the proposed mine.

In October 2000, a survey at the Bandalup Hill project area recorded a total of 70 species of birds from 30 families, including 28 non-passerines and 42 passerines (Biota 2001). Thirty-six of these species were recorded from Bandalup Hill itself whilst 31 were recorded from the adjacent Shoemaker-Levy site. Early studies by Craig and Chapman (1998) and Chapman (2000) increased the Bandalup total to 82 species. This compares to 379 species known from the South-west region (Storr 1991), 220 bird taxa recorded from the Fitzgerald Biosphere Reserve from over 201 sites investigated by Teale et al. (in prep.) and 89 species reported by Chapman and Newbey (1995) for the Ravensthorpe Range. Clearly, additional species would be detected from the Kundip site with further survey work, though given the relatively small array of different bird habitats available, the additional number of species is likely to be small. All species recorded from Kundip have been recorded from the Bandalup Hill study site. A survey of the Kundip Nature Reserve between 22 and 26 December 2003 recorded 48 species (Buchanan 2004).

There are six avian species of high conservation significance recorded from the Fitzgerald Biosphere Reserve that were not recorded in the Kundip Project area. These include:

- The Peregrine Falcon *Falco peregrinus* has been recorded from Bandalup Hill (Biota 2001);
- The Bush Stone-curlew *Burhinus grallarius* has been recorded from the Pallinup Nature Reserve and a single bird was heard calling 3 km southeast of Ravensthorpe during late 1997 (A. Sanders pers. comm., Teale et al. (in prep.)).
- Baudin's Cockatoo *Calyptorhynchus baudinii* has been reported from the Cocanarup Timber Reserve and in the northern sections of the Fitzgerald Biosphere Reserve (Teale et al. in prep.);
- A Ground Parrot *Pezoporus wallicus flaviventris* was collected from the Hopetoun to Ravensthorpe Rd in June 1995; other localities include Hamersley Drive and Moir track intersection, south of Old Ongerup Rd, West River Rd and Drummond Track;
- Rainbow Bee-eaters *Merops ornatus* have been recorded relatively frequently within the Biosphere Reserve, mostly from the northern section (Teale et al. in prep.); and
- Western Bristlebird *Dasyornis longirostris* was reported calling from East Mt Barren in July 1997 (A. Sanders pers. comm.), with one individual recorded on Bell track in 1981 and several birds recorded near Middle Mount Barren in 1997 (Teale et al. in prep.). This species was also recently sighted (December 2003) within the Kundip Nature Reserve (Buchanan 2004).

Table 3.2: Avifauna records from the Kundip (KU1 - 13) and Trilogy (TR1) survey sites during the January 2004 survey.

Common and Species Name	KU1	KU2	KU3	KU4	KU5	KU6	KU7	KU8	KU12	KU13	TR1	Opp	Total
Emu *Dromaius novaehollandiae*			2	4									6
Malleefowl *Leipoa ocellata*												1	1
Brown Quail *Coturnix ypsilophora*			3			1			4				8
Australian Shelduck *Tadorna tadornoides*											2		2
Australian Wood Duck *Chenonetta jubata*											10		10
Grey Teal *Anas gracilis*											10		10
Pacific Black Duck *Anas superciliosa*											16		16
Black-shouldered Kite *Elanus caeruleus axillaris*											1		1
Square-tailed Kite *Hamirostra isura*			1	2									3
Brown Goshawk *Accipiter fasciatus didimus*			1										1
Australian Kestrel *Falco cenchroides cenchroides*											1		1
Painted Button-quail *Turnix varia*			1										1
Common Bronzewing *Phaps chalcoptera*	1												1
Brush Bronzewing *Phaps elegans*												1	1
Carnaby's Cockatoo *Calyptorhynchus latirostris*	2					4	7						13
Purple-crowned Lorikeet *Glossopsitta porphyrocephala*	3	1	11	94	44	3	34	2					192
Australian Ringneck *Platycercus zonarius zonarius*	6	2		3		1	7			3			22
Red-capped Parrot *Platycercus spurius*		2			1								3
Fan-tailed Cuckoo *Cacomantis flabelliformis flabelliformis*			1										1
Shining Bronze Cuckoo *Chrysococcyx lucidus plagosus*	2					2		1					5
Boobook Owl *Ninox novaeseelandiae*												1	1
Barn Owl *Tyto alba delicatula*									1				1
Tawny Frogmouth *Podargus strigoides*												1	1
Spotted Nightjar *Eurostopodus argus*	1												1
Blue-breasted Fairy-wren *Malurus pulcherrimus*			3		5		2						10
Spotted Pardalote *Pardalotus punctatus*	2		1	3	6	3	9	1		1			26
Striated Pardalote *Pardalotus striatus uropygialis*	1	3	4	2	3	2	3	1					19
White-browed Scrubwren *Sericornis frontalis*		1	5	2	7	1	3	4					23
Shy Groundwren *Hylacola cauta*		4			2	5							11
Weebill *Smicrornis brevirostris*	1	3	6	17	15	11	15	1		2			71
Western Gerygone *Gerygone fusca fusca*				1									1

Table 3.2: Avifauna records from the Kundip (KU1 - 13) and Trilogy (TR1) survey sites during the January 2004 survey.

Common Name Species Name	KU1	KU2	KU3	KU4	KU5	KU6	KU7	KU8	KU12	KU13	TR1	Opp	Total
Broad-tailed Thornbill *Acanthiza apicalis*	2			2		1	2	2					9
Brown Honeyeater *Lichmera indistincta indistincta*	5	5	2	3	8	1	23						47
Purple-gaped Honeyeater *Lichenostomus cratitius*					1		8						9
White-eared Honeyeater *Lichenostomus leucotis novaenorciae*	1				1		1						3
Brown-headed Honeyeater *Melithreptus brevirostris leucogenys*		2											2
Western White-naped Honeyeater *Melithreptus chloropsis*				12			3			1			16
New Holland Honeyeater *Phylidonyris novaehollandiae*	29	57	1	30	42	50	74	10		8			301
Tawny-crowned Honeyeater *Phylidonyris melanops*	1	9			37		2						49
Yellow-throated Miner *Manorina flavigula*											2		2
Western Little Wattlebird *Anthochaera lunulata*	6	7				4	1	4		3			25
Red Wattlebird *Anthochaera carunculata*	4		4	7	2	4	13	2					36
Western Yellow Robin *Eopsaltria australis griseogularis*	1							1					2
Southern Scrub-robin *Drymodes brunneopygia*	2	3	1	5	7	3	3	3					27
White-browed Babbler *Pomatostomus superciliosus*		1				1							2
Western Whipbird *Psophodes nigrogularis oberon*	3	2	1										6
Crested Bellbird *Oreoica gutturalis*	1		2			3	1	2					9
Golden Whistler *Pachycephala pectoralis fuliginosa*	2	1			3		1	2					9
Grey Shrike-thrush *Colluricincla harmonica rufiventris*				1	3								4
Restless Flycatcher *Myiagra inquieta inquieta*								1					1
Willie Wagtail *Rhipidura leucophrys leucophrys*			2				1	1					4
Magpie-lark *Grallina cyanoleuca*											1		1
Black-faced Cuckoo-shrike *Coracina novaehollandiae*			1	2									3
Dusky Woodswallow *Artamus cyanopterus*				1	6		2						9
Grey Butcherbird *Cracticus torquatus torquatus*					1	1							2
Australian Magpie *Cracticus tibicen*							1						1
Grey Currawong *Strepera versicolor plumbea*	2	3	3		2	8	7	1		2			28
Australian Raven *Corvus coronoides perplexus*			1	1		4	1				3		10
Welcome Swallow *Hirundo neoxena*	1	6	10		2	12	4						35
Tree Martin *Hirundo nigricans nigricans*		12			8	3							23
Grey-breasted White-eye *Zosterops lateralis gouldi*	1	3	1		3	3	46	3		1			61
Australian Pipit *Anthus australis australis*											7		7

3.3 Mammals

Assemblage

The survey recorded 13 species of mammals, comprising one tachyglossid (Echidna), one dasyurid (carnivorous marsupial), two macropods (kangaroos and wallabies), one burramyid (Pygmy Possum), one tarsipedid (Honey Possum), three vespertilionids (vespertilionid bats), one molossid (sheathtail bat), one native and one introduced murid (murid rodents) and one canid (Fox).

Annotated List

Table 3.3 contains the mammal records from each fauna habitat type. The species are discussed individually in the following annotated list.

TACHYGLOSSIDAE

Echidna - *Tachyglossus aculeatus*

Evidence of this species in the form of diggings was recorded from the *Eucalyptus astringens* low woodland at KU4 and the open mallee and dense proteaceous thicket at KU6.

DASYURIDAE

Grey-bellied Dunnart – *Sminthopsis griseoventer*

Trapped on nine occasions from five sites, including KU1 (M55051), KU2 (M55059), KU4, KU5 (M55050) and KU7 (M55052 - 3). Captures comprised four males and five females including one carrying pouch young.

MACROPODIDAE

Western Grey Kangaroo - *Macropus fuliginosus*

Although scats and tracks (of varying ages) were recorded from most sites across the project area, actual sightings of animals were uncommon with just three records. Single animals were observed at KU3, KU4 and KU5. More individuals would likely be encountered in the open pasture at Trilogy particularly where such pastures lie adjacent to remnant vegetation.

Western Brush Wallaby – *Macropus irma*

Single dead animal recorded as a road kill adjacent to the entrance to the Kundip project area.

BURRAMYIDAE

Western Pygmy Possum – *Cercartetus concinnus*

This species was recorded on 56 occasions (M55054 – 8) from all sites pit-trapped during the survey. The majority of records (n=37, 66%) came from the *Eucalyptus astringens* woodland site KU4, with the low woodland of *Melaleuca cucullata* yielding the next highest number (n=9, 16%). The remaining sites yielded between one and three captures. The tally comprised 35 males and 21 females including five that were carrying pouch young.

TARSIPEDIDAE

Honey Possum – *Tarsipes rostratus*

Easily the most commonly recorded mammal from the project area, this species was recorded on 84 occasions from all sites with pit traps. The most number of captures (n=25, 30%) was recorded from KU2 which supported a large number of flowering *Banksia lemanniana*. The sex ratio of captures was skewed towards males with 47 captures compared to just 29 female captures (the sex of eight animals was unrecorded). Three of the females were carrying pouch young.

VESPERTILIONIDAE

Gould's Wattled Bat – *Chalinolobus gouldii*

Calls of this species were recorded adjacent to the mine shafts at KU12.

Chocolate Wattled Bat - *Chalinolobus morio*
Calls of this species were recorded from the *Eucalyptus astringens* woodland at KU4.

Southern Forest Bat - *Vespadelus regulus*
Calls of this species were recorded from the *Eucalyptus astringens* woodland at KU4.

MOLOSSIDAE

White-striped Freetail Bat – *Tadarida australis*
Calls of this species were recorded from about the mine shafts at KU12

MURIDAE

Bush Rat – *Rattus fuscipes*
This common species was recorded on 16 occasions, including 10 records from the *Melaleuca* sp. Kundip dense heath at KU5. Also recorded from dense low mallee at KU3 and similar habitat along the cage transect (KU11).

INTRODUCED MAMMALS

MURIDAE

House Mouse - *Mus musculus*
Six records of this species including single records from KU1, KU2 (M55049), KU6 (M55048) and KU 7 and two records from KU3.

CANIDAE

Red Fox - *Vulpes vulpes*
Scats recorded from the vehicle track adjacent to KU3.

Discussion

The survey recorded 13 species of mammals (Table 3.3), which compares to 17 recorded by Biota (2000) from Bandalup Hill, 17 by Chapman (2000) and Chapman and Craig (1998) also from Bandalup Hill, and 13 recorded by Sanders (1996) from the Bandalup Corridor in the vicinity of Bandalup Hill.

A search of the Museum's fauna record database for specimens vouchered from an area bounded by -33.6596°S (Northern Latitude), -33.6966°S (Southern Latitude), 120.2164°E (Western Latitude) and 120.1745°E (Eastern Latitude) yielded two taxa; *Macropus eugenii derbianus* and *Rattus fuscipes*.

Although the mammal assemblage recorded by this survey was comparable to that documented at Bandalup Hill, there is a notable decrease in the abundance of rodents compared to that documented by Chapman (2000). This may be due in part to a difference in survey effort:

1. This study - 516 pit-trap nights, 800 Elliott trap nights and 125 cage trap nights over one season; versus
2. Chapman (2000) - 480 pit-trap nights, 1000 Elliott trap nights and 200 cage trap nights across spring 1999 and autumn 2000.

However, there is also likely to be a climatic element, possibly reflected in the relative abundance of the House Mouse *Mus musculus* (a species known to respond quickly to favourable conditions). Chapman (2000) documented 211 records of this species, compared to just six recorded during this survey. Similarly, he reported 147 records of the Southern Bush Rat *Rattus fuscipes* compared to 16 from this survey. With respect to the rarer species, Chapman (2000) documented 17 records of the Western Mouse *Pseudomys occidentalis* and five records of the Heath Rat *Pseudomys shortridgei*. No records of either were recorded during the current survey. If rodent numbers are generally low as is suggested by these data then the chances of detecting rarer species such as the Heath Rat are greatly diminished.

Notably, a targeted survey for the Heath Rat carried out at the Bandalup Hill study site between the 2/2/04 and 6/2/04 also failed to record this species from sites where it was previously recorded. Further discussions on the occurrence of rare species are given in Section 5.1.

Table 3.3: Mammals recorded at each of the primary survey locations.

Species Code	KU1	KU2	KU3	KU4	KU5	KU6	KU7	KU11	KU12	Opp	Total
TACHYGLOSSIDAE											
Tachyglossus aculeatus				S		S					
DASYURIDAE											
Sminthopsis griseoventer	1	3		1	2		2				9
MACROPODIDAE											
Macropus fuliginosus	S	S	1	1	S	1	S	S			3
Macropus irma										1	1
BURRAMYIDAE											
Cercartetus concinnus	2	2	2	37	1	3	9				56
TARSIPEDIDAE											
Tarsipes rostratus	7	25	16	6	9	13	8				84
VESPERTILIONIDAE											
Chalinolobus gouldii									C		C
Chalinolobus morio				C							C
Vespadelus regulus				C							C
MOLOSSIDAE											
Tadarida australis									C		C
MURIDAE											
Rattus fuscipes			2		10			4			16
*Mus musculus**	1	1	2			1	1				6
CANIDAE											
*Vulpes vulpes**			S								

* Denotes introduced species.
c Denotes calls.
s Denotes signs, eg. tracks, scats etc.

3.3.1 Bats

At least four bat species are likely to be present, based on examination of call sequences: *Chalinolobus gouldii* (Figure 3.1, Table 3.4), *C. morio* (Figure 3.2, Table 3.4), *Vespadelus regulus* (Vespertilionidae; Figure 3.3, Table 3.4) and *Tadarida australis* (Molossidae; Figure 3.4, Table 3.4). Many sequences were of poor quality, limiting the confidence with which some sequences could be classified.

Seven bats may occur within the project area on the basis of previously defined distribution and habitat preferences (Table 3.5). Of these species, none are listed for the area on the mammal database of the Western Australian Museum.

Table 3.4: Mean values for three call variables used to identify bat species (Mean ± Standard Deviation, with range; n: number of sequences analysed, with total number of pulses in brackets).

Species	n	Minimum Frequency	Maximum Frequency	Duration
Chalinolobus gouldii	1(7)	27.2±0.45 Range 27-28	33.2±1.89 Range 30.5-35	6.6±0.8 Range 5.75-7.75
Chalinolobus morio	1(5)	49.7±0.61 Range 48.5-50	60.75±2.84 Range 58-65	2.54±0.25 Range 2.25-2.75
Tadarida australis	1(6)	11.64±0.63 Range 11-13	15.57±0.45 Range 15-16	12.76±1.82 Range 9.75-14.5
Vespadelus regulus	4(17)	42.94±1.2 Range 40.5-44.5	67.71±6.19 Range 52-75	3.94±1.36 Range 2.25-6.5

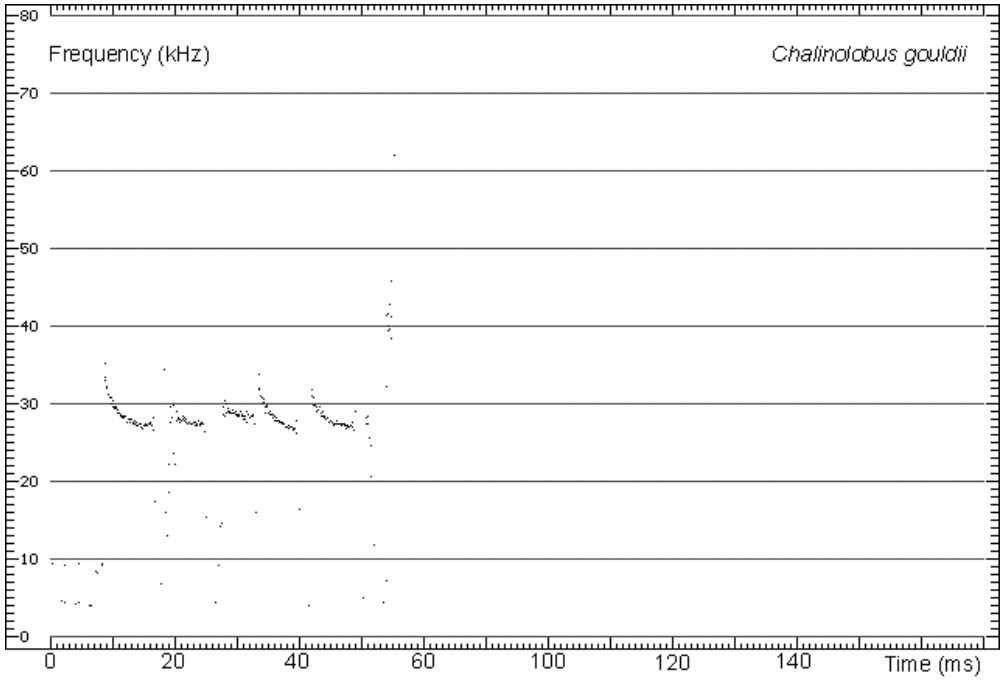

Figure 3.1: Call sequence identified as that of Gould's wattled Bat *Chalinolobus gouldii.* The minimum frequency of calls in this sequence is relatively low for this species, and relatively close to that of *Mormopterus planiceps*. Time is compressed between each pulse in this and each sequence to follow.

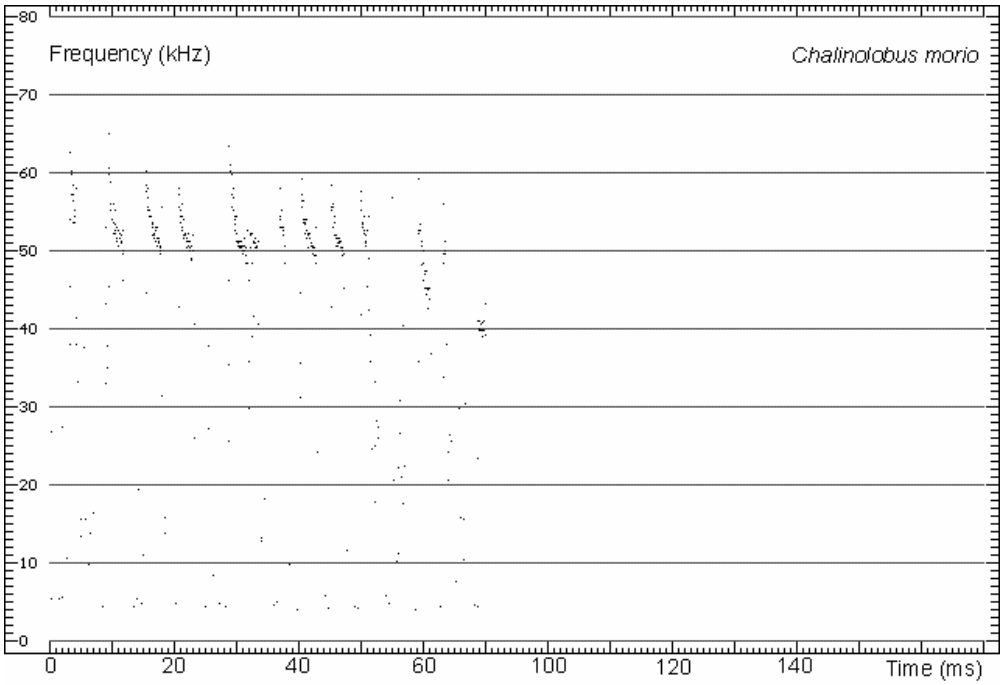

Figure 3.2: Call sequence identified as that of the Chocolate Wattled Bat *Chalinolobus morio*. This was the only sequence recorded of this species.

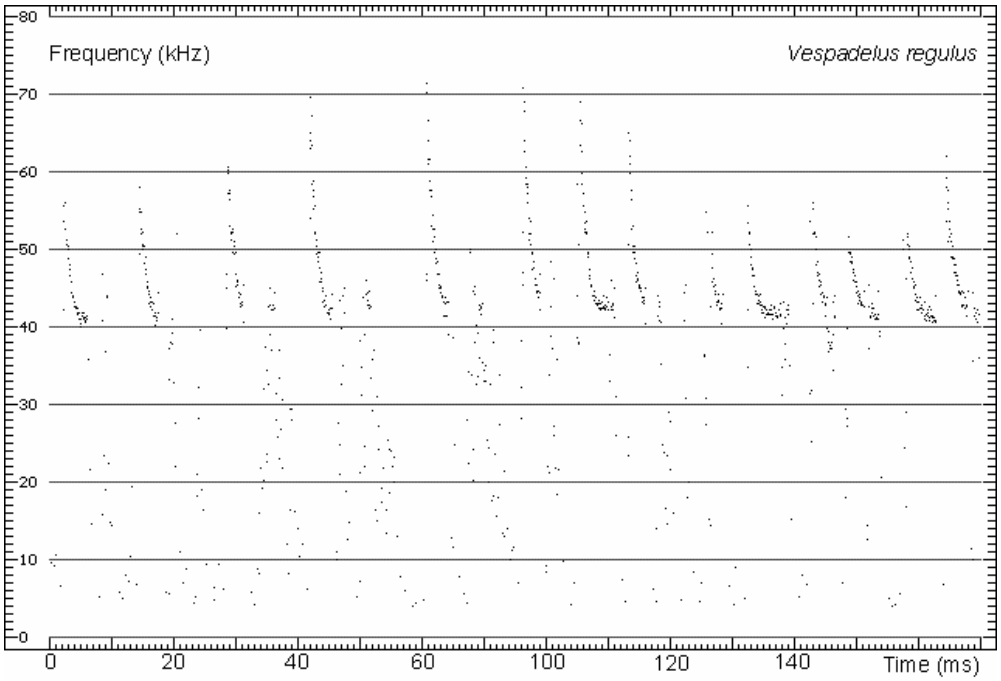

Figure 3.3: Call sequence of the Little Forest Bat *Vespadelus regulus*. Most sequences attributed to this species were difficult to identify unambiguously since they were of a type usually produced in clutter.

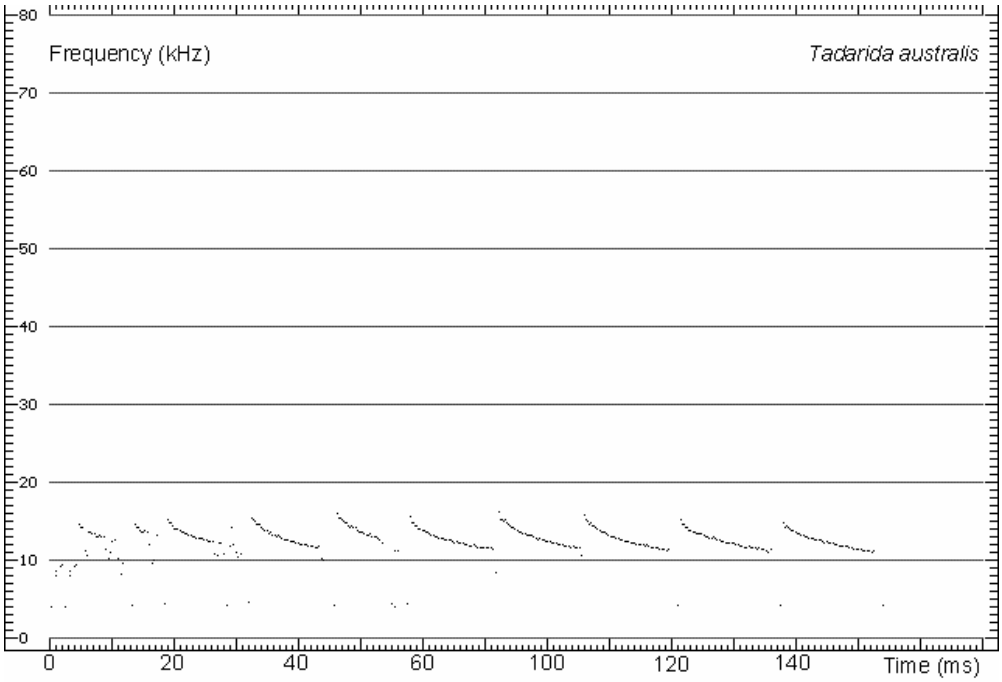

Figure 3.4: Call sequence of the White-striped Freetail Bat *Tadarida australis*.

Table 3.5: Summary of bat species potentially occurring in the vicinity of Kundip (sources: Western Australian Museum; Churchill 1998).

Common Name	Scientific Name	Roost Habitats	Foraging Habitat[1]	Food Preference	Aerial Foraging Niche
Gould's Wattled Bat	*Chalinolobus gouldii*	Tree hollows, foliage, buildings, under bark	Most habitats	Predominantly moths but a generalist	Within the lower level of canopy and along edges
Chocolate Wattled Bat	*Chalinolobus morio*	Tree hollows, buildings, under bark, bridges, martin nests	Forest, woodland, scrub	Predominantly moths but a generalist	Between canopy and understory, forest trails
Lesser Long-eared Bat	*Nyctophilus geoffroyi*	Tree hollows, foliage, buildings, under bark	Various: forest, woodland, scrub	Predominantly moths but a generalist	Gleaner, in and around vegetation
Greater Long-eared Bat	*Nyctophilus timoriensis*	Tree hollows, under bark	Tall eucalypt forests, mallee and woodlands.	Largely feeds on ground where beetles make up a significant component of their diet	Gleaner of underside of leaves and ground feeder.
Southern Forest Bat	*Vespadelus regulus*	Tree hollows	Various: forest, woodland, mallee, shrublands	Predominantly moths but also beetles and other aerial insects	In and around vegetation. Foraging at less than half the canopy height
Western Freetail Bat	*Mormopterus* sp	Tree hollows	Various: forest, woodland, mallee, coastal heaths	Unknown.	Unknown
White-striped Freetail Bat	*Tadarida australis*	Trees	Forest, woodland, scrub, urban	Moths and beetles.	Open areas, above canopy, ground

[1] Foraging habitats summarised from Churchill (1998) and are not necessarily present in the project area.

3.4 Herpetofauna

The Assemblage

Three frog and 21 reptile species were recorded from the project area during the current study (Table 3.6). The reptiles comprised four geckos, three pygopods, one agamid, one varanid, 10 skinks and two elapid snakes (common names after Cogger, 1996). Specimens lodged with the WA Museum have been assigned numbers R154175 - 243 and R154431 - 59. These are given below where relevant.

Evidence of breeding was noted for a number of species including *Diplodactylus granariensis granariensis, Cryptoblepharus virgatus clarus, Hemiergis initialis initialis*, *Hemiergis peronii peronii* and *Morethia obscura*.

Table 3.6 summarises the records of herpetofauna from each site and opportunistic collections. Each species is discussed individually in the following.

Annotated List

MYOBATRACHIDAE

Bleating Froglet - *Crinia pseudinsignifera*
Recorded on two occasions. Captured from beneath tin and leaf litter at KU9 (R154188) and pit-trapped at KU1 (R154451).

?White-footed Trilling Frog - *Neobatrachus kunapalari*
Single specimen (R154452), pit-trapped from gravelly sand at KU1. Note that this individual was not heard calling so the identification remains tentative.

HYLIDAE

Spotted-thighed Tree Frog - *Litoria cyclorhyncha*
Recorded from two specimens and a number of calls. A single animal was collected whilst head-torching at KU2 (R154431) and another from KU12. Numerous calls were heard at KU12 and from pools of water in the open cut pit adjacent to KU2.

GEKKONIDAE

Clawless Gecko - *Crenadactylus ocellatus ocellatus*
Recorded on 13 occasions, either from under debris or pit-traps, typically from clayey soils. Four animals recorded from the *Eucalyptus astringens* low woodland at KU4 (R154187, R154199 and R154232), single animal recorded from beneath debris at KU6 (mallee on clay) and eight were recorded from beneath tin and wood piles at KU8 (R154192 - 93), KU9 and KU10 (R154189 - 91).

Wheatbelt Stone Gecko - *Diplodactylus granariensis granariensis*
Recorded on 30 occasions. Most records (n=18) from the *Eucalyptus astringens* woodland at KU4 where there was plenty of fallen timber for shelter (R154175 – 77, R154179, R154237-38, R154433, R154454 – 56 and R154458 – 59) and included 11 animals collected head-torching one evening. Also recorded from KU1 (n=1), KU3 (n=2; R154180, R154443), KU5 (n=3; R154181, R154450), KU6 (n=3; R154445), KU7 (n=2; R154178, R154239) and KU12 (n=1). Records included one gravid female.

Marbled Gecko - *Christinus marmoratus*
Recorded on 14 occasions, either head-torching (n=1), raking beneath debris (n=3), from pit-traps (n=3) or from under tin and wood-piles (n=7). Most records (n=7) from those sites with tin and wood-piles (KU8, KU9 and KU10; R154183 - 86), although also recorded from the *Eucalyptus astringens* low woodland at KU4 (n=3) and the mallee at KU3 (n=3). A single animal was pit trapped from amongst *Banksia media* at KU1.

Barking Gecko - *Underwoodisaurus milii*
Ten records of this species, mostly hand captured from beneath tin and wood-piles (KU8 and KU9) or located whilst head-torching (KU12). Only two records from pit-traps (KU2 and KU7). Four specimens vouchered including R154236, R154432 and R154436 – 7.

PYGOPODIDAE

Aprasia repens
Just a single specimen recorded from the grey sands at KU1 (R154457).

Delma australis
Recorded on just three occasions, all from pit-traps. Single recorded from amongst the *Banksia lemanniana* on skeletal loams at KU6 (R154234) and two from similar habitat at KU2 (R154242 – 3).

Fraser's Legless Lizard - *Delma fraseri fraseri*
Just two records, both from pit traps. A single animal trapped in the *Banksia lemanniana* on skeletal pale grey loams at KU6 (R154435) and another from mallee on red brown loamy clays at KU3 (R154194).

AGAMIDAE

Ctenophorus maculatus griseus
This species was recorded on four occasions all from the pale gravelly sands at KU1. A single female was pit trapped, whilst the remainder were seen active in sunny patches.

VARANIDAE

Southern Monitor - *Varanus rosenbergi*
Recorded on nine occasions, typically as opportunistic records of animals crossing access tracks, but also from cage traps, Elliott traps and pit traps.

SCINCIDAE

Cryptoblepharus virgatus clarus
Second most commonly recorded species (n=28) after *Diplodactylus g. granariensis*. Most records were of individuals seen on timber, including crates and pallets etc lying around the old mines and on fallen logs particularly in debris piles on the side of tracks, but also on mine shaft walls. Six specimens vouchered including (R154195 – 98, R154235 and R154449). Records included one gravid female.

Ctenotus impar
Recorded on three occasions, including two records from the *Banksia lemanniana* on skeletal pale grey loamy sands at KU6 (R154226 – 7) and a single from similar habitat at KU2 (R154442).

Ctenotus labillardieri
A single animal was recorded from beneath tin at KU9 (R154453).

Hemiergis initialis initialis
One of the most commonly recorded species with 24 records, mostly raked from beneath soil and litter in the *Eucalyptus astringens* woodland at KU4 (n=8) or the *E. platypus* woodland at KU13 (n=3), but also from beneath tin and wood-piles at KU8 and KU9 (n=3). Pit-trapped at all trapping sites. Twelve individuals vouchered including R154211 – 20, R154439 – 40 and R154447. Records included two gravid females.

Hemiergis peronii peronii
This species was pit-trapped on seven occasions, including one each from KU3 and KU7, two from KU2 (including R154434) and three from KU5. In contrast, it was recorded on 15 occasions from beneath layers of tin and wood-piles, mostly from KU9 (n=12; R154202 – 08), but also from KU8 (n=2, R154209 – 10) and KU10 (n=1, R154201). Specimens were also raked from beneath wood and leaf litter particularly along windrows. Specimens included two gravid females.

Lerista distinguenda
Recorded on just five occasions, all as pit-trapped animals. Most records from amongst *Banksia lemanniana* at KU6 (n=4, including R154229, R154231 and R154240 – 1), with a single animal recorded from the *Banksia media* at KU1 (R154230).

Lerista viduata
Single specimen collected from a pit trap at KU2 (determined by Greg Harold).

Menetia greyii
This species was relatively uncommon with just four records. Single animals were pit-trapped from KU3, KU4 (R154228), KU5 (R154441) and KU6 (R154233).

Morethia obscura
Recorded on twelve occasions including seven from pit traps, four collected from beneath debris and one observed active. Records from KU3 (n=2 including R154224), KU4 (n=3, including R154222 and R154225), KU6 (n=4 including R154221 and R154223), KU8 (n=2) and KU9 (n=1). Records included one gravid female.

Bobtail - *Tiliqua rugosa rugosa*
Recorded on just two occasions, a single animal trapped at KU2 and a skull collected from KU4.

ELAPIDAE

Dugite - *Pseudonaja affinis affinis*
Recorded on two occasions, one specimen caught in an Elliott trap (where it regurgitated a partially digested *Cercartetus concinnus*) and a second disturbed from a wood pile in the *Eucalyptus astringens* woodland.

Tiger Snake - *Notechis scutatus occidentalis*
Single specimen seen on highway adjacent to the main access track.

Discussion
The thoroughness of surveys is often gauged in terms of the completeness of the recorded species assemblage in comparison to the known and predicted assemblage, as collated from the State's collection (housed at the WA Museum) and published and unpublished studies. The current study recorded three frogs and 21 reptiles (Table 3.6). This compares to 70 species recorded from the Fitzgerald Biosphere Reserve (Teale et al. in prep.) comprising two hylids (tree frogs), 13 myobatrachids (ground frogs), one cheluid (freshwater tortoise), six agamids (dragon lizards), six geckos (geckos), six Pygopodidae (legless lizards), 20 Scincidae (skinks), two Varanidae (monitor lizards), five Typhlopidae (blind snakes), one Boidae (python) and eight Elapidae (front-fanged snakes) (from Teale et al. in prep.). These latter tallies have been sourced from collections and surveys spanning many decades and a greater array of habitats than present in the Kundip survey area (Teale et al. in prep.). The potential occurrence of many of these species within the Kundip study site could be discounted based on the absence of suitable habitat (eg. lack of granite outcrops for *Ctenophorus ornatus*).

A more appropriate comparison is probably gained from analysis of comparable surveys (in terms of area, duration and habitats examined) carried out locally. Biological surveys at Bandalup Hill associated with the Ravensthorpe Nickel project have been undertaken since 1998, whilst Sanders (1996) conducted trapping in the Bandalup Corridor and Chapman undertook a trapping program in the Ravensthorpe Range. Craig and Chapman (1998) and Chapman (2000) recorded five species of frog and 18 species of reptiles from the proposed Halley's pit area and the long term monitoring sites at Bandalup Hill. Further studies at Bandalup Hill added seven additional species, and investigations of sandy substrates adjacent to Bandalup Hill as part of the Shoemaker extension added another one species (Biota 2001 and Teale et al. in prep.). Four frogs and 22 reptiles were collected from study sites examined by Sanders (1996), whilst Chapman and Newbey (1995) recorded seven frog and 27 reptiles from the Ravensthorpe Range surveys. From

these comparisons it can be seen that the Kundip survey recorded a relatively standard assemblage for the region given the survey duration, and that additional sampling would in all likelihood add additional species.

Notably absent from the results were any records of blind snakes (Typhlopidae) despite the apparent suitability of conditions (approximately 30 mm of rainfall over four days). The review by Teale et al. (in prep.) indicates that up to five species may be recorded from the Biosphere Reserve, including one currently undescribed species known from the Cocanarup Timber Reserve and possibly Cape Arid National Park to the east of Esperance.

Snakes in general were poorly represented during the survey with just three records across two species (Table 3.6). An additional four species of elapid snakes including the Crowned Snake *Elapognathus coronatu*s, Bardick *Echiopsis curta*, Gould's Snake *Parasuta gouldii* and Black-backed Snake *P. nigriceps*, and one python the Carpet Python *Morelia spilota imbricata* may all occur at Kundip. The latter species is listed as a Schedule 4 species and is discussed in more detail in Section 5.1.

With the exception of the skink *Lerista viduata* and the Carpet Python *Morelia spilota imbricata,* none of the herpetofauna recorded or potentially occurring are of special conservation status according to State lists. However, little is known of the distribution and taxonomic status of the as yet undescribed blind snake *Ramphotyphlops* sp., so its conservation status is questionable.

Of additional note is the possible occurrence of the dragon *Amphibolurus norrisi*. The known distribution of this species was extended westward to Bandalup Hill by Chapman (1998), currently the only known locality for this species in the Fitzgerald Biosphere Reserve.

A search of the Museum's fauna record database for an area bounded by -33.6596°S (Northern Latitude), -33.6966°S (Southern Latitude) 120.2164°E (Western Latitude) and 120.1745°E (Eastern Latitude) yielded seven taxa (Appendix B), comprising two myobatrachid frogs, one agamid, one gecko and three skinks.

Table 3.6: Herpetofauna records from the Kundip project area.

Species Code	KU1	KU2	KU3	KU4	KU5	KU6	KU7	KU8	KU9	KU10	KU11	KU12	KU13	Opp	Total
Myobatrachidae															
Crinia pseudinsignifera	1								1						2
Neobatrachus kunapalari	1														1
Hylidae															
Litoria cyclorhyncha		1										7			8
Gekkonidae															
Crenadactylus ocellatus ocellatus				4		1		2	3	3					13
Christinus marmoratus	1		3	3				3	2	2					14
Diplodactylus granariensis granariensis			2	18	3	3	2					1			30
Underwoodisaurus milii		1					1	1	3			4			10
Pygopodidae															
Aprasia repens	1														1
Delma australis		2				1									3
Delma fraseri fraseri		1	1												2
Agamidae															
Ctenophorus maculatus griseus	4														4
Varanidae															
Varanus rosenbergi	1	2	3		1	1					1				9
Scincidae															
Cryptoblepharus virgatus clarus		5	1	2		1		5	8	3		3			28
Ctenotus impar		1				2									3
Ctenotus labillardieri									1						1
Hemiergis initialis initialis	1	2	1	10	2	1	1	2	1				3		24
Hemiergis peronii peronii		3	2	2	3		1	2	12	1					26
Menetia greyii			1	1	1	1									4
Morethia obscura			2	3		4		2	1						12
Lerista distinguenda	1					4									5
Lerista viduata		1													1
Tiliqua rugosa rugosa		1		1											2
Elapidae															
Notechis scutatus occidentalis														1	1
Pseudonaja affinis affinis							1						1		2
Total species	**9**	**11**	**9**	**9**	**5**	**10**	**5**	**7**	**9**	**4**	**1**	**4**	**1**	**1**	**24**

4.0 Invertebrate Fauna Inventory Survey

4.1 Overview

Many recent publications have highlighted taxonomic groups of invertebrates with naturally small distributions (less than 10, 000 km^2) (general reference, Harvey 2002; freshwater snails, Ponder and Colgan 2002; land snails, Clark and Richardson 2002). These taxa are variously described as narrow range endemics or short-range endemics (see Harvey 2002) 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 millipedes, mygalomorph spiders, and freshwater and terrestrial molluscs.

The survey of Kundip recorded over 30 invertebrate taxa, many of which were not identified beyond family level. Only those taxa belonging to groups known to include short-range endemics (Mygalomorphs, Pulmonate land snails), that were otherwise of conservation significance (eg. Buprestidae) or for which expertise was readily available at the WA Museum (eg. wolf spiders and other spider groups) were identified to genus or species level.

4.2 Arachnida

4.2.1 Mygalomorph Spiders

Two species of mygalomorph spiders from the family Nemesiidae were recorded from the Kundip project area; *Aname mainae* and *Chenistonia tepperi*. Three juvenile females from this family were excavated from burrows in the Moort *Eucalyptus platypus* woodland (KU13) and could not be identified beyond family level.

- *Aname mainae*

A total of nine specimens were collected, all of which were adult males and all from pit-traps. This species (Plate 4.1) was widespread throughout the project area, recorded from all sites with the exception of KU2 and KU4. At KU4 it was apparently replaced by another species *Chenistonia tepperi* (see below). Its absence from KU2 probably reflects a sampling artefact, as it was recorded from the same vegetation type (and presumably soil type) at KU6. The distribution of *A. mainae* is shown in Figure 4.1.

Plate 4.1: *Aname mainae* from KU5.

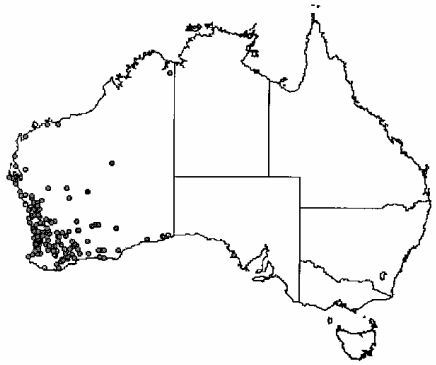

Figure 4.1: Distribution of *A. mainae* (map provided by the WA Museum).

- *Chenistonia tepperi*

Apparently much less widespread in the project area than *Aname mainae*, *C. tepperi* (Plate 4.2) was only recorded from three adult males collected from pit-traps in the *Eucalyptus astringens* woodland on grey, calcareous clay loam. The broader distribution of *C. tepperi* encompasses mostly coastal localities in the far South-west, with scattered records from the Wheatbelt.

Plate 4.2: *Chenistonia tepperi* from KU4.

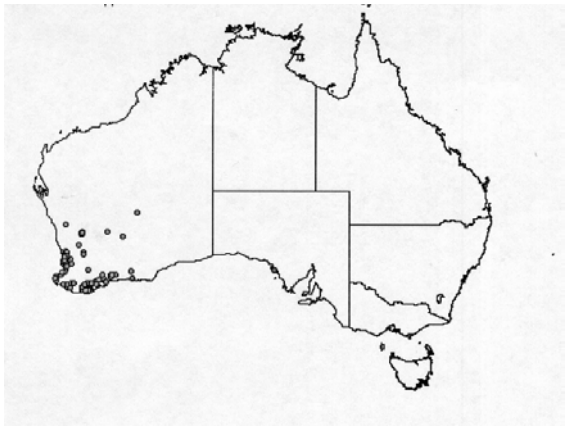

Figure 4.2: Distribution of *C. tepperi* (map provided by the WA Museum).

4.2.2 Lycosidae Wolf Spiders

The family Lycosidae is currently the subject of a detailed taxonomic review by Dr. Volker W. Framenau of the Western Australian Museum and many specimens collected cannot be allocated to a described species. There are currently 145 wolf spider species in 22 genera in Australia (http://www.alphalink.com.au/~framenau/Lycosidae/) with an estimated 300-500 species awaiting description (Dr. Volker Framenau pers. comm. 2004).

Five species of Lycosidae were collected during the survey including *Hoggicosa* sp (member of the *bicolor* group) (Plate 4.3), *Lycosa ariadnae*, *Venator* sp1 (undescribed species, Plate 4.4), *Venator* sp2 (undescribed species) and *Zoica* sp1 (new species). The *Zoica* sp is of interest as it is a rarely collected genus due to its small size (Framenau pers. comm. 2004). This particular species was only collected from the sandy loam with a quartzite rubble in the south-west sector of the lease at KU5, but may well occur elsewhere. This site also supports a potentially new species of *Melaleuca* that may have a very restricted distribution (Dr. Gillian Craig pers. comm. 2004).

Plate 4.3: *Hoggicosa* species from KU2.

Plate 4.4: *Venator* sp1 collected from KU4.

Lycosa ariadnae is one of the most commonly collected Wolf Spiders within the WA Museum's collection. This largely southwestern Western Australian species has a distribution demarcated by a line drawn from the Murchison River Bridge through Mullewa, 30km east of Wubin, between Merredin and Southern Cross to Hopetoun (McKay 1979). A single specimen is also known from South Australia (see Figure 4.3). It is absent from Karri forest and some areas of Jarrah (McKay 1979). This current classification encompasses two distinct taxa, with those collected from Kundip representing the nominate form (Dr. V. Framenau pers. comm. 2004).

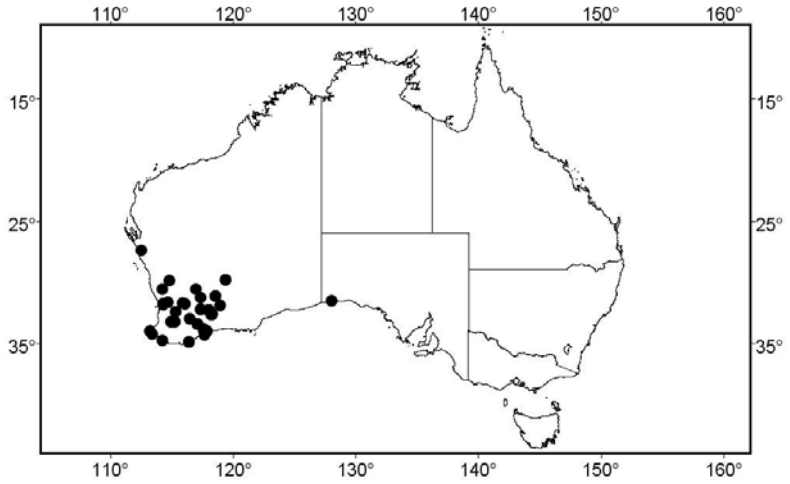

Figure 4.3: Distribution of *Lycosa ariadnae* (map provided by the Western Australian Museum).

4.2.3 Other Spiders

Several other spiders were collected during the survey, either from pit traps or whilst head-torching. These included a species of *Isopedella* from the family Sparassidae, and representatives of the Gnaphosidae, Oxyopidae, Salticidae, Zoridae and Zodariidae.

4.3 Pulmonata

4.3.1 *Bothriembryon* snails

A single Bothriembryon that was not known to Ms Shirley Slack-Smith (WA Museum) was collected during the survey from leaf litter at KU8. *Bothriembryon* snails are potentially of interest as they may have relatively small distributions (ie. short-range endemics). Additional collections could be made in winter, when these species are typically active, to better document their occurrence within and adjacent to the project area.

4.4 Scorpionida

Two species of scorpion were collected from the study area comprising several specimens of the buthid *Archisometrus austroccidentalis* and a single juvenile urodacid that could not be identified beyond the level of genus, *Urodacus* sp. *A. austroccidentalis* was represented by seven specimens from four sites including KU3, KU4, KU5 and KU8. The *Urodacus* sp was collected from beneath a large rock at KU6.

4.5 Buprestidae

Two species of buprestid beetle were collected during the survey. The following information regarding taxonomy and identification was kindly provided by Mr David Knowles.

Astraeus (*Depollus*) *multinotatus* is endemic to WA with records from the Murchison, Coolgardie, Yalgoo, and Mallee bioregions (after Thackway and Cresswell 1995). Specimens have been collected from mid September through to early February on *Allocasuarina dielsiana*, *A. humilis* and *A. helmsii*.

Cisseis duodecemaculata is a widespread species recorded from the Swan, Geraldton Sandplain, Avon-Wheatbelt, Jarrah Forrest, Mallee, Esperance, Coolgardie and Hampton bioregions, as well as inter-state (after Thackway and Cresswell 1995), between early November and early March. In Western Australia, this species has been collected from *Allocasuarina corniculata*, *A. littoralis*, *A. acutivalvis*, *A. huegeliana*, *A. humilis* and *Xanthorrhoea preissii*. According to Mr David Knowles (pers. comm. 2004), it represents one of the most widespread and common members of its genus and is probably a complex of similar species.

5.0 Conservation Significance

5.1 Threatened Fauna

Native fauna species which are rare, threatened with extinction or have high conservation value are specially protected by law under the *Western Australian Wildlife Conservation Act 1950.* In addition, some species of fauna are covered under the 1991 ANZECC convention, while certain birds are listed under the Japan and Australia Migratory Bird Agreement (JAMBA) and the China and Australia Migratory Bird Agreement (CAMBA).

Classification of rare and endangered fauna under the *Wildlife Conservation (Specially Protected Fauna) Notice 1998* recognises four distinct schedules of taxa:

1. Schedule 1 taxa are fauna which are rare or likely to become extinct and are declared to be fauna in need of special protection;

2. Schedule 2 taxa are fauna which are presumed to be extinct and are declared to be fauna in need of special protection;

3. Schedule 3 taxa are birds which 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

4. Schedule 4 taxa are fauna 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 four different Priority codes:

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

Taxa which are known from 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 which 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 which 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.

Conservation Dependent Species

This list includes species previously listed as Specially Protected Fauna (Schedule 1) but that have benefited from fox baiting such that populations have increased substantially. However, it is felt that without continued baiting and monitoring, populations may again be at risk.

Two Schedule listed fauna were recorded from the project area; Carnaby's Cockatoo *Calyptorhynchus latirostris* and the Malleefowl *Leipoa ocellata*. The survey also recorded three Priority species; the skink *Lerista viduata,* Western Whipbird (southern WA subspecies) *Psophodes nigrogularis oberon* and Western Brush Wallaby *Macropus irma*. See under each species in the above annotated lists for more details.

A search of the CALM Schedule and Priority Fauna database for species potentially occurring in the area yielded six Schedule 1 species, two Schedule 4 species and six Priority species (see Appendix C). An additional Schedule 1, Schedule 4 and Priority taxon may occur in the area based on other information. More detailed discussion for these species of conservation significance is given below.

Schedule 1 Fauna

- Carnaby's Cockatoo *Calyptorhynchus latirostris* (Endangered under *EPBC Act 1999*)

This species occupies the south-western zone between Kalbarri and Esperance, and was recorded during the current survey. It feeds on the seeds and flowers of a range of species including *Banksia*, *Dryandra*, *Hakea*, *Eucalyptus* and *Grevillea*. Clearing of semiarid sandplains and removal of its principal nesting tree (salmon gum) from the Wheatbelt has been implicated in the decline of this species (Garnett 1992; Johnstone and Storr 1998).

Recorded on three occasions as flocks of between two and seven individuals flying over the project area. These birds were not positively identified as *C latirostris,* rather the identification is based on the current distribution of the two White-tailed Black Cockatoos in WA as given by Johnstone and Storr (1998).

- Western Ground Parrot *Pezoporus wallicus flaviventris* Schedule 1 (Endangered under *EPBC Act 1999*)

At the time of European settlement, the Western Ground Parrot probably extended though coastal and near-coastal areas from Point Malcolm in the east to Dongara in the north. They had disappeared from all areas west of Albany in the first few decades of the 20th century, although recent unconfirmed reports from around Jurien Bay raise hope that a small population may still exist there. Until the existence of this population is confirmed, it is generally accepted that Western Ground Parrots remain in only three areas. The main population is found within Fitzgerald River National Park, with smaller populations to the west in the Cheyne Beach/Waychinicup area and to the east in Cape Arid National Park and Nuytsland Nature Reserve. The total population is estimated to be only about 250 individuals. The population trends of the Fitzgerald River and Cape Arid populations are not clear due to large variations in the number of singing birds recorded but recent surveys indicate that the Cheyne Beach population has declined dramatically and may be close to extinction.

The subspecies typically occurs in low heathland, including low *Banksia* and *Hakea*, and often occurs in low open mallee in swampy areas. Sites are typically not occupied until they are at least six years post fire, often older, and densities typically increase until the vegetation is 20 to 30 years post-fire.

It is possible, but not probable that the species occurs in the study area. Factors in favour of its occurrence are that the study area lies between known populations and the habitat appears suitable. In addition, the subspecies typically only calls well before dawn or well after dusk and is almost impossible to see, so it may be missed by standard diurnal bird surveys. Factors against its occurrence are that the distribution of the subspecies is well

known and that the area is relatively frequently visited by birders yet this species has not been recorded.

- Malleefowl *Leipoa ocellata* Schedule 1 (Vulnerable under *EPBC Act 1999*)

Just the single record from the project area. This species appears to be relatively common in the Ravensthorpe district compared to other areas in its range, and has been recorded throughout mallee-heath habitat in the Fitzgerald Biosphere Reserve (Teale et al. in prep.).

No attempt was made to systematically search the project area for active mounds during the current survey and such a search of the impact areas may be warranted once these have been identified.

- Chuditch *Dasyurus geoffroyii* (Vulnerable under *EPBC Act 1999*)

Single record of this species from the Kundip townsite during 1992. A single male roadkill was also recorded in May 1994 10km east of Ravensthorpe on Highway 1 in mallee-heath (Teale et al. in prep.).

- Dibbler *Parantechinus apicalis* (Endangered under *EPBC Act* 1999).

Record from Kundip in 1986.

- Heath Rat *Pseudomys shortridgei*

Within the Fitzgerald Biosphere Reserve this species appears to be largely confined to habitats with a mallee overstory on variable soils including loamy-sands and sandy-loams with a laterite component, stony clays and sandy light clay on greenstone (Cooper et al. 2003; Teale et al. in prep.). A component common to all capture sites was the presence of sedges in the understorey and that the vegetation was long unburnt (greater than 20 years) (Teale et al. in prep.).

This species was not recorded during the current survey, however suitable habitat occurs across much of the lease. Teale et al. (in prep.) report 77 capture events across 11 sites within the Fitzgerald Biosphere Reserve. The discussion in Section 3.3 notes that rodent captures in general were fairly low when compared to some historical trapping events. It is considered likely that this species would occur within the lease, though its abundance may fluctuate both temporally and spatially dependent on condition and age of the vegetation.

Recent molecular analysis found that the level of genetic divergence between populations in eastern and western Australia supported the current treatment of those populations as single species (Cooper et al. 2003).

It is recommended that seasonal trapping be undertaken at the study site in spring 2004 in an attempt to capture this species.

Schedule 4 Fauna

- Peregrine Falcon *Falco peregrinus*

This widespread species, although common in parts of WA, would be rare or scarce in the project area according to Johnstone and Storr (1998). It primarily inhabits wooded watercourses and lakes, coastal cliffs, rivers and ranges, none of which are prevalent in the project area.

- Carpet Python *Morethia spilota imbricata*

This sub-species is broadly distributed across much of the South-west, but has been given its protected status due to the fact that it is not common anywhere in its range. Just three records from two sites were collated by Teale et al. (in prep.) for the Fitzgerald Biosphere Reserve.

Priority Taxa

- *Lerista viduata* (Priority 1)

The majority of records of this species are from eucalypt woodland on the south facing slopes of the Ravensthorpe Range immediately north of Ravensthorpe (G. Harold pers. comm. 2004). Closer to the study area they have been recorded from the Moort Woodland *Eucalyptus platypus* just to the west of the old Kundip townsite (G. Harold pers. comm.). Over two hours of raking in this same habitat within the lease boundaries did not yield this species, however, one specimen was collected from a pit trap at KU2. This species is represented by just 14 specimens in the State collection.

- Quenda *Isoodon obesulus fusciventer* (Conservation Dependent, Priority 4)

This species is locally common in and adjacent to wetlands in the South-west of the state and recently its classification has changed from a Priority 4 species to Conservation Dependent. No convincing evidence of this species was recorded from the project area although old diggings that may indicate the presence of this species were recorded along Steere River.

This species has been recorded from the Fitzgerald Biosphere Reserve as far east as Bandalup Hill (Teale et al. in prep.).

- Tammar *Macropus eugenii derbianus* (Conservation Dependent, Priority 4)

Not recorded during the survey but two recent records of road kills from just south of the old Kundip townsite on the Ravensthorpe to Hopetoun Road.

- Western Whipbird (southern WA subspecies) *Psophodes nigrogularis oberon* (Vulnerable under *EPBC Act 1999*)

Identified on six occasions from calls given in mallee associations (sites KU1, KU2 and KU3). Teale et al. (in prep.) have compiled 165 records from 76 sites across the Fitzgerald Biosphere Reserve. The records include an adult feeding a sub-adult in October 2000 and of a nest with two eggs in September 1993. Sanders (1996) found the species to be widespread and common during the Fitzgerald Biosphere Reserve study with the majority of records being from open mallee over a dense heath understorey, but with some also from heath and shrubland. Johnstone (pers. comm. 2004) considered this species to be common in suitable habitat throughout the Ravensthorpe district, compared to elsewhere in its range.

- Western Mouse *Pseudomys occidentalis* (Priority 4)

Teale et al. (in prep.) document 279 capture events from 37 sites within the Fitzgerald Biosphere Reserve with most records from mallee. The last moderate capture rate for this species was documented by Chapman (2000) who recorded 17 capture events at Bandalup Hill. Additional trapping at Bandalup Hill yielded just one other individual (Biota 2001).

Habitat for this species is described as shrublands that have not been burnt for 15-30 years on clay loams, usually with a laterite component (Lee 1995).

This species may well occur in the project area but at population levels that are currently very difficult to detect. It is therefore suggested that a seasonal trapping program be undertaken in an attempt to capture this species.

- Western Brush Wallaby *Macropus irma* (Priority 4)

The Western Brush Wallaby is considered to be uncommon over much of its range (Christensen 1995). The preferred habitat of this species is open forests and woodlands but it also occurs in scrubby thickets, mallee and heath. Teale et al. (in prep.) document thirty-one records from 14 sites plus an additional nine specimens from nine locations documented by the WA Museum, all from the Fitzgerald Biosphere Reserve. Sites are typically in mallee-heath and animals are mostly encountered whilst travelling along roads and tracks, and as roadkills.

During the current survey this species was recorded from a single carcass on the Ravensthorpe to Hopetoun road, just to the north of the mine entrance.

5.2 Requirement for Referral Under the *EPBC Act 1999*

In determining whether Tectonic Resources NL have any obligations in respect of the Kundip project under the Federal *Environment Protection and Biodiversity Conservation Act 1999* (EPBC), the following was considered:

- does the project constitute an 'action' that would affect any of the triggers for Federal referral identified in the Act.

Under the Act, an 'action' consists of 'a project, development, undertaking, activity or series of activities'. Actions are required to be referred under the *EPBC Act 1999* if they take place on Commonwealth land or are an action by the Commonwealth, or are likely to significantly impact a matter of National Environmental Significance (NES). The project is not on Commonwealth land or a Commonwealth action and would not require referral on this basis, leaving consideration of the NES factors only.

There are currently six NES factors identified in the Act. Five of these, Ramsar wetlands, World Heritage properties, migratory waders, nuclear actions and Commonwealth waters, are clearly not relevant to this project. The only possible trigger factor of relevance relates to threatened flora and fauna species and threatened ecological communities.

The fauna surveys of the sites recorded one species listed as Endangered (Carnaby's Cockatoo) and two species (Malleefowl and Western Whipbird) listed as Vulnerable under the *EPBC Act 1999*.

Local populations of the Western Whipbird will be impacted by the development of the Kundip site. These birds are resident within the area and may be displaced by development of the pits and associated infrastructure. The exact extent of this impact is unclear as the foot print for the development is uncertain. This species is considered locally common in the region (Ron Johnstone pers. comm. 2004)

It is also unclear to what extent the Malleefowl will be impacted. A single Malleefowl was recorded from the mallee west of the Harbour View site and may well range into the proposed development areas. As with the Western Whipbird, this species is considered locally common in the region (Ron Johnstone pers. comm. 2004)

It is unlikely that the project will directly impact populations of Carnaby's Cockatoos other than by contributing to the regional cumulative reduction of potential foraging habitat through clearing of vegetation. This species predominantly nests within smooth-barked eucalypts including wandoo *Eucalyptus wandoo* and salmon gums *E. salmonophloia*, but also in red morel *E. longicornis*, York gum *E. loxophleba*, tuart *E. gomphocephala* and marri *Corymbia calophylla* (Johnstone and Storr 1998). Within the Fitzgerald Biosphere Reserve, breeding records have been obtained from the Stirling Range and Cocanarup Timber Reserve (10km west of Ravensthorpe; A. Sanders pers. comm.).

In summary, it is our opinion that the proposal to develop the Kundip operations requires referral to the Federal Minister for the Environment under the *Environment Protection and Biodiversity Conservation Act 1999*. This is based principally on the very probable impacts of the project on the population of Western Whipbirds currently resident within the project area, but also that the level of impact to Malleefowl is uncertain. Both these species are considered common in the region (Ron Johnstone pers. comm. 2004) and their occurrence on site is not exceptional (see also Biota 2000, Chapman 2000). This assessment should be revisited once project definition is finalised and a more accurate review of potential impacts is possible.

5.3 Recommendations

The following recommendations arise from the fauna survey of the Kundip study area:

1. The opportunity exists, should the project proceed, to utilise existing cleared and disturbed areas for proposed new disturbances. The use of these disturbed areas should be maximised as part of project design.

2. Within the Kundip lease area, mature woodland habitat is restricted in distribution and supports both an abundant and species rich fauna assemblage. This is evident in the very high number of captures of species such as the Western Pygmy Possum *Cercartetus concinnus* and *Diplodactylus granariensis granariensis*. Clearing of mature woodland should be minimised where possible.

3. The proponent should undertake an additional seasonal survey of the project area to more fully document the faunal assemblage and identify any additional constraints. This study could usefully target threatened fauna taxa not well represented during the current survey including Schedule listed rodent and bird species.

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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.

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9 FURTHER CONDITIONS (NUMBERED 1 TO 10) ARE ATTACHED.

PURPOSE KUNDIP FAUNA SURVEY (20KM NORTH OF HOPETOUN)