INTERIM REPORT

A FAUNA SURVEY OF THE PROPOSED MULGA ROCK PROJECT AREA, GREAT VICTORIA DESERT, WESTERN AUSTRALIA

Prepared for: Energy and Minerals Australia Limited

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January 2010

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1 INTRODUCTION

This interim report has been prepared for Energy and Minerals Australia Limited (EMA) and describes the study objectives, methods used and results from the first of two vertebrate fauna surveys to the Mulga Rock Project Area. The study area lies approximately 230 km ENE of Kalgoorlie and is situated 55 km north-east of Queen Victoria Spring, a Nature Reserve within the Great Victoria Desert.

A report by W.G. Martinick & Associates Pty Ltd (1986) provided historical data on a larger study area which encompassed the Mulga Rock Project Area. This early report documented the flora, vegetation and vertebrate fauna of three survey areas: Emperor, Shogun and Ambassador; this current study concentrated on an area within Ambassador.

2 NOMENCLATURE, TAXONOMY AND DISTRIBUTION PATTERNS

The following literature sources have been used to discuss nomenclature, taxonomy and fauna distribution patterns in this report:

Birds: Barrett *et al*. (2003); Johnstone & Storr (1998 and 2004).
Mammals: Van Dyck & Strahan (2008). **Bats**: Churchill (2008)
Amphibians: Tyler and Doughty (2009).
Reptiles: Storr *et al.* (1983; 1990; 1999; and 2002); Wilson & Swann (2008).

Other, more recent, taxonomic revisions have been used when applicable. These are noted in text and are listed in References. In particular, the recent revision of two skink species has resulted in a large number of new skinks being added to the State's list (Smith and Adams 2007, and Horner 2007).

Several authors including Thompson and Thompson (2002) and How (1998) discuss the need for extensive sampling in both temporal and spatial scales in order to more fully document the biodiversity of the fauna of an area. In addition, Cowan and How (2004) conclude that short-term studies infrequently encounter threatened and/or rare ground-dwelling vertebrate fauna species and therefore do not provide adequate information to assist land managers. As only a relatively small percentage of the vertebrate fauna species that could occur within the Mulga Rock Project Area are likely to have been recorded during October 2009, with supplementary information from Martinick *et al*. 1986) taken into account, the list of animals that could potentially occur has been constructed from a number of additional sources. While some of the survey areas are fairly distant from Mulga Rock, many of the habitats surveyed are similar. The literature and data search included both Australian Government and State databases including DEWHA, DEC and the Western Australian Museum (WAM).

3 STUDY OBJECTIVES

The arid regions of Western Australia have a diverse range of vertebrate fauna including several endemic species. Therefore, the main study objectives of the survey were to:

- prepare an inventory of the vertebrate fauna recorded in the Mulga Rock Project Area;
- compare the results to the list of species that could potentially occur in the Project Area;
- review vertebrate fauna considered to be rare, threatened, vulnerable, geographically restricted, or those that occur as an outlier population;
- assess the status of introduced and feral animals, both predators and herbivores, through the Project Area;
- assess the relationships between vertebrate fauna and the vegetation communities of the project area in order to clearly identify any habitats of significance;
- assess the regional and local conservation status, both at the species and ecosystem levels, of the project area;

- based on all the above, assess the potential impact of mining on the fauna; and
- develop strategies for the environmental management of these species and their habitats.

3.1 Study Limitations

Initially it was planned that four of the systematic sampling sites would be located within the Queen Victoria Spring Nature Reserve. They would be situated in similar habitat to the Mulga Rock Project Area in order to provide data on habitats and species that would remain undisturbed by mining activity. However, following a brief reconnaissance to the Reserve, it was discovered that a large percentage of the northern section of the Reserve had been recently burnt and had not recovered to the extent that sampling sites established there would in any way act as control sites. Therefore, additional sites were established in the Mulga Rock Project Area, with one site being located within the Shogun ore body where the rare Sandhill Dunnart (*Sminthopsis psammophila*) had been captured in 1985 (site MR10 - equal to 1985 site 11).

Thunderstorms were experienced over two days/nights during the survey, preventing the use of Anabats© and camera traps for those nights.

4 DEFINITION OF TERMS

A summary of Australian Government and Western Australian Acts is set out below, as is an additional listing by the Western Australian Department of Environment and Conservation (DEC).

While some animals are present on all World, Australian Government and State lists, their classification may differ. This is mainly a result of each animal's distribution so that, for example, an animal may be endangered in Western Australia but relatively common in other States. In addition, the status of rare, threatened or vulnerable species is a dynamic process, with intensive field surveys and taxonomic reviews providing information that may result in a species being added or removed from these lists. For example, recent taxonomic work has resulted in the small marsupial carnivore known as the Mulgara (*Dasycercus cristicauda*), which was listed under both Australian Government and State Acts, being separated into two species. The more common Western Australian species, the Brush-tailed Mulgara (*Dasycercus blythi*) is not listed under either Australian or State Acts.

4.1 Protected Species - Australian Government

The Department of the Environment, Water, Heritage and the Arts (DEWHA) administers the *Environmental Protection and Biodiversity Conservation Act 1999 (EPBC).* There are six parts to this Act covering species that are:

1. extinct;
2. extinct in the wild;
3. critically endangered;
4. endangered;
5. vulnerable;
6. conservation dependent.

DEWHA also administers international treaties as discussed below.

A range of birds are listed under the Japan-Australia (JAMBA), China-Australia (CAMBA) and Republic of Korea/Australia (ROKAMBA) Migratory Bird Agreements. The main aim of these international agreements is to protect migratory birds and their breeding and/or feeding habitats.

4.2 Protected Species - Western Australia

Currently in Western Australia, rare or endangered species are protected by the *Wildlife Conservation Act 1950 (WC)* administered by the DEC, The various schedules defined under this act are:

- Declared Threatened Fauna - fauna that is ranked as presumed extinct, critically endangered, endangered or vulnerable;
- Conservation Dependent Fauna; and
- Other Specially Protected Fauna.

4.3 Priority Species - Western Australia

The DEC Priority Fauna List does not confer any additional legal protection to the species listed, apart from the normal protection afforded to most native animals. It does, however, indicate the need for vigilance during the construction and commissioning of mining or other development projects to ensure that Priority species, should they occur, do not meet the IUCN Criteria for listing on the Threatened Species List. The Priority Fauna List classifies species as:

- Priority 1 - taxa with few, poorly known populations on threatened lands.
- Priority 2 - taxa with few, poorly known populations on conservation lands.
- Priority 3 - taxa with several, poorly known populations, some on conservation lands.
- Priority 4 - taxa in need of monitoring.
- Priority 5 - taxa in need of monitoring.

4.4 Significant Fauna Habitats

Australia-wide, a small number of Threatened Ecological Communities (TEC) has been defined under Australian Government legislation. These TEC's are usually described in flora and vegetation reports as they may not be relevant to vertebrate fauna. However, while not defined under any legislation, other fauna habitats within a project area may be defined as locally significant because they:

- support rare or vulnerable species;
- support specialised or habitat specific fauna;
- are regionally or locally uncommon; or
- are restricted in area.

Although not protected under any State or Australian Government legislation, in the interests of good project management, where possible, conservation of such locations within a project area will provide the basis for the fauna component of an environmental management plan to be put in place for the duration of a project.

5 METHODS

The Ninox team members were:

Ninox Principal	Jan Henry	Survey leader and senior zoologist
Team members	Greg Harold	Assisting zoologist
	Maureen Francesconi	Senior ornithologist
	Kevin Fairbairn	Assisting ornithologist

The survey was carried out under DEC License Number SF007091. A second, seasonal survey is planned for 2010 and this, combined with the historical data provided in Martinick & Associates Pty Ltd (1986) and a more detailed literature review that will be undertaken for the final report, will satisfy the requirements for a Level 2 Detailed Survey as defined in Environmental Protection Authority (2004).

During negotiations with the DEC Kalgoorlie Branch, a number of additional study objectives were discussed, with particular reference to individual species of interest; these are set out below.

> ***Recommendation 1:*** *The following species-specific surveys techniques for Malleefowl should be incorporated into your survey program. Such techniques could take the form of aerial surveys using a helicopter to look for mounds (Brickhill 1985), searching for footprints along roads each morning while the sun is at an oblique angle after roads have been lightly graded using a light drag towed behind a vehicle, or using large numbers of people to form "human chains" to search for mounds and footprints.*
>
> ***Recommendation 2:*** *That species-specific surveys techniques for moles are incorporated into the survey program. This could take the form of mole trenches (see Benshemesh 2005) or analysis of the scats of mole predators (e.g., cats, foxes and dingoes). When using the latter, it is important to recognize that more than 100 predator scats are needed to have a reasonable chance of successfully detecting moles if they are present (Benshemesh 2004; Brennan et al. unpublished data).*
>
> ***Recommendation 3:*** *Given the importance of successfully detecting Sandhill Dunnarts* (*Sminthopsis psammophila*) *it is recommended that double the number of Elliott traps are used per site. A pitfall trap no less than 600 mm in depth should also be used.*
>
> ***Recommendation 4:*** *Sampling should be according to EPA Guidance Statement 56 - Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia, in particular Appendix 2, and Level 2 surveys over multiple seasons are likely required.*
>
> ***Recommendation 5:*** *It is recommended you include active searching for burrows and the characteristic latrine piles left by Great Desert Skinks into afternoon searches.*
>
> ***Recommendation 6:*** *It is recommended that greater than double the number of Elliott traps be used per site in order to increase the potential for trapping of the Brush-tailed Mulgara. A pitfall trap no less than 600 mm in depth should also be used.*
>
> ***Recommendation 7:*** *The minimum number of nights and hours per night that will be devoted to spotlighting should be commited to within the scope to provide DEC with more certainty that there will be a greater chance of identifying Womas and Bush Stone-curlews. It should also be indicated whether call play back tapes will be utilized for Bush Stone-curlews.*

In order to comply with these recommendations, changes to some of the standard methods were incorporated into the survey techniques as discussed in Section 5.2.

5.1 Fauna Habitats

A brief description of each of the sites chosen for sampling during October 2009 was provided by Mattiske Consulting Pty Ltd. As the DEC had specifically requested that the rare Sandhill Dunnart be targeted during the survey, three sites were chosen specifically because they were where this animal had been captured in 1985 (Martinick & Associates Pty Ltd 1986). These sites are shown below as PNC sites. The remaining sites were chosen because they represented the range of plant community types and soil variations present within the current sampling area. Table 1 lists these sites, their corresponding PNC site code where relevant, the plant community code with a brief description, and the coordinates taken at trap one in each location.

Table 1 List of systematic sampling sites within the Mulga Rock Project Area. The coordinates provided are in GDA94 format.

Fauna Site Code	PNC Site Code	Mattiske Plant Community Code	Description	Easting Northing
MR01	7	E6 with influence E5 species	E6 Open Scrub Mallee to Very Open Scrub Mallee of *Eucalyptus rigidula* over *Westringia rigida*, *Grevillea acuaria* and mixed low shrubs over *Triodia desertorum* with *Halgania cyanea*. E5 Low Open Woodland of *Eucalyptus gongylocarpa* over *Eucalyptus rigidula* with *Hakea francisiana* and *Grevillea juncifolia* over *Westringia cephalantha*, *Eremophila platythamnos* subsp. *platythamnos* and mixed low shrubs over *Triodia desertorum.*	575 160 6 680 830
MR02		E8	E8 Open Scrub Mallee to Very Open Scrub Mallee of varying *Eucalyptus* spp. with *Hakea francisiana* and *Grevillea juncifolia* over *Westringia cephalantha*, *Acacia hemiteles*, *Acacia fragilis*, *Acacia helmsiana* and mixed low shrubs over *Triodia desertorum* with emergent *Eucalyptus gongylocarpa*.	573 052 6 682 213
MR03		E3	E3 Low Open Woodland of *Eucalyptus gongylocarpa* over *Eucalyptus youngiana*, *Grevillea juncifolia*, *Callitris preissii* and *Hakea francisiana* over mixed low shrubs over *Triodia desertorum* with *Chrysitrix distigmatosa* and *Lepidobolus deserti* (P4).	575 537 6 683 050
MR04	?3	E6	E6 Open Scrub Mallee to Very Open Scrub Mallee of *Eucalyptus rigidula* over *Westringia rigida*, *Grevillea acuaria* and mixed low shrubs over *Triodia desertorum* with *Halgania cyanea*.	576 919 6 681 716
MR05		S6	S6 Low Shrubland of *Thryptomene biseriata, Allocasuarina spinosissima, Jacksonia arida* (ms), *Calothamnus gilesii, Acacia fragilis, Conospermum toddii* (R), *Pityrodia lepidota, Lomandra leucocephala, Anthotroche pannosa* and mixed low shrubs over *Triodia desertorum* with *Lepidobolus deserti* (P4) and occasional emergent *Eucalyptus* spp. This community occurs on yellow sand dunes.	576 869 6 681 745
MR06		Near ecotone of E5 and E3	E3 Low Open Woodland of *Eucalyptus gongylocarpa* over *Eucalyptus youngiana*, *Grevillea juncifolia*, *Callitris preissii* and *Hakea francisiana* over mixed low shrubs over *Triodia desertorum* with *Chrysitrix distigmatosa* and *Lepidobolus deserti* (P4). E5 Low Open Woodland of *Eucalyptus gongylocarpa* over *Eucalyptus rigidula* with *Hakea francisiana* and *Grevillea juncifolia* over *Westringia cephalantha, Eremophila platythamnos* subsp. *platythamnos* and mixed low shrubs over *Triodia desertorum.*	573 908 6 684 097
MR07		E5	E5 Low Open Woodland of *Eucalyptus gongylocarpa* over *Eucalyptus rigidula* with *Hakea francisiana* and *Grevillea juncifolia* over *Westringia cephalantha, Eremophila platythamnos* subsp. *platythamnos* and mixed low shrubs over *Triodia desertorum.*	578 700 6 682 698
MR08		S7 next to track, then moves into E3	S7 Low Shrubland to Low Open Shrubland of *Enekbatus eremaeus*, *Acacia desertorum* var. *desertorum*, *Verticordia helmsii*, *Homalocalyx thryptomenoides*, *Leptospermum fastigiatum*, *Baeckea* sp. Great Victoria Desert (A.S. Weston 14813) (P2), *Leptosema chambersii* and mixed low shrubs over *Triodia desertorum* and *Chrysitrix distigmatosa* with occasional emergent mallee *Eucalyptus* species, *Grevillea juncifolia* and *Hakea francisiana*. E3 Low Open Woodland of *Eucalyptus gongylocarpa* over *Eucalyptus youngiana*, *Grevillea juncifolia*, *Callitris preissii* and *Hakea francisiana* over mixed low shrubs over *Triodia desertorum* with *Chrysitrix distigmatosa* and *Lepidobolus deserti* (P4).	574 930 6 683 986
MR09		S8 at top of slope, E3 at bottom	S8 Low Open Shrubland of *Calothamnus gilesii*, *Persoonia pertinax* and mixed low shrubs with occasional emergent *Eucalyptus youngiana* and *Eucalyptus gongylocarpa*. E3 Low Open Woodland of *Eucalyptus gongylocarpa* over *Eucalyptus youngiana*, *Grevillea juncifolia*, *Callitris preissii* and *Hakea francisiana* over mixed low shrubs over *Triodia desertorum* with *Chrysitrix distigmatosa* and *Lepidobolus deserti* (P4).	578 057 6 683 470
MR10	11	S1	S1 Shrubland of *Melaleuca hamata* with *Hakea francisiana* and mixed shrubs over *Triodia desertorum* with emergent *Eucalyptus* spp.	566 315 6 688 517

Much of the Mulga Rock Project Area had been burnt in 1997 and the regeneration of spinifex (*Triodia desertorum*) in sites MR01 to MR05, MR07 and MR10 remained at Stage 1 or 2 as shown below; Site MR08 and MR09 had Stage 3 spinifex and Site MR06 had Stage 5 (see Plates 1 to 10).

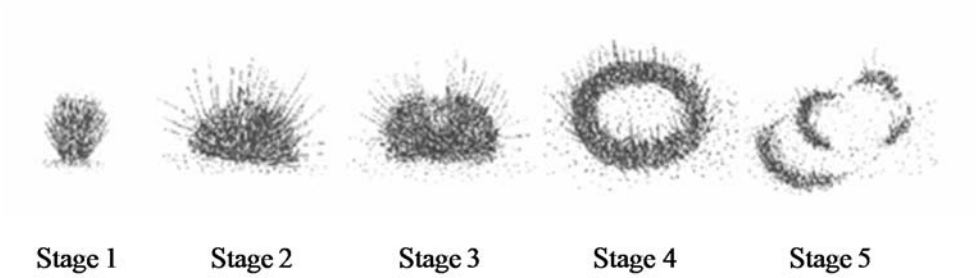


Figure 1 ***Spinifex life stages (from Churchill 2001, sketches by V. Reynolds – extracted from the* Sminthopsis psammophila *Action Statement [Department for Environment and Heritage 2008]).***

Each site was photographed at the time of the survey and these are proved in Plate 1 to *Plate 10*.

Plate 1 Fauna sampling site MR01.

Plate 2 Fauna sampling site MR02.

Plate 3 Fauna sampling site MR03.

Plate 4 Fauna sampling site MR04.

Plate 5 Fauna sampling site MR05.

Plate 6 Fauna sampling site MR06.

Plate 7 Fauna sampling site MR07.

Plate 8 Fauna sampling site MR08.

Plate 9 Fauna sampling site MR09.

Plate 10 Fauna sampling site MR10.

5.2 Vertebrate Fauna

Although the main objective of the survey was to sample as effectively as possible to gain an inventory of the range of vertebrate fauna species that could occur within the Mulga Rock Project Area, the DEC provided a list of animals that required specific targeting (Section 5) and requested some variations on the normal trapping techniques used by Ninox. These are described in later sections.

5.2.1 General Sampling

Ten individual sampling sites were established in the dominant plant communities within the Project Area. Four personnel were required to efficiently monitor the number of traplines established. Two people were responsible for clearing traplines, identification, marking and safe release of animals; two additional personnel conducted systematic bird sampling which was carried out concurrently with trapline monitoring.

Mammals, Amphibians and Reptiles: 10 traplines were established which consisted of ten pitfall traps bisected across the top by 10 metres of flywire drift fence 300mm high. Five of the pitfall traps consisted of 15 litre plastic drums with custom-made plastic inserts to ensure that small vertebrates could not escape and which gave shade during hot conditions. The lid of each plastic drum was also used to provide additional shade. The remaining five pitfall traps consisted of PVC pipe 160mm in diameter and 600mm deep. Figure 2 shows a diagram of the trapline layout.

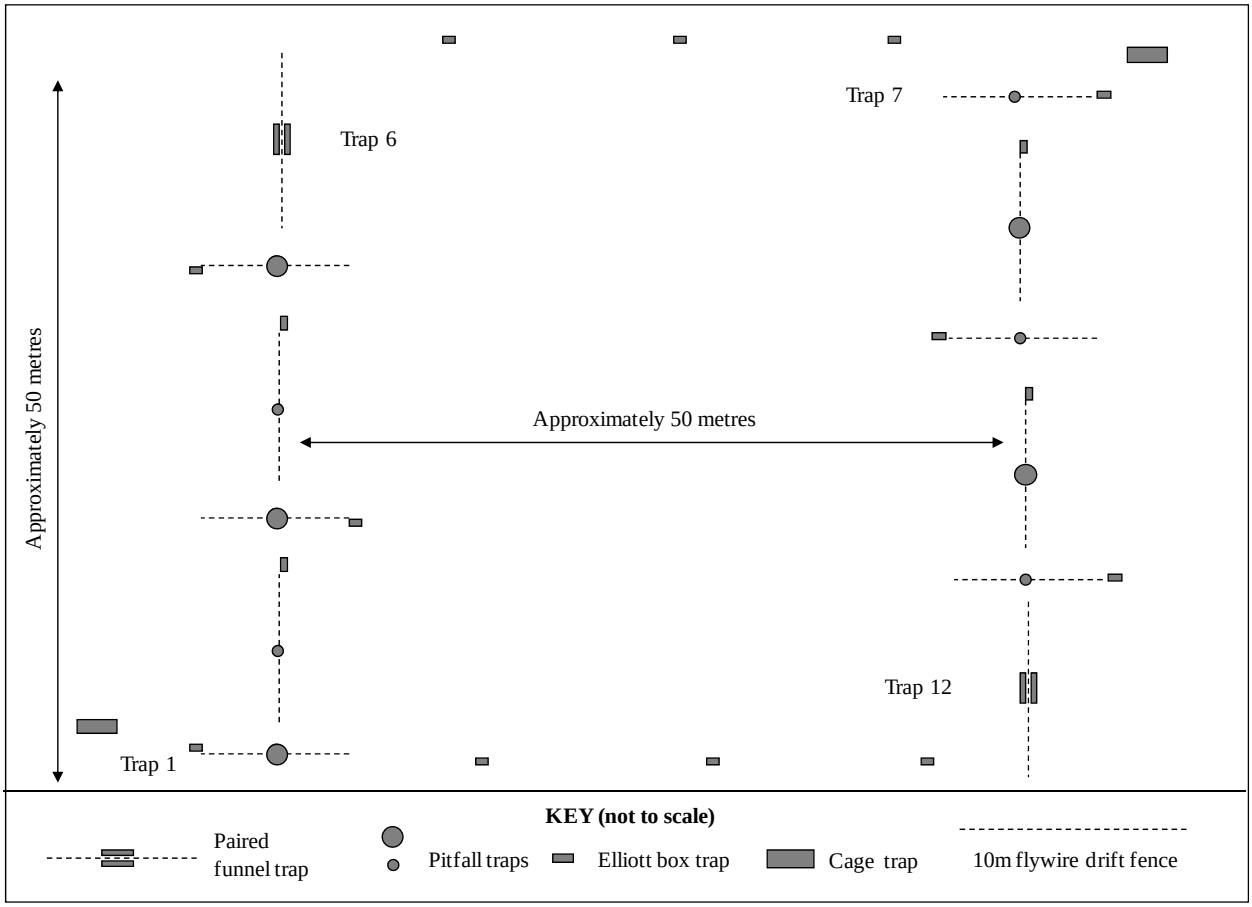


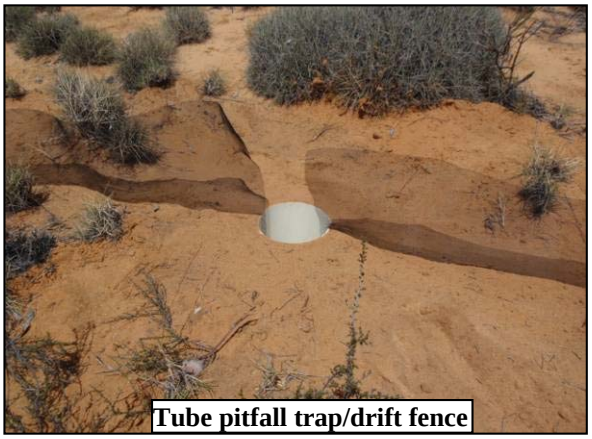
Figure 2 Diagrammatic layout of vertebrate fauna trapline used in the survey of the Mulga Rock Project Area during October 2009.

Surface traps in each site consisted of 16 medium Elliott box traps and two cage traps that were placed in association with the pitfall traps. Two additional 10 metre fence lines in each sampling location included two flywire funnel traps each. Each trap type is shown in Plate 11.

Traplines were monitored over six consecutive nights during the survey (7 - 14 October 2009 inclusive) and were checked each morning. A grid reference (GDA94) was recorded at trap one in each sampling location (a brief description of each of the sites chosen for sampling during October 2009 was provided by Mattiske Consulting Pty Ltd. As the DEC had specifically requested that the rare Sandhill Dunnart be targeted during the survey, three sites were chosen specifically because they were where this animal had been captured in 1985 (Martinick & Associates Pty Ltd 1986). These sites are shown below as PNC sites. The remaining sites were chosen because they represented the range of plant community types and soil variations present within the current sampling area. Table 1 lists these sites, their corresponding PNC site code where relevant, the plant community code with a brief description, and the coordinates taken at trap one in each location.

Captured animals were identified and details of trapping location and method, sex, age and reproductive status were recorded on field data sheets. The animals were released near their point of capture as soon as practicable. Small mammals received a fur clip on the rump prior to release in order to confirm recapture data.

Bats: bats were sampled by means of two bat echolocation recorders (Anabat©) set a various locations throughout the survey area. Analysis of resulting data was undertaken by K. Armstrong of Specialised Zoological who provided a report which was consistent with the minimum standards recommended by the Australasian Bat Society in terms of the transparency of the identification process. This included presentation of parameter summaries derived from echolocation pulses, a representative call for each species, and a description of the reference library used.


Tube pitfall trap/drift fence


Bucket pitfall trap with plastic insert/drift fence


Elliott trap with Coreflue cover


Cage trap with shade cloth cover


Paired funnel traps with shadecloth cover


Anabat© *in situ*

Plate 11 Trap types used in the October 2009 survey in the Mulga Rock Project Area.

Birds: during each sampling period the second team member searched the surrounding plant community in order to record all birds utilising the habitat. The observer moved slowly through each habitat for approximately 45 minutes each day, identifying and counting all bird species seen and heard. Recording commenced during the peak bird activity period immediately following dawn. Sampling times in the various locations were rotated to minimise variations in weather and the peak activity periods of birds. The resulting data allows for statistically valid comparisons to be made between the various habitats.

While systematically monitoring a site over a set number of days, it is inevitable that some birds will be recorded on several occasions. Examples are highly territorial birds such as Fairy-wrens, inquisitive species such as Grey Fantails which sometimes follow the observer, nesting birds or flocking species such as cockatoos and Tree Martins which may remain in a localised area for an extended period. This over-recording unavoidably results in an exaggerated figure of relative abundance for some species. To overcome this difficulty, the daily data from the 10 sites were scanned to ascertain the specific day in each season when the highest number of individuals for each species in every site was recorded. The total for this day was selected as being a reliable index of the relative abundance of birds on a site-by-site and seasonal basis.

Birds were also recorded opportunistically while team members travelled between sites and while participating in other activities such as setting out the Anabats© in various locations, and opportunistic sampling during the afternoons.

Some more specific and targeted methodology was required by the DEC as part of the conditions for the Regulation 17 license to survey/collect vertebrate fauna. These are discussed below and a summary of trapping effort is provided in Table 2.

Table 2 Summary of trapping effort used in the October 2009 sampling period within the Mulga Rock Project Area.

Trap Type	**No. of Trapnights**
Bucket pitfalls/fences	305
Tube pitfalls/fences	305
Elliott Traps	1058
Funnel Traps	244
Cage Traps	124
Total	**2036**
Other Sampling	
Systematic bird sampling	50 hours
Malleefowl assessment	92 km
Spotlight runs	24.5 km / 6 hours
Head-torching	12 personnel hours
Anabat©	9 nights
Camera trap nights	6

5.2.2 Mulgara Species (Dasycercus blythi and Dasycercus cristicauda)

As this species is known to be captured mainly by Elliott traps, in addition to the 10 used as a standard trapline design by Ninox, six more of this style of trap was used in each sampling site. An additional two lines of 10 Elliott traps were also set on dune crests where small animal activity was considered to be high (a judgement based on the number of fresh tracks in the sand).

Two camera traps were also set at various places over three nights along these dune crests (Plate 12) where there appeared to be particularly high activity levels of small animals, a judgement based on the number of individual tracks in the sand. It was noted that, due to wind, fresh tracks were indistinct after approximately 24 hours.

Plate 12 Camera trap located on a dune crest in the October 2009 survey of the Mulga Rock Project Area.

During systematic bird sampling and afternoon opportunistic work, all personnel specifically searched for the distinctive burrow systems and footprints of Mulgara species.

5.2.3 Sandhill Dunnart (Sminthopsis psammophila)

Information from the DEC indicated that pitfall traps at least 600mm deep would be required to adequately sample for the Sandhill Dunnart (*Sminthopsis psammophila*). Therefore, five of the 10 pitfall traps in each sampling site consisted of plastic tubes 160mm wide by 600mm deep. As this species is also known to be captured by Elliott traps, in addition to the 10 used as a standard by Ninox, six more were used in each site. Two lines consisting of 10 Elliott traps were also set on dune crests where small animal activity was considered to be high (a judgement based on the number of fresh tracks in the sand).

5.2.4 Southern Marsupial Mole (Notoryctes typhlops)

While the Southern Marsupial Mole (*Notoryctes typhlops*) will be targeted later in the process of environmental assessment, the Ninox team took advantage of the presence of several costines within the survey area to inspect the vertical walls for the soil disturbance associated with the movement of this cryptic animal (Plate 13).

Plate 13 Ninox team members inspecting the vertical walls of one of the costeans present within the Mulga Rock Project Area.

5.2.5 Great Desert Skink (Liopholis kintorei)

The Great Desert Skink (*Liopholis kintorei,* previously known as *Egernia kintorei*) is a large, burrowing reptile that has declined throughout its range with many sites no longer supporting populations (McAlpine 2001). DEWHA states that three populations occur in WA at Patjarr (population estimated to be less than 2500 individuals), near the Kiwirrkura community, including the vicinity of Lake Mackay (<500 individuals), and in Rudall River National Park (unknown population size). During all other activities by all team members, special attention was given to searching for and identifying burrow systems and latrine piles. In particular, the wide-ranging foot transects undertaken by the ornithologists surrounding each trapline increased the potential of finding large burrow systems within these locations, and afternoon foraging by all team members focused on searching for signs of this species.

5.2.6 Woma (Aspidites ramsayi)

The Woma is rarely captured but may be seen opportunistically, particularly at dusk and during the early evening. Vehicle spotlight runs and foot transects using head-torches during these time periods increased the chance of locating this snake.

5.2.7 Malleefowl (Leipoa ocellata)

The Malleefowl (*Leipoa ocellata*) has undergone a decline in range and distribution of about 50% in the last century (Benshemesh 2000). As this large bird has been recorded in the Great Victoria Desert, the DEC requested that special attention be paid to detecting its presence.

Several survey methods were suggested by the DEC but, as a preliminary method, given the number of tracks and gridlines present within the survey area, as many defined tracks/gridlines as possible were driven along slowly with team members searching the track and verges for the distinctive footprints of this bird. In this way, 92km of track were meticulously searched over a period of days. If detected, special attention was to be paid to grid searching the area in the vicinity of the tracks.

In addition, as for other species, both ornithologists searched for tracks during their wide-ranging, systematic bird observation assessments each morning in each sampling site.

5.2.8 Bush Stone-curlew (Burhinus magnirostris)

As for Malleefowl, these birds leave distinctive footprints and all field personnel specifically searched for indications of this species presence. In addition, particular attention was paid to detecting this bird during nocturnal vehicle spotlight runs and foot transects using head-torches.

5.3 Weather Conditions

The following table shows the daily temperatures and rainfall in the region during the course of the October 2009 sampling session. More detailed and local information from Mulga Rock camp may be available for the final report.

Table 3 Minima, maxima temperatures and rainfall experienced during the fauna survey within the Mulga Rock Project Area in October 2009. Data extracted from the Bureau of Meteorology for Laverton and Kalgoorlie.

Date	6 Oct.	7 Oct.	8 Oct.	9 Oct.	10 Oct.	11 Oct.	12 Oct.	13 Oct.	14 Oct.
Laverton									
Min	16.4	17.9	14.6	12.5	22.7	15.0	9.1	11.2	14.2
Max	32.9	30.4	32.7	34.0	32.5	24.8	22.1	25.4	29.1
Rainfall	0	0	0	0	0	0	0	0	0
Kalgoorlie									
Min	14.7	14.2	15.4	14.2	19.4	12.3	6.6	9.1	11.2
Max	32.1	30.3	28.6	32.9	29.2	20.2	22.5	25.8	25.2
Rainfall	0	0	0	4.0	0	0	0	0	0

6 RESULTS

6.1 Native Mammals

Thirteen species of native mammal consisting of one monotreme, four small carnivores, one large kangaroo, five bats, one rodent and one large carnivore (Table 4) were recorded during the survey.

The Echidna (*Tachyglossus aculeatus*) was only recorded by the presence of fresh scats. Of the small carnivores, the Southern Ningaui (*Ningaui yvonneae*) and Hairy-footed Dunnart (*Sminthopsis hirtipes*) were particularly common with 22 and 20 individuals recorded. Several individuals were also recaptured of the latter species. Both species were captured in eight of the 10 sampling sites. The Wongai Ningaui (*Ningaui ridei*) was less common with only four individuals captured in three of the 10 sites.

Table 4 List of native mammal species recorded during the October 2009 survey of the Mulga Rock Project Area. (RC – recapture; OP – results from opportunistic sampling, including Anabat© results – designated with an X; S – signs such as scats, tracks or diggings etc, counted as one individual.)

NATIVE MAMMAL SPECIES		MR 01	MR 02	MR 03	MR 04	MR 05	MR 06	MR 07	MR 08	MR 09	MR 10	OP
TACHYGLOSSIDAE												
Tachyglossus aculeatus	Echidna		S									
DASYURIDAE												
Ningaui ridei	Wongai Ningaui		1 +RC						2		1	
Ningaui yvonneae	Southern Ningaui	1	3	4 +RC	1	2		1	6	4		
Sminthopsis dolichura	Little Long-tailed Dunnart	1	2	1	2		1				1	
Sminthopsis hirtipes	Hairy-footed Dunnart	8	1	1	1	3	2	2	2			

NATIVE MAMMAL SPECIES		MR 01	MR 02	MR 03	MR 04	MR 05	MR 06	MR 07	MR 08	MR 09	MR 10	OP
		+RC			+RC	+RC						
MACROPODIDAE												
Macropus fuliginosus	Western Grey Kangaroo	S	1	S	S	S	S	S	S	3	1	8
MOLOSSIDAE												
Mormopterus sp. (sp. 3)	Inland Free-tailed Bat	X[1]				X[1]		X[1]	X[1]			
Tadarida australis	White-striped Free-tailed Bat			X			X		X			
VESPERTILIONIDAE												
Chalinolobus gouldii	Gould's wattled bat	X	X	X		X	X	X	X	X		
Scotorepens balstoni	Inland broad-nosed bat							X	X[1]			
Vespadelus finlaysoni	Finlayson's cave bat	X										
MURIDAE												
Pseudomys hermannsburgensis	Sandy Inland Mouse								2			
CANIDAE												
Canis lupus dingo	Dingo	S								S		
	Number of Species	**5**	**6**	**4**	**4**	**3**	**3**	**3**	**5**	**3**	**3**	**1**
	Number of Individuals	**12**	**9**	**7**	**5**	**6**	**4**	**4**	**13**	**8**	**3**	**8**

X[1] – calls require confirmation.

Large kangaroos (*Macropus fuliginosus*) were infrequently observed although signs of their presence, scats and footprints, were detected throughout the survey area.

Four of the five bat species were confirmed with unambiguous identifications but one species, the Inland Free-tailed Bat (*Mormopterus* sp.), could not be adequately determined. Gould's Wattled Bat (*Chalinolobus gouldii*) was the most frequently recorded species and was detected in eight of the 10 sites. The analysis of the Anabat© recordings is shown in Appendix 2.

Only one species of rodent, the Sandy Inland Mouse (*Pseudomys hermannsburgensis*), represented by two individuals, was captured and the Dingo was detected by the presence of footprints in two sites.

6.1.1 Comparisons with 1985

Six traplines were established within the Ambassador study area during 1985 and, as far as was possible, these were duplicated during October 2009. A comparison of the results of these two surveys is shown in Table 5. Please note that only mist-netting for bats was conducted in 1985 and there is taxonomic uncertainty regarding the identification of the larger long-eared bats in the region.

Table 5 shows the results from the six traplines within Ambassador (1985) and the single trapline from Shogun (1985) that was resampled during 2009. The 2009 results include the nine traplines within Mulga Rock (Ambassador) and the Shogun trapline. The number of individuals captured or observed is provided in order to give some indication of population changes over time.

Table 5 List of native mammal species recorded during June/July 1985 and October 2009.

NATIVE MAMMAL SPECIES		1985	2009
TACHYGLOSSIDAE	**Monotremes**		
Tachyglossus aculeatus	Echidna		S
DASYURIDAE	**Carnivorous Marsupials**		
Dasycercus cristicauda	Mulgara	1	
Ningaui ridei	Wongai Ningaui	5	4
Ningaui yvonneae	Southern Ningaui	6	22
Sminthopsis dolichura	Little Long-tailed Dunnart	1	8
Sminthopsis hirtipes	Hairy-footed Dunnart	8	20

NATIVE MAMMAL SPECIES		1985	2009
Sminthopsis Ooldea	Ooldea's Dunnart	1	
Sminthopsis psammophila	Sandhill Dunnart	3	
MACROPODIDAE	**Kangaroos**		
Macropus fuliginosus	Western Grey Kangaroo	X	13+S
MOLOSSIDAE	**Free-tailed Bats**		
Mormopterus sp. (sp. 3)	Inland free-tailed bat		?X
Tadarida australis	White-striped free-tailed bat		X
VESPERTILIONIDAE	**Vespertilionid Bats**		
Nyctophilus sp.	? Central Long-eared Bat	X	
Chalinolobus gouldii	Gould's wattled bat	X	X
Scotorepens balstoni	Inland broad-nosed bat		X
Vespadelus finlaysoni	Finlayson's cave bat		X
MURIDAE	**Rodents**		
Pseudomys hermannsburgensis	Sandy Inland Mouse	18	2
Notomys alexis	Spinifex Hopping Mouse	6	
CANIDAE	**Carnivorous Placental Mammals**		
Canis lupus dingo	Dingo	S	S
	Number of species (17)	**12**	**13**

It can be seen from Table 5 that there are substantial differences in both the number of species and the abundance of individuals captured during the two surveys. Three carnivorous marsupials and one rodent that were uncommon in 1985 were not captured during 2009, and one rodent that was abundant in 1985 was only represented by two individuals in 2009. However, two carnivorous marsupials that were relatively uncommon in 1985 were especially abundant in 2009.

6.1.2 Mulgara Species (Dasycercus blythi *and* Dasycercus cristicauda*)*

No Mulgaras were captured and no signs of their presence were recorded during October 2009. Only one Mulgara (unknown species) was captured in 1985 in PNC site 1, an *Acacia jutsonii* open scrubland. The Crest-tailed Mulgara (*Dasycercus cristicauda*) is listed on Appendix 3 as Vulnerable under the EPBC Act and as potentially occurring in the area.

*6.1.3 Sandhill Dunnart (*Sminthopsis psammophila*)*

No Sandhill Dunnarts were recorded during October 2009 although two sites sampled in 1985 where this species had been captured were resampled in 2009: PNC site 7 (MR01 in 2009) where one Sandhill Dunnart had been captured, and PNC site 11, located in Shogun (MR10 in 2009) where two had been captured. This species is listed on Appendix 3 as Endangered under the EPBC Act and as potentially occurring in the area.

*6.1.4 Southern Marsupial Mole (*Notoryctes typhlops*)*

No Southern Marsupial Moles were recorded in either 1985 or 2009. This species will be specifically targeted in future work within the Mulga Rock Project Area. This species is listed on Appendix 3 as Endangered under the EPBC Act and as potentially occurring in the area.

6.2 Amphibians

No amphibians were recorded during the October 2009 survey. None was recorded in 1985 and the DEC species list from the search of NatureMap (Appendix 1) does not include any frogs. However, a range of species could occur; all being burrowing species and opportunistic breeders following sufficient rainfall. This aspect will be discussed in more detail following the second survey. No amphibians are listed in Appendix 3 as potentially occurring in the area.

6.3 Reptiles

A total of 42 species of reptile was recorded during October 2009. This consisted of six dragons, eight geckos, four legless lizards, 15 skinks, three monitors, two blind snakes and four elapid (venomous) snakes (Table 6). Although the total of 42 species was high, the greatest number of species in any one site was 16 in sites MR05 and MR08. The lowest number of species in a site was recorded in MR10 with eight and MR03 with nine.

Table 6 List of reptile species recorded during the October 2009 survey of the Mulga Rock Project Area. (OP – results from opportunistic sampling.)

REPTILE SPECIES		**MR 01**	**MR 02**	**MR 03**	**MR 04**	**MR 05**	**MR 06**	**MR 07**	**MR 08**	**MR 09**	**MR 10**	**OP**
AGAMIDAE	**Dragons**											
Ctenophorus clayi		1						1	1			
Ctenophorus cristatus									3			
Ctenophorus affin. *fordi*			2	1		3						
Ctenophorus isolepis gularis			1	3	10		1	3	2	1	2	6
Moloch horridus		3	1	2	1	3	1	1	5	2		6
Pogona m. minor		2							1	1		3
GEKKONIDAE	**Geckos**											
Diplodactylus conspicillatus					9							
Diplodactylus damaeus						1	7		3	2	2	
Diplodactylus wiru					1		2		2			
Nephrurus laevissimus		1	2	2		4	1	1	1	2		
Rhynchoedura ornata									2			
Strophurus assimilis									1			
Gehyra purpurascens									1			1
Gehyra variegata								1				
PYGOPODIDAE	**Legless Lizards**											
Delma australis					1							
Delma butleri						1						
Lialis burtonis										1		
Pygopus n. nigriceps											1	
SCINCIDAE	**Skinks**											
Ctenotus atlas				1		2	1				1	
Ctenotus b. brooksi		2				2						
Ctenotus pantherinus ocellifer					3				2			
Ctenotus quattuordecimlineatus		5			1				4			
Ctenotus schomburgkii		6	2	7	10	1	10	9	8	2	3	
Cyclodomorphus melanops elongatus				1								
Egernia inornata		1	2				2	2	1	1		3
Lerista bipes			3			2	1			3		
Lerista desertorum			1			1						
Lerista rhodonoides			1		1	1		2				

REPTILE SPECIES		MR 01	MR 02	MR 03	MR 04	MR 05	MR 06	MR 07	MR 08	MR 09	MR 10	OP
Menetia greyii		1	2	3	1	2	3	7		2		
Morethia butleri			1	2		5					1	
Morethia obscura		1										
Proablepharus reginae					2							
Tiliqua occipitalis		1									2	
VARANIDAE	**Monitors**											
Varanus eremius											1	
Varanus gouldii			1						1			3
Varanus t. tristis						1	1					
TYPHLOPIDAE	**Blind Snakes**											
Ramphotyphlops bituberculatus					1							
Ramphotyphlops bicolor								1				
ELAPIDAE	**Venomous Snakes**											
Brachyurophis semifasciata						1						
Demansia psammophis cupreiceps		1										
Parasuta spectabilis nullarbor						1						
Pseudonaja modesta												1
Number of Species (42)		**12**	**12**	**9**	**12**	**16**	**11**	**10**	**16**	**10**	**8**	**7**
Number of Individuals		**25**	**19**	**22**	**39**	**31**	**30**	**28**	**38**	**17**	**13**	**23**

The greatest abundance of individuals was recorded in sites MR04 and MR08 with 39 and 38 reptiles respectively. The lowest was recorded in site MR10 with only 13 individuals. Fifteen reptile species were represented by single individuals; these were mainly legless lizards and snakes (blind and elapid). The most common reptile was the small skink *Ctenotos schomburkii* which was represented by 58 individuals.

6.3.1 Comparisons with 1985

Table 7 shows the number of species recorded in both 1985 and 2009. However, the 1985 survey was conducted in winter and, therefore, reptiles were not commonly recorded as they are least active during this season. It is not possible to differentiate the total results between the three study areas surveyed during 1985 from the Martinick *et al.* (1986) report; the majority of the species recorded appear to have been hand foraged and these captures are not shown relative to the sites sampled. Actual trapping results from the sampling sites within Ambassador show that only four species were recorded by trapping during winter 1985. Therefore, the 1985 list of reptile species does not represent those recorded only within the Ambassador (Mulga Rock) study area.

Table 7 shows that three species were recorded during 1985 that were not recorded during October 2009; these were one dragon, one gecko and one legless lizard.

Table 7 List of reptile species recorded during June/July 1985 and October 2009.

REPTILE SPECIES		1985	2009
AGAMIDAE	**Dragons**		
Ctenophorus clayi			X
Ctenophorus cristatus			X
Ctenophorus affin. *fordi*			X
Ctenophorus isolepis gularis		X	X
Ctenophorus nuchalis (inermis)		X	
Moloch horridus		X	X

REPTILE SPECIES		**1985**	**2009**
Pogona m. minor			X
GEKKONIDAE	**Geckos**		
Diplodactylus conspicillatus			X
Diplodactylus wiru			X
Gehyra purpurascens		X	X
Gehyra variegata		X	X
Lucasium damaeum			X
Nephrurus laevissimus		X	X
Rhynchoedura ornata			X
Strophurus assimilis			X
Strophurus elderi		X	
PYGOPODIDAE	**Legless Lizards**		
Delma australis			X
Delma butleri			X
Delma fraseri		X	
Lialis burtonis			X
Pygopus n. nigriceps			X
SCINCIDAE	**Skinks**		
Ctenotus atlas		X	X
Ctenotus b. brooksi		X	X
Ctenotus leae		X	
Ctenotus pantherinus ocellifer			X
Ctenotus quattuordecimlineatus		X	X
Ctenotus schomburgkii		X	X
Cyclodomorphus melanops elongatus		?X	X
Lerista bipes		X	X
Lerista desertorum			X
Lerista rhodonoides		?X	X
Liopholis inornata		X	X
Menetia greyii		X	X
Morethia butleri		X	X
Morethia obscura			X
Proablepharus reginae			X
Tiliqua occipitalis			X
VARANIDAE	**Monitors**		
Varanus eremius		X	X
Varanus gouldii		X	X
Varanus t. tristis			X
TYPHLOPIDAE	**Blind Snakes**		
Ramphotyphlops bituberculatus			X
Ramphotyphlops bicolor			X
ELAPIDAE	**Venomous Snakes**		
Brachyurophis semifasciata			X
Demansia psammophis cupreiceps			X
Parasuta spectabilis nullarbor			X
Pseudonaja modesta			X
	Number of species (45)	**21**	**42**

*6.3.2 Great Desert Skink (*Liopholis kintorei*)*

This large skink, previously known as *Egernia kintorei*, was not recorded in either 1985 or 2009. Specific searches for evidence of this species were undertaken during October 2009 and will be repeated in future surveys of the project area. No reptiles are listed in Appendix 3 as potentially occurring in the area.

*6.3.3 Woma (*Aspidites ramsayi*)*

The Woma was not recorded in either 1985 or 2009 although a fresh road kill specimen was retrieved by EMA personnel on 26th November 2008 at 1700 hrs just north of Ninox site MR03 on the Nippon Hwy.

6.4 Birds

Only 28 species of bird were recorded during October 2009 and, of these, 26 were recorded in the 10 systematic sampling sites. Two additional bird species were recorded only during opportunistic sampling: the Little Black Cormorant and Little Eagle. Table 8 lists the species recorded and provides an index of abundance of each species within sampling sites MR01 to MR10.

Table 8 shows that the maximum number of species recorded in any one site was 14 in MR08, 11 species were recorded in site MR06. Four sites had very low species richness of between five and six species. Ten species were only recorded in single sites.

Table 8 List of bird species recorded during the October 2009 survey of the Mulga Rock Project Area. (OP – results from opportunistic sampling.)

BIRD SPECIES		MR 01	MR 02	MR 03	MR 04	MR 05	MR 06	MR 07	MR 08	MR 09	MR 10	OP
PHALACROCORACIDAE												
Phalacrocorax sulcirostris	Little Black Cormorant											1
ACCIPITRIDAE												
Aquila morphnoides	Little Eagle											1
FALCONIDAE												
Falco berigora	Brown Falcon								1		1	
Falco cenchroides	Australian Kestrel									2		
PSITTACIDAE												
Cacatua roseicapilla	Galah				5							
Platycercus zonarius	Australian Ringneck								1	2	1	
CUCULIDAE												
Chrysococcyx basalis	Horsfield's Bronze-Cuckoo						2					
HALCYONIDAE												
Todiramphus pyrrhopygia	Red-backed Kingfisher		1		1				2		2	
MEROPIDAE												
Merops ornatus	Rainbow Bee-eater			4		4						
PARDALOTIDAE												
Pardalotus striatus	Striated Pardalote						1					
ACATHIZIDAE												
Smicrornis brevirostris	Weebill	2	4	8	6	6	4	4	6	2	5	
Acanthiza apicalis	Broad-tailed Thornbill						2				2	
MELIPHAGIDAE												
Manorina flavigula	Yellow-throated Miner		3	3	3	4	5	5	3	3		
Anthochaera carunculata	Red Wattlebird								2			
PETROICIDAE												

BIRD SPECIES		MR 01	MR 02	MR 03	MR 04	MR 05	MR 06	MR 07	MR 08	MR 09	MR 10	OP
Microeca fascianus	Jacky Winter						1					
Petroica goodenovii	Red-capped Robin				1	1						
PACHYCEPHALIDAE												
Oreoica gutturalis	Crested Bellbird						1	1	1		1	
Colluricincla harmonica	Grey Shrike-thrush								1			
DICRURIDAE												
Rhipidura leucophrys	Willie Wagtail	1							1			
CAMPEPHAGIDAE												
Coracina novaehollandiae	Black-faced Cuckoo-shrike	2		2	2	2	2		2	2	1	
Lalage tricolor	White-winged Triller	2										
ARTAMIDAE												
Artamus personatus	Masked Woodswallow		2			4	4	5	30		2	
Artamus cinereus	Black-faced Woodswallow								1			
CRACTICIDAE												
Cracticus torquatus	Grey Butcherbird	1			1	1		1	2	1		
Cracticus nigrogularis	Pied Butcherbird		1	1		1	1		1	2	1	
Cracticus tibicen	Australian Magpie		1				3					
CORVIDAE												
Corvus orru	Torresian Crow									1		
HIRUNDINIDAE												
Cheramoeca leucosternum	White-backed Swallow				2	1						
Number of Species (28)		**5**	**6**	**5**	**8**	**9**	**11**	**5**	**14**	**8**	**9**	**2**
Index of Abundance		**8**	**12**	**18**	**21**	**24**	**26**	**16**	**54**	**15**	**16**	

As stated in Section 5.2.1, the daily data from the 10 sites were scanned to ascertain the specific day in each season when the highest number of individuals for each species in every site was recorded. The total for this day was selected as being a reliable index of the relative abundance of birds on a site-by-site and seasonal basis. Based on this, site MR08 had the highest abundance with 54 birds; however, 30 of these were a single flock of Masked Woodswallows. Smaller groups of this species were observed in other sites. Discounting this large flock of highly mobile birds, sites MR05 and MR06 had relatively high abundance figures with 24 and 26 respectively. Site MR01 had a very low index of abundance with only eight birds.

6.4.1 Comparisons with 1985

Table 9 shows that 38 species of bird have been recorded within the Mulga Rock (Ambassador) study area during 1985 and 2009. A total of 25 were recorded in 1985 and 28 during 2009. Eight species were recorded in 1985 that were not recorded during 2009 and 12 were added to the area inventory during 2009. Only 16 species were in common between the two survey periods.

Table 9 List of bird species recorded during June/July 1985 and October 2009.

BIRD SPECIES		1985	2009
PHALACROCORACIDAE			
Phalacrocorax sulcirostris	Little Black Cormorant		X
ACCIPITRIDAE			
Aquila morphnoides	Little Eagle		X
Haliastur sphenurus	Whistling Kite	X	
FALCONIDAE			
Falco berigora	Brown Falcon	X	X
Falco longipennis	Australian Hobby	X	
Falco cenchroides	Australian Kestrel		X

BIRD SPECIES		1985	2009
OTIDIDAE			
Ardeotis australis	Australian Bustard	X	
PSITTACIDAE			
Cacatua roseicapilla	Galah		X
Platycercus zonarius	Australian Ringneck	X	X
Polytelis anthopeplus	Regent Parrot	X	
CUCULIDAE			
Chrysococcyx basalis	Horsfield's Bronze-Cuckoo		X
HALCYONIDAE			
Todiramphus pyrrhopygia	Red-backed Kingfisher		X
MEROPIDAE			
Merops ornatus	Rainbow Bee-eater		X
CLIMACTERIDAE			
Climacteris rufa	Rufous Treecreeper	X	
PARDALOTIDAE			
Pardalotus striatus	Striated Pardalote	X	X
ACATHIZIDAE			
Smicrornis brevirostris	Weebill	X	X
Acanthiza apicalis	Broad-tailed Thornbill	X	X
Acanthiza uropygialis	Chestnut-rumped thornbill	X	
MELIPHAGIDAE			
Manorina flavigula	Yellow-throated Miner	X	X
Lichenostomus plumulus	Grey-fronted Honeyeater	X	
Phylidonyris albifrons	White-fronted Honeyeater	X	
Anthochaera carunculata	Red Wattlebird	X	X
PETROICIDAE			
Microeca fascianus	Jacky Winter	X	X
Melanodryas cucullata	Hooded Robin	X	
Petroica goodenovii	Red-capped Robin	X	X
PACHYCEPHALIDAE			
Oreoica gutturalis	Crested Bellbird	X	X
Colluricincla harmonica	Grey Shrike-thrush		X
DICRURIDAE			
Rhipidura leucophrys	Willie Wagtail	X	X
CAMPEPHAGIDAE			
Coracina maxima	Ground cuckoo-shrike	X	
Coracina novaehollandiae	Black-faced Cuckoo-shrike	X	X
Lalage tricolor	White-winged Triller		X
ARTAMIDAE			
Artamus personatus	Masked Woodswallow		X
Artamus cinereus	Black-faced Woodswallow	X	X
CRACTICIDAE			
Cracticus torquatus	Grey Butcherbird	X	X
Cracticus nigrogularis	Pied Butcherbird	X	X
Cracticus tibicen	Australian Magpie		X
CORVIDAE			
Corvus orru	Torresian Crow	X	X
HIRUNDINIDAE			
Cheramoeca leucosternum	White-backed Swallow		X
	Number of species (38)	**25**	**28**

*6.4.2 Malleefowl (*Leipoa ocellata*)*

No Malleefowl were recorded in 1985. Extensive and detailed searches for evidence of the presence of this large bird were undertaken in 2009 but none was located. Additional assessment for the presence of the large breeding mounds of this species was also undertaken ~~by~~ during a low level helicopter ~~by~~ surveyof dune complexes within and surrounding the Narnoo Projecture tenure. This work was undertaken by Scott Reiffer of Mattiske Consulting and Colin Woolard of Woolard Consulting Pty Ltd ~~…….. more info to come from Colin.~~in November 2009. This species is listed in ~~Appendix 3~~Appendix 3 as potentially occurring in the area.

*6.4.3 Bush Stone-curlew (*Burhinus magnirostris*)*

Not recorded in 1985, this bird was specifically targeted during October 2009 by searches for footprints or any other evidence of their presence including listening for calls during nocturnal sampling. None was recorded.

6.4.4 Other Significant Species

A range of additional species are listed in Appendix 3 as potentially occurring in the area. This includes a number of wetland species that are unlikely to occur within the current survey areas no suitable habitat occurs. However, other species such as the Rainbow Bee-eater, a migratory bird, have been recorded. Similarly, the Fork-tailed Swift could be present although this bird rarely lands in Australia, spending all of its time on the wing. A more detailed discussion of the species listed under the EPBC Act will be undertaken for the final report following the second survey.

6.5 Introduced or Feral Species

Only three species of introduced mammal were recorded during the October 2009 survey: the Cat (*Felis catus*); Donkey (*Equus asinus*) and One-humped Camel (*Camelus dromedarius*). While the Cat and Donkey were uncommon, evidence of One-humped Camels was widespread and abundant. While none of these species are mentioned in the Martinick *et al*. (1986) report, the introduced House Mouse (*Mus musculus*) was represented by a small number of captures.

7 DISCUSSION

7.1 Native Mammals

While the number of small marsupial carnivore species was less in 2009 than in 1985 (four species as against seven) the number of individuals captured was more than double (52 as against 25). Although some sampling methods have changed over the intervening years, this more than likely reflects the natural fluctuations in population levels over time. This is also evident in the rodent captures, although only two native species are represented in the 1985/2009 results.

Appendix 1 shows the results of the search of the DEC's NatureMap database. From this it can be seen that two additional small native mammals could be recorded in the Mulga Rock Project Area: the Western Pygmy Possum (*Cercartetus concinnus*) and Fat-tailed Dunnart (*Sminthopsis crassicaudata*).

It is likely that additional species will be recorded during a second sampling session planned for 2010, especially if this follows good rainfall through the general area. A more detailed data and literature review will be incorporated into the final report following the second field survey.

7.2 Amphibians

The lack of amphibian records from either 1985 or 2009 sampling is not surprising given the lack of substantial rainfall which would initiate breeding by this group of species. No frogs are listed on Appendix 1 indicating that this is a substantially under sampled group of animals. However, only four species of frog are listed in Tyler and Doughty (2009) as occurring in the Kalgoorlie area and these mainly require areas subject to seasonal flooding such as claypans for breeding. This habitat does not occur in the current Mulga Rock study area therefore it is unlikely that frogs form a significant component of the fauna of the area.

7.3 Reptiles

The inventory of reptile species recorded from the Nrnoo Project Area is extensive with 42 being captured or observed during 2009. Three species recorded in 1985 were not recorded during 2009 and Appendix 1 lists a further 12 species that could potentially occur in the general area. Several of these species are known to occur in the Queen Victoria Spring Nature Reserve and are likely to be present in similar habitat within the Mulga Rock Project Area. Further sampling in 2010 will almost certainly add more reptile species to the project area inventory. A more detailed data and literature review will be incorporated into the final report following the second field survey.

7.4 Birds

The species richness of birds within the Mulga Rock Project Area is very low with only 38 species being recorded in total (1985 and 2009), with 28 being the maximum in 2009. This inventory of species would almost certainly increase if sampling coincided with flowering of either *Eucalyptus* species, *Banksia* and/or *Grevillea* species. However, the lack of any Mulga or Sheoak woodlands within the Mulga Rock Project Area would decrease the potential for several small insectivorous bird species to occur as these habitats generally have a very diverse and abundant bird fauna wherever they are present.

In addition, the slow recovery of the understorey from fire, temporarily reducing the density of the shrublands, would also discourage a range of small bird species such as fairy-wrens from the area.

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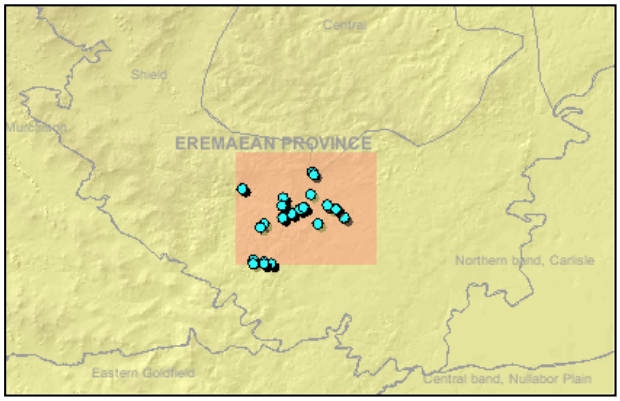
Appendix 1 Results of the search of the DEC's NatureMap.



Search Results

Method='By Rectangle'; Extent=123°33' 20" E, 124°12' 30" E, 30°14' 30" S, 29°43' 25" S; Kingdom=Animalia; Group By=Species Group;

Species Group	Species	Records
Mammal	13	135
Reptile	46	193
TOTAL	59	328

Mammal

Cercartetus concinnus Western Pygmy-possum, Mundarda
Dasycercus blythi Brush-tailed Mulgara, Ampurta **P4**
Dasycercus cristicauda Crest-tailed Mulgara **T**
Mus musculus House Mouse
Ningaui ridei Wongai Ningaui
Ningaui yvonneae Southern Ningaui
Notomys alexis Spinifex Hopping-mouse
Pseudomys hermannsburgensis Sandy Inland Mouse
Sminthopsis crassicaudata Fat-tailed Dunnart
Sminthopsis dolichura Little long-tailed Dunnart
Sminthopsis hirtipes Hairy-footed Dunnart
Sminthopsis ooldea Ooldea Dunnart
Sminthopsis psammophila Sandhill Dunnart **T**
13 species, 135 records

Reptile

Brachyurophis semifasciata
Ctenophorus clayi Collared Dragon
Ctenophorus cristatus Bicycle Dragon
Ctenophorus fordi Mallee Sand Dragon
Ctenophorus isolepis subsp. gularis Central Military Dragon
Ctenophorus nuchalis Central Netted Dragon
Ctenotus atlas
Ctenotus brooksi
Ctenotus helenae
Ctenotus leae
Ctenotus pantherinus subsp. ocellifer
Ctenotus quattuordecimlineatus
Ctenotus schomburgkii
Cyclodomorphus melanops subsp. elongatus
Delma butleri
Delma petersoni
Demansia psammophis subsp. psammophis
Diporiphora linga
Diporiphora reginae

Egernia inornata
Egernia striata Night Skink
Eremiascincus richardsonii Broad-banded Sand Swimmer
Gehyra purpurascens
Gehyra variegata
Lerista bipes
Lerista desertorum
Lerista puncticauda **P2**
Lerista taeniata
Lialis burtonis
Lucasium damaeum
Menetia greyii
Moloch horridus Thorny Devil
Morethia butleri
Nephrurus laevissimus
Parasuta monachus
Pogona minor subsp. minor
Proablepharus reginae
Pseudechis australis Mulga Snake
Pygopus nigriceps
Ramphotyphlops bituberculatus
Rhynchoedura ornata Beaked Gecko
Simoselaps bertholdi Jan's Banded Snake
Strophurus assimilis Goldfields Spiny-tailed Gecko
Strophurus elderi
Varanus eremius Pygmy Desert Monitor
Varanus gouldii Bungarra or Sand Monitor
46 species, 193 records

Conservation Status
T - Rare or likely to become extinct
X - Presumed extinct
IA -Protected under international agreement
S - Other specially protected fauna
1 - Priority 1
2 - Priority 2
3 - Priority 3
4 - Priority 4
5 - Priority 5

Appendix 2 Analysis of Anabat© results.

Bat call identification

from Mulga Rock, WA

Type:	Bat Call Analysis
Prepared for:	Ninox Wildlife Consulting
Date:	1 November 2009
Job No.:	SZ131
Prepared by:	Specialised Zoological Kyle Armstrong and Yuki Konishi ABN 92 265 437 422 0404 423 264 kyle.armstrong@graduate.uwa.edu.au kyle.n.armstrong@gmail.com

SUMMARY

Bat identifications from Anabat echolocation call recordings are provided from Mulga Rock, in the Great Victoria Desert, Western Australia. Five species were identified as being present (Table 1).

Some sequences could not be identified reliably to one species. Some calls of Gould's wattled bat *Chalinolobus gouldii* can be confused with those of the inland free-tailed bat *Mormopterus* sp. 3. All identifications of *C. gouldii* are made from high quality diagnostic call sequences, but other calls might have been M*ormopterus* sp. 3. Likewise, some calls of the inland broad-nosed bat *Scotorepens balstoni* and *C. gouldii* were difficult to distinguish unambiguously.

Details supporting the identifications are provided, as recommended by the Australasian Bat Society (ABS 2006). A summary of pulse parameters is provided in Table 2, and representative call sequences are illustrated in Figure 1. Further data is available should verification be required.

METHODS

Signals as recorded with an Anabat SD1 unit were supplied as downloaded sequences, which were examined in AnalookW 3.7a software. Three call variables were measured on good quality search phase pulses in representative call sequences: pulse duration (milliseconds), maximum frequency (kHz) and characteristic frequency (equivalent to minimum frequency; kHz). Species were identified based on information in Pennay et al. (2004). Nomenclature follows Armstrong and Reardon (2006). Species designations of Churchill (2008) are not followed until formal publication of the relevant taxonomic study.

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TABLE 1. Species identifications, with the degree of confidence indicated by a code. Date correlates with site; see Table 2 for full species names.

Date	Site	*C. gouldii*	*Mormopterus sp. 3*	*S. balstoni*	*T. australis*	*V. finlaysoni*
Serial 3725						
9/10/2009	MR08	H	NC	NC	H	—
10/10/2009	MR07	H	NC	H	—	—
11/10/2009	MR03	H	—	—	H	—
12/10/2009	MR06	H	—	—	H	—
13/10/2009	MR08	H	NC	NC	H	—
Serial 4497						
9/10/2009	MR02	—	—	—	—	—
10/10/2009	MR05	H	NC	—	—	—
11/10/2009	MR09	—	—	—	—	—
12/10/2009	MR01	H	NC	—	—	H

Definition of confidence level codes:

H High. Unambiguous identification of the species at the site based on measured call characteristics and comparison with available reference material. Greater confidence in this ID would come only after capture and supported by morphological measurements or submission of a specimen/tissue to a museum.

NC Needs Confirmation. Either call quality was poor, or the species cannot be distinguished reliably from another that makes similar calls. Alternative identifications are indicated in the Summary section of this report. If this is a species of conservation significance, further survey work might be required to confirm the record.

TABLE 2. Summary of variables from representative call sequences.

Species	s,p[1]	Duration (msec)[2]	Max Frequency (kHz)[2]	Char frequency (kHz)[2]
Gould's wattled bat *Chalinolobus gouldii*	4,52	6.9 ± 1.6 4.2 – 10	43.8 ± 9.1 31.1 – 70.5	28.9 ± 1.3 26.2 – 31.3
Inland free-tailed bat *Mormopterus* sp. (sp. 3)	8,34	8.9 ± 1.4 3.5 – 11.2	31.2 ± 2.5 28.4 – 39.3	27.3 ± 0.9 25.8 – 28.9
Inland broad-nosed bat *Scotorepens balstoni*	4,33	5.8 ± 1.5 4 – 9.1	54.7 ± 11.2 35.5 – 71.4	33.5 ± 1.4 31.8 – 36.6
White-striped free-tailed bat *Tadarida australis*	3,11	11.6 ± 2.6 7.7 – 16.2	18.2 ± 1.4 16.1 – 20.8	12.4 ± 0.9 10.7 – 14.2
Finlayson's cave bat *Vespadelus finlaysoni*	1,13	3.9 ± 0.6 3 – 4.6	69.8 ± 7.3 58.8 – 82.5	51.2 ± 0.3 50.3 – 51.6

[1] s,p: number of sequences measured, combined total number of pulses measured;

[2] Mean ± SD; range.

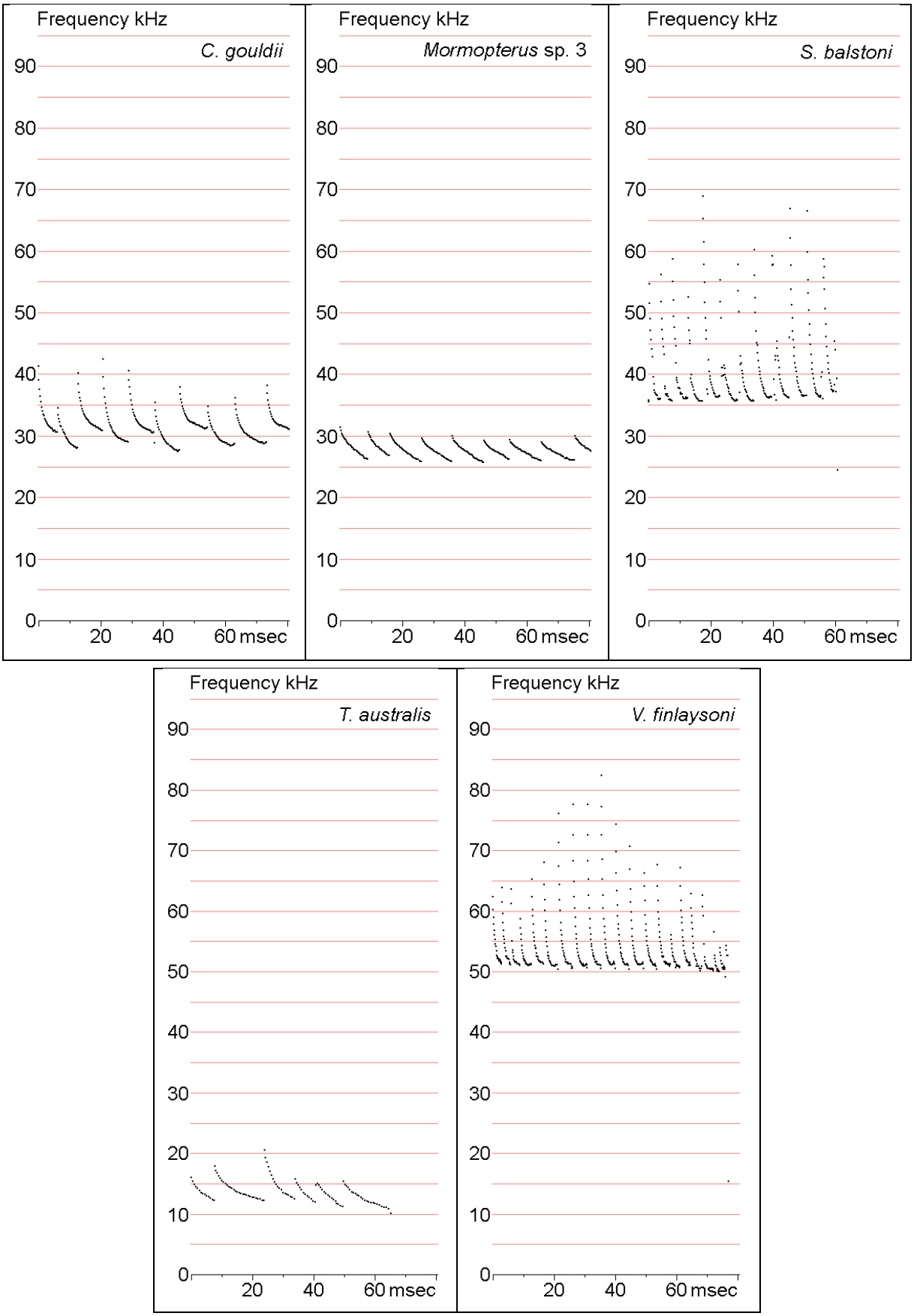

FIGURE 1. Representative call sequences of the species identified (time is compressed between pulses).

Appendix 3 EPBC Act Protected Matters Report.

Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance - seehttp://www.environment.gov.au/epbc/assessmentsapprovals/guidelines/index.html.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Significance: (Ramsar Sites)	None
Commonwealth Marine Areas:	None
Threatened Ecological Communities:	None
Threatened Species:	7
Migratory Species:	8

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place and the heritage values of a place on the Register of the National Estate. Information on the new heritage laws can be found athttp://www.environment.gov.au/heritage/index.html.

Please note that the current dataset on Commonwealth land is not complete. Further information on Commonwealth land would need to be obtained from relevant sources including Commonwealth agencies, local agencies, and land tenure maps.

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species. Information on EPBC Act permit requirements and application forms can be found at http://www.environment.gov.au/epbc/permits/index.html.

Commonwealth Lands:	None
Commonwealth Heritage Places:	None
Places on the RNE:	1
Listed Marine Species:	5
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	1
Other Commonwealth Reserves:	None
Regional Forest Agreements:	None

Details
Matters of National Environmental Significance

Threatened Species [Dataset Information]	Status	Type of Presence
Birds		
Acanthiza iredalei iredalei Slender-billed Thornbill (western)	Vulnerable	Species or species habitat likely to occur within area
Leipoa ocellata Malleefowl	Vulnerable	Species or species habitat likely to occur within area
Mammals		
Dasycercus cristicauda Mulgara	Vulnerable	Species or species habitat likely to occur within area
Notoryctes typhlops Southern Marsupial Mole, Yitjarritjarri, Itjaritjari	Endangered	Species or species habitat likely to occur within area
Sminthopsis psammophila Sandhill Dunnart	Endangered	Species or species habitat known to occur within area
Plants		
Conospermum toddii Victoria Desert Smokebush	Endangered	Species or species habitat likely to occur within area
Eucalyptus articulata Ponton Creek Mallee	Vulnerable	Species or species habitat likely to occur within area
Migratory Species [Dataset Information]	Status	Type of Presence
Migratory Terrestrial Species		
Birds		
Leipoa ocellata Malleefowl	Migratory	Species or species habitat likely to occur within area
Merops ornatus Rainbow Bee-eater	Migratory	Species or species habitat may occur within area
Migratory Wetland Species		
Birds		
Ardea alba Great Egret, White Egret	Migratory	Species or species habitat may occur within area
Ardea ibis Cattle Egret	Migratory	Species or species habitat may occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel	Migratory	Species or species habitat may occur within area
Migratory Marine Birds		

Apus pacificus Fork-tailed Swift	Migratory	Species or species habitat may occur within area
Ardea alba Great Egret, White Egret	Migratory	Species or species habitat may occur within area
Ardea ibis Cattle Egret	Migratory	Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species [Dataset Information]	Status	Type of Presence
Birds		
Apus pacificus Fork-tailed Swift	Listed - overfly marine area	Species or species habitat may occur within area
Ardea alba Great Egret, White Egret	Listed - overfly marine area	Species or species habitat may occur within area
Ardea ibis Cattle Egret	Listed - overfly marine area	Species or species habitat may occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel	Listed - overfly marine area	Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater	Listed - overfly marine area	Species or species habitat may occur within area

Places on the RNE [Dataset Information]
Note that not all Indigenous sites may be listed.

Natural

Queen Victoria Spring Nature Reserve WA

Extra Information

State and Territory Reserves [Dataset Information]

Queen Victoria Spring Nature Reserve, WA

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the *Environment Protection and Biodiversity Conservation Act 1999*. It holds mapped locations of World Heritage and Register of National Estate properties, Wetlands of International Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

For species where the distributions are well known, maps are digitised from sources such as recovery plans and detailed habitat studies. Where appropriate, core breeding, foraging and roosting areas are indicated under "type of presence". For species whose distributions are less well known, point locations are collated from government wildlife

authorities, museums, and non-government organisations; bioclimatic distribution models are generated and these validated by experts. In some cases, the distribution maps are based solely on expert knowledge.

Only selected species covered by the migratory and marine provisions of the Act have been mapped.

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers.

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites;
- seals which have only been mapped for breeding sites near the Australian continent.

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Acknowledgments

This database has been compiled from a range of data sources. The Department acknowledges the following custodians who have contributed valuable data and advice:

- New South Wales National Parks and Wildlife Service
- Department of Sustainability and Environment, Victoria
- Department of Primary Industries, Water and Environment, Tasmania
- Department of Environment and Heritage, South Australia Planning SA
- Parks and Wildlife Commission of the Northern Territory
- Environmental Protection Agency, Queensland
- Birds Australia
- Australian Bird and Bat Banding Scheme
- Australian National Wildlife Collection
- Natural history museums of Australia
- Queensland Herbarium
- National Herbarium of NSW
- Royal Botanic Gardens and National Herbarium of Victoria
- Tasmanian Herbarium
- State Herbarium of South Australia
- Northern Territory Herbarium
- Western Australian Herbarium
- Australian National Herbarium, Atherton and Canberra
- University of New England
- Other groups and individuals

ANUClIM Version 1.8, Centre for Resource and Environmental Studies, Australian National University was used extensively for the production of draft maps of species distribution. Environment Australia is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.