A Preliminary Fauna Survey of New Island Bay, Cape Le Grand National Park

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Tarsipes rostratus photo M.A. Cowan

Executive Summary

A terrestrial vertebrate fauna survey was undertaken over a period of seven nights from the 30th November 2011 to the 7th of December 2011 at New Island Bay, Cape Le Grand National Park. Data collected from this work is compiled here with that of reports and electronic database sources from the Western Australian Museum and the Department of Environment and Conservation. This information is used to provide an overview of fauna present or likely to occur within a proposed development envelope at New Island Bay.

Within the National Park there are several species of conservation significance, including seven species of birds, two species of mammals, one reptile and three invertebrates. A further six species of invertebrates, primarily millipedes, are considered short range endemics and therefore are also of conservation significance. Although none of these species were recorded during this survey, suitable habitat (dense vegetation associated with drainage lines) for one of the mammals, the priority 5 listed *Isoodon obesulus* (southern brown bandicoot) forms some of the peripheral habitat within the development envelope. Where there is adequate leaf litter these same areas may also provide suitable habitat for any of the listed invertebrates. Several bird species such as the Endangered *Botaurus poiciloptilus* (Australasian bittern) and the priority 4 *Charadrius rubricollis* (hooded plover) could make periodic and opportunistic use of areas along the creekline within the proposed development envelope but any such use is only likely to be intermittent.

The terrestrial fauna recorded represented a relatively high proportion of that known to occur within Cape Le Grand National Park but the majority of these species were only detected in habitats around the margins of the proposed development envelope. This may be a consequence of the relatively recent fire that burnt much of the central parts of the project area, although this could only be determined through additional work as vegetative regeneration occurs.

The invasive species *Mus musculus* (house mouse) was caught in high numbers at almost all trapping sites. It is quietly likely this is also the result of the relatively recent burn which has provided conditions known to favour this species. Feral cats (*Felis catus*) are present in the area and were detected on cameras on two occasions. These are likely to have a negative impact on all extant vertebrate fauna in the vicinity.

1. Introduction

New Island Bay is in Cape Le Grand National Park at approximately 34° 00' 34" S, 122° 08' 32" E and is some 28 km southeast of the town of Esperance. The bay faces southwest and is separated from the popular tourist destination of Hellfire Bay to the east by an extensive rocky headland while Mt Le Grand is only a few kilometres north. The bay is bordered by large outcropping of pre-Cambrian granites (Morgan and Peers 1973) while along the ocean edge there is a long stretch of sandy beach some 50 metres wide, edged behind by a steep low vegetated foredune. Immediately behind the foredune is an area of consolidated dune with low shrubland comprising mixed Proteaceae and Myrtaceae. Along the eastern margin of the project area is a freshwater creek while the western margin comprises of a Mallee shrubland adjacent to areas of exposed granite. A more detailed description of the vegetation is given by Markey (2012).

A program coordinated by the Department of Environment and Conservation and Tourism WA, Naturebank, which aims to develop ecotourism accommodation opportunities in an environmentally sensitive manner, has identified New Island Bay as a potential development location.

For sites to become available for development requires pre-release clearances that meet environmental and cultural objectives. One of the environmental clearances required in this instance is that of a preliminary fauna assessment to 1) provide an inventory of species present within the development envelope and 2) identify species that occur or are likely to occur and have threatened, specially protected, or priority conservation status under state and federal legislation and that may be adversely impacted on by any development of the area.

The work reported on here was targeted at terrestrial vertebrates with opportunistic data for birds. Short range endemic and conservation listed invertebrates known to occur in the area are also identified. A trapping program was focussed on the proposed development envelope while a visual assessment was made along the proposed 4km access track (Figure 1).

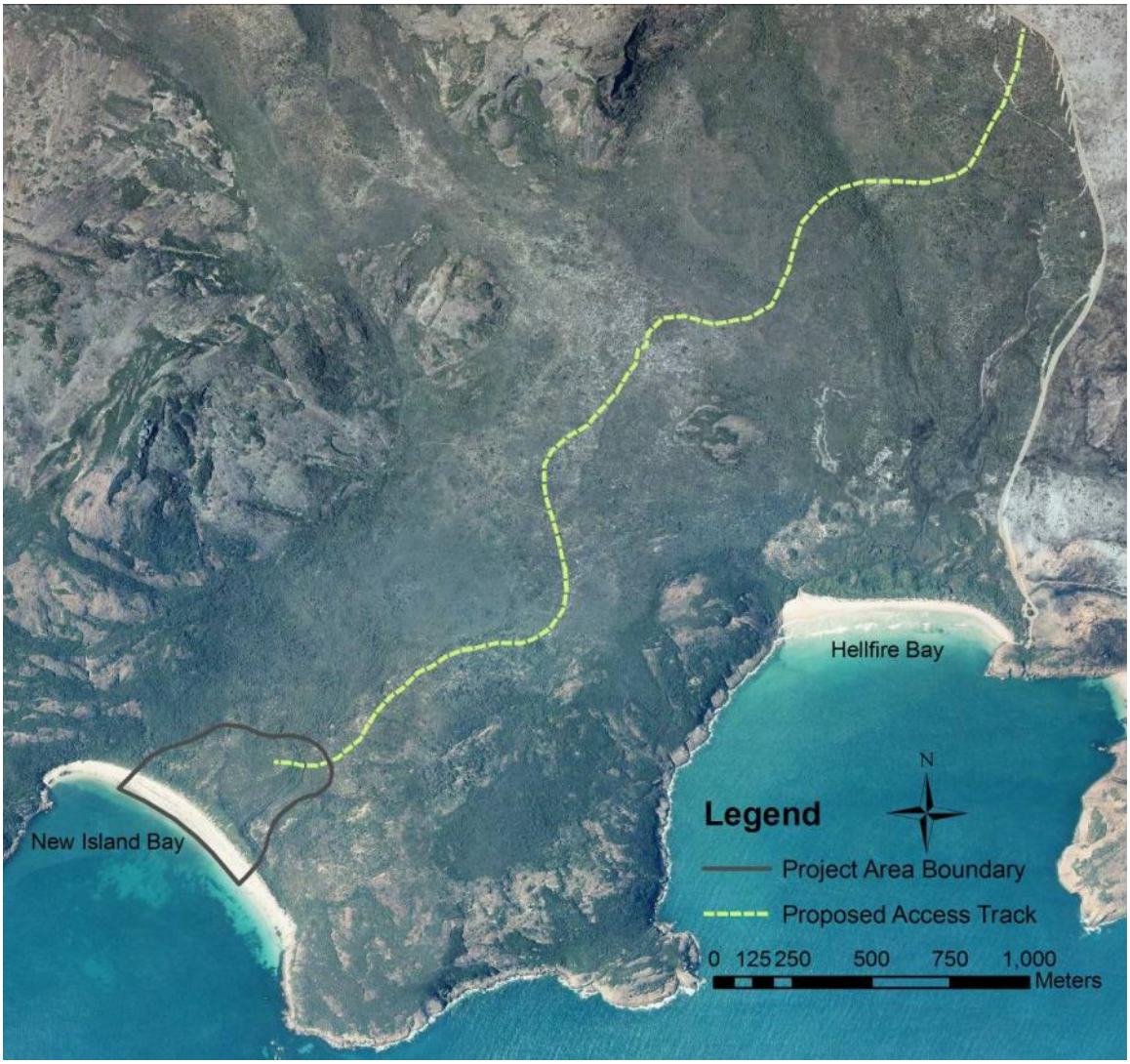

Figure 1. Map showing position of New Island Bay in relation to Hellfire Bay and the position of the proposed development envelope and associated access track.

2. Desktop Assessment

The only formal survey of Cape Le Grand National Park was undertaken by the Western Australian Museum (WAM) in 1975 (Kitchener *et al*. 1975), but none of the survey locations were in close proximity to New Island Bay. From this work and a search of the WAM fauna database, 43 native and 3 introduced ground dwelling vertebrates have been recorded for the park. There are two trapping locations that have been used since 1997 for Western Shield Monitoring (E. Adams pers. comm.)[1], one near Mt Le Grand and the other at Lucky Bay. Many of

[1] Emma Adams, Conservation Officer, Esperance District, Dept. Environment and Conservation

the species identified by Kitchener *et al.* (1975) are recorded from these sites with the addition of a further three native vertebrates and one introduced species bringing the total recorded for the park to 46 native and 4 introduced species (Appendix B). This comprises of 7 frogs, 25 lizards, 6 snakes, 8 native mammals and 4 introduced mammals- the mouse, rabbit, cat and fox. From this list of known taxa there are only three species to be considered of conservation significance under state legislation and these are the threatened *Petrogale lateralis (*black-footed rock wallaby), the priority 5 *Isoodon obesulus* (southern brown bandicoot) and the specially protected *Morelia spilota* (carpet python). *P. lateralis* is also identified as vulnerable under Commonwealth Legislation. While *P. lateralis* was recorded from the Park in the early 1900's (Kitchener et al. 1975) it was believed to have become locally extinct later that century, as was the case for many other south coast populations of the same species. Translocations of this species were made by the Department of Conservation and Land Management in 2003 when 25 individuals were released in Cape Le Grand National Park. While in recent years there have been occasional sightings or signs of this species, their current status in the park is uncertain.

A bird list was compiled from the survey work of Kitchener *et al.* (1975), from the WA Museum fauna database and from NatureMap and is provided in Appendix C. The list contains 132 species for the entire National Park with 63 of these species being waterfowl, shore birds, waders and marine species, a few of which are aberrant records or infrequent sightings. Within this particular group there are three species that have formal conservation status under state legislation. These are the endangered *Botaurus poiciloptilus* (Australasian bittern), the vulnerable *Diomedea exulans* (wandering albatross) and the priority 4 *Charadrius rubricollis* (hooded plover). For the 69 land based species remaining, four also have formal conservation status under state legislation. These are the endangered *Calyptorhynchus latirostris* (carnaby's cockatoo), the specially protected *Falco peregrinus* (peregrine falcon), and two priority 4-listed species *Ardeotis australis* (Australian bustard) and *Oreoica gutturalis* (crested bell-bird). *B. poiciloptilus, C. latirostris, D. exulans* along with *Sterna nereis* (fairy tern) are also listed under Commonwealth Legislation (Department of Sustainability, Environment, Water, Population and Communities 2009).

Although invertebrates were not targeted during this field work there are conservation significant aspects of this fauna in Cape Le Grand National Park and they warrant mention here. Short range endemic invertebrates (SRE's) are considered of high conservation significance due the likelihood of habitat loss or other threatening processes impacting adversely on their conservation status (EPA 2009). Cape Le Grand is recognised as having high diversity for some SRE's, particularly millipedes (Class: Diplopoda) (Moir *et al.* 2009) with currently eight species, some of which are still awaiting formal description. Three of these species are also recognised as schedule 1 vulnerable species in the Wildlife Conservation (Specially Protected Fauna) Notice *2012.* There is also at least one species of spider only recorded from Cape Le Grand. A list of these SRE and vulnerable species is provided in

Appendix D. All of these species are recorded from shaded moist gullies within leaf litter (M. Harvey pers. comm.).[2]

3. Methodology

Five pit trap lines were established at locations considered to represent both the spatial extent of the study area and the main habitat variability (Figure 2). These locations incorporated the vegetation associated with the primary dune (site 1), with the consolidated dune area (site 3), through the Mallee thickets on the western margin of the study area (site 2), along the edge of the creekline incorporating areas of sedge, and heath with occasional Mallee towards the eastern edge of the study area (site 5) and, around the periphery of the dense vegetation associated with drainage at the north eastern part of the study area.

Each line consisted of aluminium flywire fence approximately 60 m long and 30 cm high with the bottom few centimetres buried in the soil. At several metres in from either end of the fence, and then at approximately 10 m intervals, a pitfall trap were positioned with its opening centrally located under the fence and flush to the ground. The pitfall traps used were 250 mm wide by 400 mm deep plastic buckets (20 L) with six established along each trap line. Insulating material in the form of small polystyrene packing trays, along with small amounts of soil and leaf litter, were placed in the bottom of buckets to provide protection for trapped animals from both weather and predation. At each site eight funnel traps were also established. These were set in pairs on either side of the aluminium fence line and located approximately centrally between two pit traps (Figure 3). At site 2, 4, and 5, elliot trap lines were established consisting of 25 medium sized elliot traps (type A) and 10 large traps(type B). These were placed in lines (Figure 2) with a spacing of 10 to 15 metres between each trap. A line of 25 type A elliot's was also established running between site 1 and site 3 (elliot line 1.3). Each trap was baited with a small ball of universal bait, a combination of oats and peanut butter. Bait was replenished as required and traps were re- baited after three days. All traps were checked and cleared early each morning.

Captured animals were identified to species level and had body mass (g), sex and reproductive status recorded. For reptiles, snout-vent length (mm) was also recorded with a plastic ruler, and for mammals additional measurements taken were cranium (mm) and pes length (mm) with a set of vernier callipers. A small mark from a paint pen or marker pen (xylene free) was applied to the outside of one ear for mammals and to the abdomen of reptiles so it was possible to determine recaptures over the trapping period.

Although birds were not the primary focus of this study and no systematic survey was undertaken for them, daily observations were collated during the course of

[2] Dr Mark Harvey, Curator of Arachnology, Western Australian Museum.

other work and are provided in Appendix C. Records were also collated for the entire park from the work of Kitchener et al. (1975) along with the records of the WA Museum (Western Australian Museum 2011) and from NatureMap (Department of Environment and Conservation 2007). Threatened and priority species were identified and some comment on risk to these species is provided.

Species accumulation data was analysed for vertebrate captures in Primer-E (Clarke and Gorley 2006) using the Jacknife 1 and Chao1 richness estimators, which are considered two of the best performers for analysing abundance data (Magurran 2004).

Species nomenclature for amphibians, reptiles, birds and mammals followed that of the Western Australian Museum. The Western Australian Museum field guides were the primary source used for reptile species identification (Storr et al. 1983, 1990, 1999 and 2002) although natural history information was also sought from A Complete Guide to Reptiles of Australia (Wilson and Swan 2008). Reference material for mammals was from The Mammals of Australia (Van Dyck and Strahan 2008) and A Field Guide to the Mammals of Australia (Menkhorst and Knight 2004). Bird identification was through a Field Guide to Australian Birds (Morcombe 2004).

Coordinate details for each of the trap sites are given in Appendix E while a general habitat photo for each of the trapping sites is provided in Appendix F.

All pit trapping sites including funnel traps were established on the 30th of November 2011 and then operated for the next seven nights/days through to the 7th of December 2011. Elliot trap lines 2 and 5 were established on the 30th November while sites 1.3 and 4 were established the following day (1st December) and all traps were closed again on the 7th December. Five camera traps were also established on the 1st December and operated for 6 nights. Thus the trapping effort across all sites during the survey in terms of trap nights for each trap type was: medium elliots 650, large elliots 200, pit traps 210, funnel traps 280 and, cameras 30.

Access to the survey site involved traversing 3.5 km of cross country, which limited the opportunity to undertake spotlighting and head torching to a single occasion when we camped on site. Unfortunately the conditions on this occasion were overcast, windy and relatively cold with the threat of some rain. The only species observed on this occasion were frogs, for which each species was also recorded in our traps.

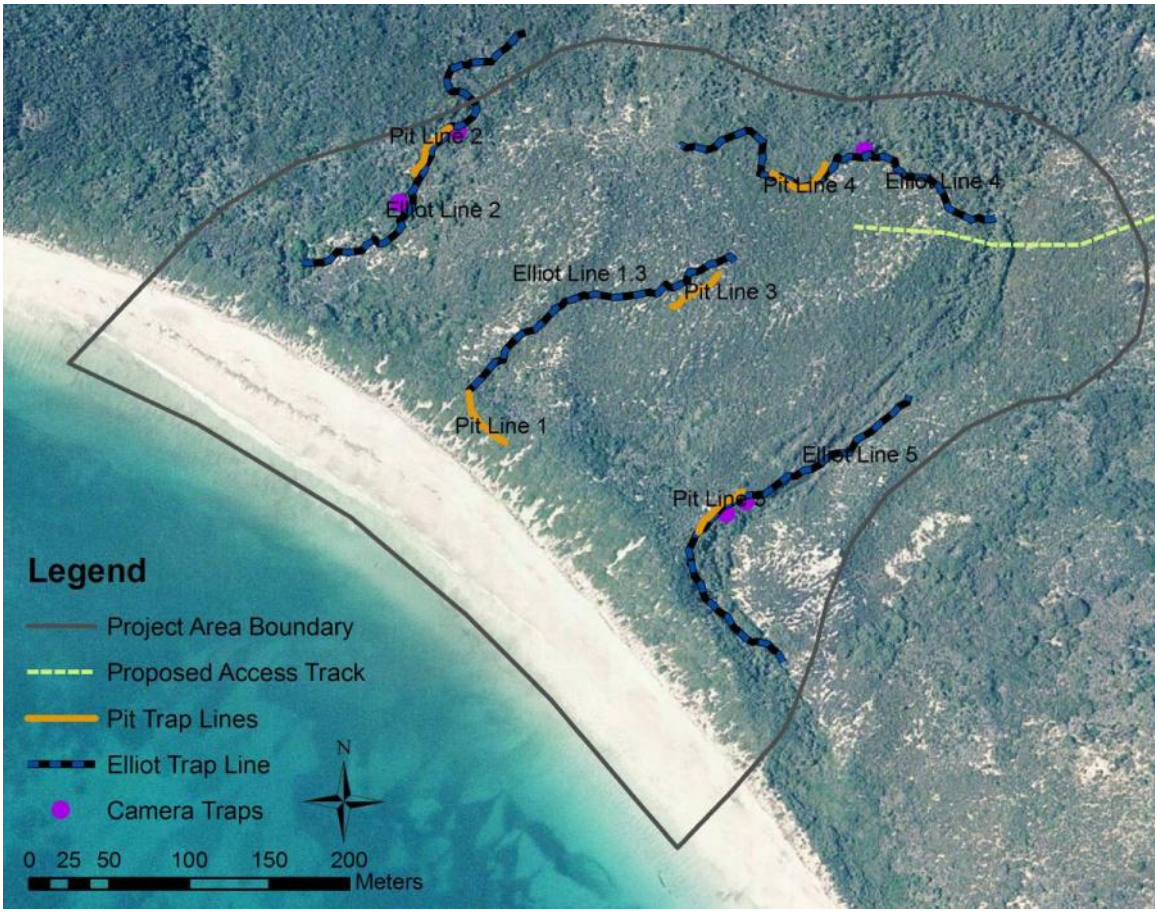

Figure 2. Layout of both pit trap lines and elliot trap lines at each of the five main sites within the project area, along with the position of the five camera traps.

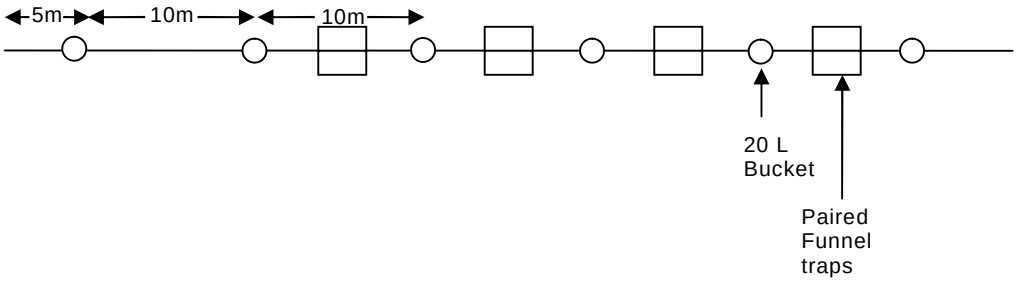

Figure 3. Drift fence and trap layout showing spacing and arrangement of each of the traps types. Spacing between each of the buckets was approximately 10 m with a pair of funnel traps positioned in between all but one pair of buckets.

4. Field Investigation

The timing of the survey was targeted for early summer as this is the period most likely to coincide with peak activity of ground vertebrates. Temperatures were mild to warm throughout the survey with maximum daytime temperature ranging from 20 to 31 °C (mean 23.7, SD 3.9) and minimum temperatures ranging from 9.2 to 17.2 °C (mean 13.3, SD 2.7). There was 7 mm of rainfall recorded at the Cape Le Grand National Park rangers station on the day prior to the start of the survey and 4 mm recorded over the day and night preceding trap closure (Figure 4).

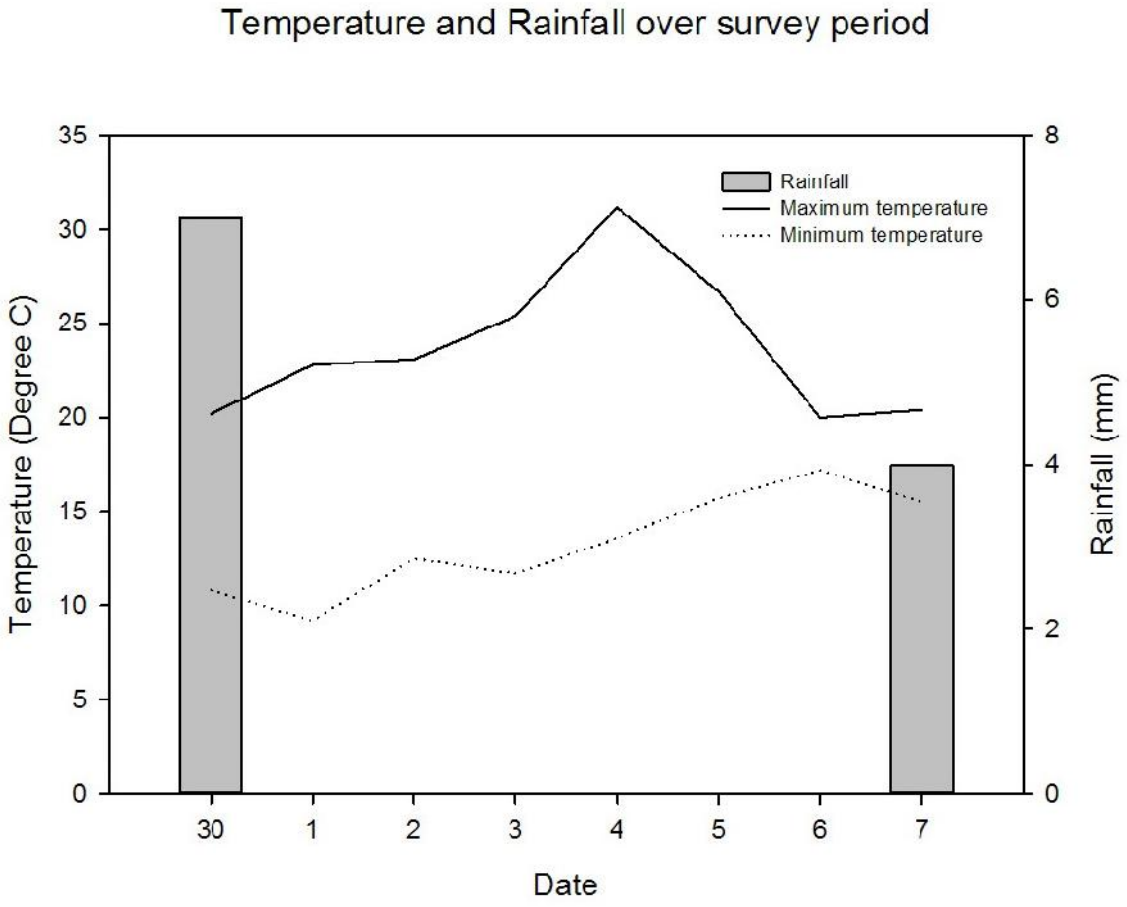

Figure 4. Climate data from the 30th of November to 7th of December 2011 was acquired from the Esperance weather station for temperature, which is 28 km northwest of the study area, while rainfall was recorded from the ranger's station at Cape Le Grand National Park. (BOM 2012)

Over the course of the survey there were 286 vertebrate captures with 143 caught in pits, 80 in funnel traps and, 63 in elliot traps. The total number of species recorded from the traps in the survey area was 20 with another 3 species either observed or recorded on camera. Captures in pits were responsible for 16 species,

funnels 15 species and elliot traps only 3 species. An additional 5 species were recorded from rocky habitat adjacent to the study area (appendices 1 and 2). Four species of mammal were trapped with the most abundant being *Mus musculus* (house mouse) with 64 recorded, followed by the native *Rattus fuscipes* (bush rat) and *Tarsipes rostratus* (honey possum) both with 28 individuals and then *Sminthopsis griseoventer* (grey-bellied dunnart) with 19 individuals. For the reptiles there were 13 species recorded with the small skink *Morethia obscura* recorded on 66 occasions and frequently sighted. Three other small skinks, *Ctenotus gemmula*, *C. catenifer* and *Hemiergis peronii*, were recorded 21, 9 and 7 times respectively. The other nine reptile species were recorded only between one and five occasions for each species. Three species of frog were captured with *Crinia georgiana* (quacking frog), *Limnodynastes dorsalis* (banjo frog) and, *Litoria adelaidensis* (slender tree frog) recorded 9, 8 and 1 occasions respectively.

The proposed road access route (Figure 1) was traversed by foot and while no trapping was undertaken along this route, a visual assessment of habitat types was made along with recordings of any species or their sign that was observed.

The survey sites ground fauna was comparatively rich with more than 40% of the total fauna known for Cape Le Grand National Park being recorded within the study area. For frogs this was 42.8%, lizards 50%, snakes, 33%, native mammals 55.5% and for introduced mammals 75%. When species accumulation data were plotted for the survey trapping data, a total of 20 species, the graph was beginning to reach an asymptote suggesting further trapping effort would have detected few additional species (Figure 5). When the species observed data for the graph (SOBs) is compared with that of the Chao1 and Jacknife1 indicators, the prediction is for only an additional two and three species respectively.

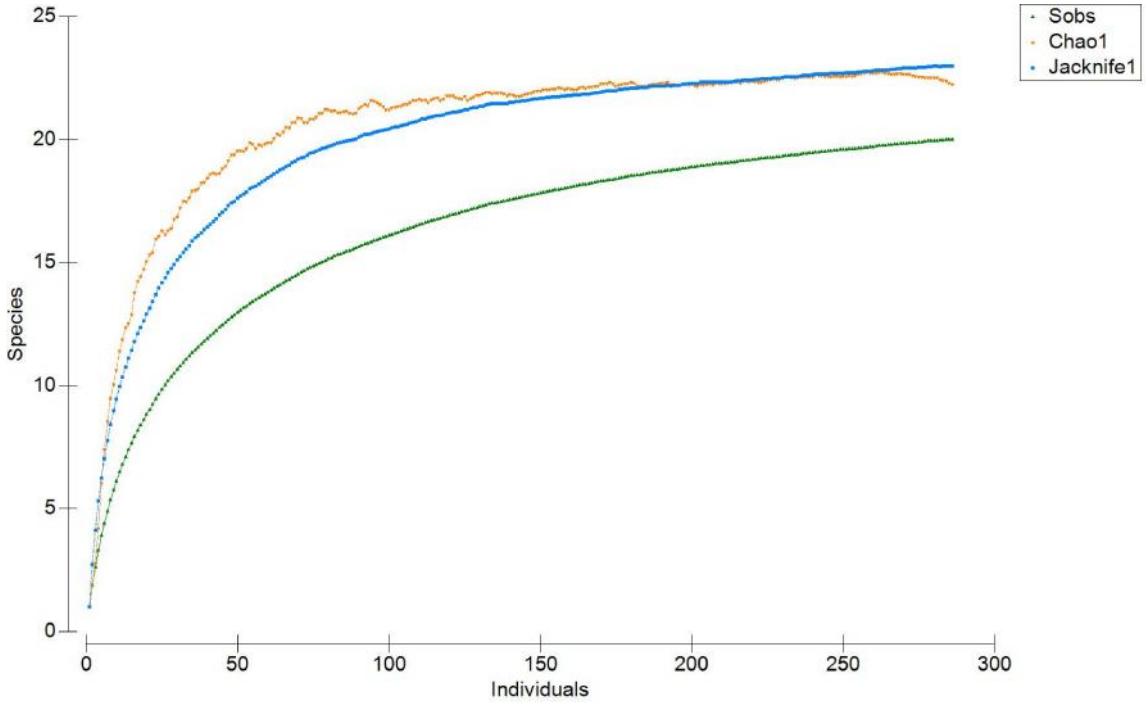

Figure 5. Species accumulation curves for species observed in green, for the Chao1 species richness estimator in orange and, for the first order Jacknife1 estimator in blue.

5. Discussion

What was evident from this study was that the fringing habitats to the study site, particularly the Mallee on the western edge (site 2), the dense heath at the northern edge (site 4) and the periphery of the creek (site 5), supported the richest faunas (Appendix A). The foredune (site 1) and the consolidated dunes (site 3) were less rich although this may be a direct result of the relatively recent fire history in which the majority of the area was burnt in January 2009. For the mammals, both *Tarsipes rostratus* and *Rattus fuscipes* were most abundant in sites 4 and 5 respectively although both were recorded at most sites. *Sminthopsis griseoventer* showed a greater preference for the lower vegetation and more open areas of sites 1 and 3. Reptiles were more diverse and abundant in the habitats located around the periphery of the study area with the exception of the foredune (site 1) which while having low species richness, had the second highest count of individuals (31). For the frogs both richness and abundance were, not surprisingly, greatest along the creek margin at site 5. However relatively high numbers of *Limnodynastes dorsalis* were caught at site 3 in the central part of the study area, which is well away from water and a location unlikely to ever become inundated. This demonstrates that habitat usage for some species extends beyond what is often considered core areas.

Observational records provided confirmation of several species that were not trapped. These included *Tachyglossus aculeatus* (the echidna), *Macropus fuliginosus* (western grey kangaroo) and *Pseudonaja affinis* (dugite). All of these species tend to be wide ranging and to move over quite large distances, especially *M. fuliginosus.*
This species was observed in numbers ranging from one to five regularly along the proposed access track while walking in to the study area. Only diggings and scats were found for *T. aculeatus* along the western margin of the study area, while one observation was made of *P. affinis* near the creek line close to site 5.

The remote cameras only provided a record of one additional ground dwelling vertebrate and that was a feral cat (*F. catus*), although they did also record other species including *R. fuscipes, M. musculus* and *S. grisioventer*. Due to the secretive nature of feral cats and the low density when compared with other smaller vertebrates, they often remain undetected but are likely to be widespread through the Park. The numbers of mice and small mammals present in the study area would provide a plentiful food source for a predator such as this and one image captured of a cat shows it with a small mammal in its mouth.

The traverse along the length of the access track did not identify any particularly unique fauna habitats. However, notable areas do include the dense expanses of vegetation associated with the drainage tracts as well as the lateritic outcropping towards the tops of the ridges. The drainage tract vegetation is particularly important as it appears to have some capacity to exclude or limit fire, probably as a result of the associated higher moisture content than that of the surrounding areas, which are generally dryer, lower and more open shrublands and heaths. This then provides potential breeding and refuge habitat as well as safe flight paths for a number of bird species, particularly for the passerines. The dense ground vegetation and moisture retention in the soil, as well as the water course itself, provides ideal habitat for the species of frogs recorded in the park. Priority mammal species such as *I. obesulus*, when present, tend to also occupy and forage along and around areas of dense cover such as those provided here (Van Dyck and Strahan 2008). These areas could also be potential habitat for some of the peviously mentioned invertebrtaes. There were several small lateritic breakaways towards the tops of ridges that due to the presence of a rocky substrate with associated crevices and rocks may support different species of reptile other than those found in the surrounding sandy habitats. These could include species such *Ctenotus labillardieri, Ctenophorus ornatus* (ornate rock dragon) and *Christinus marmoratus* (marbled gecko) but these and other rock inhabiting species are likely to be found in greater numbers in the extensive areas of granite outcropping present throughout the park.

While no threatened or priority species were identified during this study, a number are recorded within Cape Le Grand National Park. For most of these the New Island Bay project area would not be considered primary habitat other than, similarly to the comments above, for *I. obesulus* which could be present in the dense vegetation associated with the drainage tract and creekline towards the northern end and along the eastern side of the project area. Species such as *Petrogale lateralis* (black-footed rock wallaby), if still present in the park, is

invariably confined to the extensive rocky areas or may occasionally forage along the base of these and would not be considered at risk from any development. There is generally a lack of suitable cover for species such as *Morelia spilota* which tend to shelter in rock crevices, tree hollows, burrows, caves or beneath rocks (Wilson and Swan 2008).
Of the conservation significant birds known from the area there are two of the seven that could be occasional visitors and make use of specific habitats within the project site. These are *Botaurus poiciloptilus* (Australasian bittern) and *Charadrius rubricollis* (hooded plover) which could occasionally forage along parts of the creek line. However, due to the small extent of this habitat it is unlikely that either of these species are either frequent visitors or highly dependant on it. A further three species, *Falco peregrinus* (peregrine falcon) , *Ardeotis australis* (australian bustard) and *Oreoica gutturalis* (crested bell-bird) could also either forage over or within the project area but again dependency on this area for any of these species would be unlikely.
Although *Calyptorhynchus baudinii* (baudin's cockatoo) was historically recorded as present at Cape Le Grand (Kitchener et al. 1975) this was prior to the recognition of two taxa within that species, the second being *C. latirostris* (caranaby's cockatoo), and it is this latter species which has a know distribution extending out east of Esperance and would be what has been observed at Cape Le Grand National Park. As such the species list in Appendix C has been updated to reflect this. This species is known to forage in low heath and so it is possible also that occasional foraging may occur within the project area.

6. Conclusions and Recommendations

This survey revealed a comparatively rich vertebrate ground fauna, in terms of total species known from Cape Le Grand National Park, with most species that might be expected to be present being recorded and the data analysis suggesting that few additional species are likely to be encountered with greater trapping effort. However the snakes and frogs were not as well represented as the other groups and this probably relates to the survey timing for frogs, as it was outside of the peak winter breeding period and, for snakes they tend to be less abundant than many other reptile species and are more difficult to catch or observe. Mammals were reasonably well sampled but other species that might be expected to be present in the survey area, although in the peripheral habitats rather than through the central area, would include *I. obesulus* and *Cercartetus concinnus* (Pygmy possum). The desktop analysis of birds identifies several threatened, priority or specially protected species but none of these would be considered to be entirely reliant on the extent of suitable habitat in the project area and if present are probably infrequent visitors.

Due to the potential importance of the creeks and the associated dense unburnt vegetation as refugia and core habitat in both the project area, and along the proposed access route, to a variety of species of fauna, an important recommendation would be to minimise any direct impacts or disturbance to these

areas. This would require careful selection of crossing points along drainage lines enabling the maintenance of contiguous dense vegetation tracts where possible, while ensuring no alteration to existing drainage characteristics or water quality. Within the project area it is recommended to restrict development to the low heath consolidated dune area behind the primary dune system with provision of a buffer of at least 50 metres along the peripheral habitats. This would safeguard what are identified as the more productive and species rich areas of the project footprint - the Mallee stands along the western edge, the dense thickets of vegetation at the northern end and the creekline and fringing vegetation in the west. This pragmatic location of development would assist in maintaining the natural values of the area which is a primary reason for visitation.

While this work forms a preliminary vertebrate assessment of the proposed development area, formal survey would need to take into account short range endemic and other conservation significant invertebrates for which at least nine are known to occur in Cape Le Grand National Park. Further targeted survey work should also be directed towards other conservation significant species identified as potentially occurring in the project area.

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8. Acknowledgements

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9. Appendices

9.1 Appendix A

TAXON	Site 1	Site 2	Site3	Site 4	Site 5	Site 1-3 (elliots only)	No of Individuals
Hylidae							
Litoria adelaidensis	-	-	-	-	1	-	1
Limnodynastidae							
Limnodynastes dorsalis	1	-	6	-	1	-	8
Myobatrachidae							
Crinia georgiana	-	-	1	-	8	-	9
Carphodactylidae							
Nephrurus milii	-	3	-	-	1	-	4
Pygopodidae							
Delma australis	-	-	-	2	1	-	3
Pygopus lepidopodus	-	2	-	-	-	-	2
Scincidae							
Acritoscincus	-	2	-	-	2	-	4

TAXON	Site 1	Site 2	Site3	Site 4	Site 5	Site 1-3 (elliots only)	No of Individuals
trilineatum							
Ctenotus catenifer	1	1	2	-	5	-	9
Ctenotus gemmula	10	4	-	-	7	-	21
Hemiergis peronii	-	4	-	2	1	-	7
Lerista distinguenda	-	-	-	3	1	-	4
Lerista microtis	1	-	1	1	2	-	5
Morethia obscura	19	13	10	9	15	-	66
Tiliqua rugosa	-	-	-	1	-	-	1
Varanidae							
Varanus rosenbergi	-	-	-	1	-	-	1
Elapidae							
Elapognathus coronatus	-	-	-	1	1	-	2
Dasyuridae							
Sminthopsis griseoventer	6	5	7	1	-	-	19
Muridae							
Mus musculus	4	10	1	14	13	22	64
Rattus fuscipes	4	6	1	1	15	1	28
Tarsipedidae							
Tarsipes rostratus	5	7	4	12	-	-	28
Species of Frogs	1	0	2	0	3	0	3
Species of Reptiles	4	7	3	8	10	0	13
Species of Mammals	4	4	4	4	2	2	4
Individuals of Frogs	1	0	7	0	10	0	18
Individuals of Reptiles	31	29	13	20	36	0	129
Individuals of Mammals	19	28	13	28	28	23	139

9.2 Appendix B

Taxon	New Island Bay Survey	Western Shield monitoring and observation data (2006-2011)	WA Museum database and survey records (2012)
Hylidae			
Litoria adelaidensis	+	+	+
Litoria cyclorhyncha	+%	+	+
Limnodynastidae			
Heleioporus eyrei		+	+
Limnodynastes dorsalis	+	+	+
Neobatrachus albipes		+	
Myobatrachidae			
Crinia georgiana	+	+	+
Crinia pseudinsignifera		+	+
Agamidae			
Ctenophorus ornatus	+%	+	+
Pogona minor		+	+
Rankinia adelaidensis			+
Carphodactylidae			
Nephrurus milii	+		+
Gekkonidae			
Christinus marmoratus	+%	+	+
Pygopodidae			
Aprasia striolata		+	+
Delma australis	+	+	+
Pygopus lepidopodus	+	+	+
Scincidae			
Acritoscincus trilineatum	+	+	+
Ctenotus catenifer	+	+	+
Ctenotus impar		+	
Ctenotus gemmula	+	+	+
Ctenotus labillardieri	+%	+	+
Egernia kingii	+%	+	+
Egernia multiscutata			+
Egernia napoleonis		+	+
Hemiergis peronii	+	+	+

Taxon	New Island Bay Survey	Western Shield monitoring and observation data (2006-2011)	WA Museum database and survey records (2012)
Lerista distinguenda	+	+	+
Lerista microtis	+	+	+
Menetia greyii		+	+
Morethia obscura	+	+	+
Tiliqua occipitalis		+	+
Tiliqua rugosa	+	+	+
Varanidae			
Varanus rosenbergi	+	+	+
Boidae			
Morelia spilota SP		+	+
Elapidae			
Echiopsis curta		+	+
Elapognathus coronatus	+	+	+
Notechis scutatus		+	+
Pseudonaja affinis		+	
Typhlopidae			
Rhamphotyphlops australis		+	+
Burramyidae			
Cercartetus concinnus		+	+
Canidae			
Vulpes vulpes		+	+
Dasyuridae			
Sminthopsis griseoventer	+	+	+
Felidae			
Felis catus	+	+	
Leporidae			
Oryctolagus cuniculus	+%		+
Muridae			
Mus musculus	+	+	+
Pseudomys albocinerius			+
Rattus fuscipes	+	+	+
Macropodidae			
Petrogale lateralis *§		+	+

Taxon	New Island Bay Survey	Western Shield monitoring and observation data (2006-2011)	WA Museum database and survey records (2012)
Macropus fuliginosus	+[%]	+	+
Peramelidae			
Isoodon obesulus P5		+	+
Tachyglossidae			
Tachyglossus aculatus	+[%%]		
Tarsipedidae			
Tarsipes rostratus	+	+	+
Frogs (7)	4	7	6
Lizards (24)	16	21	23
Snakes (6)	1	6	5
Native mammals (9)	5	7	8
Introduced mammals (4)	3	3	2

[%] observed near to study site.
[%%] Scats and diggings.
* Threatened - State legislation
SP Specially Protected - State Legislation
P5 Priority 5 - State Legislation
§ Vulnerable - EPBC Act

9.3 Appendix C

Order	Taxon	Vernacular
Struthioniformes	**Casuariidae**	
	Dromaius novaehollandiae	emu
Galliformes	**Phasianidae**	
	Coturnix ypsilophora	brown quail
Anseriformes	**Anatidae**	
	Biziura lobata	musk duck
	Cygnus atratus	black swan
	Tadorna tadornoides	Australian shelduck (mountain duck)
	Chenonetta jubata	Australian wood duck (wood duck)
	Anas gracilis	grey teal
	Anas castanea	chestnut teal
	Anas superciliosa	Pacific black duck
	Anas rhynchotis	Australasian shoveler
	Malacorhynchus membranaceus	pink-eared duck
	Anythya australis	hardhead
Podicipediformes	**Podicipedidae**	

Order	Taxon	Vernacular
	Tachybaptus novaehollandiae	Australasian grebe (black-throated grebe)
Sphenisciformes	**Spheniscidae**	
	Eudyptula minor	little penguin
Procellariiformes	**Procellariidae**	
	Macronectes halli	northern giant petrel
	Pterodroma macroptera	great-winged petrel
	Puffinus carneipes	fleshy-footed shearwater
	Puffinus tenuirostris	short-tailed shearwater
	Puffinus assimilis	little shearwater
	Diomedeidae	
	*Diomedea exulans**§	wandering albatross
Pelecaniformes	**Sulidae**	
	Sula serrator	Australasian gannet
	Phalacrocoracidae	
	Phalacrocorax carbo	great cormorant
	Phalacrocorax varius	pied cormorant
	Phalacrocorax sulcirostris	little black cormorant
	Phalacrocorax fuscescens	black-faced cormorant
	Phalacrocorax melanoleucos	little pied cormorant
	Pelecanidae	
	Pelecanus conspicillatus	Australian pelican
Ciconiiformes	**Ardeidae**	
	Ardea pacifica	white-necked heron
	Ardea novaehollandiae	white-faced Heron
	Ardea sacra	eastern reef heron (eastern reef egret)
	Nycticorax caledonicus	rufous night heron
	*Botaurus poiciloptilus*** §§	Australasian bittern
	Threskiornithidae	
	Plegadis falcinellus	glossy ibis
	Threskiornis spinicollis	straw-necked ibis
Falconiformes	**Accipitridae**	
	Elanus caeruleus	black-shouldered kite
	Aquila audax	wedge-tailed eagle
	Haliaeetus leucogaster[%]	white-bellied sea-eagle
	Circus approximans	swamp harrier
	Falconidae	
	Falco berigora[%]	brown falcon
	Falco cenchroides[%]	Australian kestrel
	Falco longipennis	Australian hobby
	Falco peregrinus SP	peregrine falcon
Gruiformes	**Rallidae**	
	Gallirallus philippensis	buff-banded rail
	Porzana fluminea	Australian spotted crake
	Porzana tabuensis	spotless crake
	Porphyrio porphyrio	purple swamphen
	Fulica atra	Eurasian coot
	Otididae	

Order	Taxon	Vernacular
	Ardeotis australis P4	Australian bustard
Turniciformes	**Turnicidae**	
	Turnix varia[%]	painted button-quail
Charadriiformes	**Scolopacidae**	
	Limosa lapponica	bar-tailed godwit
	Tringa nebularia	common greenshank
	Tringa hypoleucos	common sandpiper
	Tringa brevipes	grey-tailed tattler
	Calidris canutus	red knot
	Calidris alba	sanderling
	Calidris ruficollis	red-necked stint
	Calidris acuminata	sharp-tailed sandpiper
	Calidris ferruginea	curlew sandpiper
	Haematopodidae	
	Haematopus longirostris	pied oystercatcher
	Haematopus fuliginosus	sooty oystercatcher
	Recurvirostridae	
	Cladorhynchus leucocephalus	banded stilt
	Recurvirostra novaehollandiae	red-necked avocet
	Charadriidae	
	Vanellus tricolor	banded lapwing
	Pluvialis squatarola	grey plover
	Charadrius ruficapillus	red-capped plover
	Charadrius leschenaultii	greater sand plover
	Charadrius melanops	black-fronted dotterel
	Charadrius rubricollis P4	hooded plover
	Erythrogonys cinctus	red-kneed dotterel
	Laridae	
	Larus pacificus	Pacific gull
	Larus novaehollandiae[%]	silver gull
	Sterna caspia	caspian tern
	Sterna bergii	crested tern
	Sterna nereis §	fairy tern
	Sterna hybrida	whiskered tern
Columbiformes	**Columbidae**	
	Phaps chalcoptera[%]	common bronzewing
	Phaps elegans	brush bronzewing
	Ocyphaps lophotes[%]	crested pigeon
Psittaciformes	**Psittacidae**	
	Calyptorhynchus latirostris **§§	carnaby's cockatoo
	Glossopsitta porphyrocephala	purple-crowned lorikeet
	Polytelis anthopeplus	regent parrot
	Platycercus zonarius[%]	Australian ringneck (ring-necked parrot)
	Platycercus spurius	red-capped parrot
	Neophema elegans	elegant parrot
	Neophema petrophila[%]	rock parrot
Cuculiformes	**Cuculidae**	

Order	Taxon	Vernacular
	Cacomantis flabelliformis[%]	fan-tailed cuckoo
	Chrysococcyx lucidus	shining bronze-cuckoo
Caprimulgiformes	**Podargidae**	
	Podargus strigoides	tawny frogmouth
	Caprimulgidae	
	Eurostopodus argus	spotted nightjar
Apodiformes	**Apodidae**	
	Apus pacificus	fork-tailed swift
Coraciiformes	**Halcyonidae**	
	Todiramphus sanctus[%]	sacred kingfisher
Passeriformes	**Maluridae**	
	Malurus splendens[%]	splendid fairy-wren
	Stipiturus malachurus	southern emu-wren
	Pardalotidae	
	Pardalotus punctatus	spotted pardalote
	Pardalotus striatus[%]	striated pardalote
	Acanthizidae	
	Sericornis frontalis	white-browed scrubwren
	Acanthiza apicalis	broad-tailed thornbill (inland thornbill)
	Acanthiza uropygialis	chestnut-rumped thornbill
	Acanthiza chrysorrhoa	yellow-rumped thornbill
	Meliphagidae	
	Lichmera indistincta[%]	brown honeyeater
	Lichenostomus virescens[%]	singing honeyeater
	Lichenostomus leucotis[%]	white-eared honeyeater
	Melithreptus chloropsis	western white-naped honeyeater
	Phylidonyris novaehollandiae[%]	New Holland honeyeater
	Phylidonyris melanops	tawny-crowned honeyeater
	Acanthorhynchus superciliosus	western Spinebill
	Manorina flavigula[%]	yellow-throated miner
	Anthochaera lunulata	western little wattlebird
	Anthochaera carunculata[%]	red wattlebird
	Epthianura albifrons	white-fronted chat
	Petroicidae	
	Petroica cucullata	hooded robin
	Pachycephalidae	
	Oreoica gutturalis P4	crested bellbird
	Pachycephala pectoralis	golden whistler
	Colluricincla harmonica	grey shrike-thrush
	Dicruridae	
	Myiagra inquieta	restless flycatcher
	Rhipidura leucophrys[%]	willie wagtail
	Grallina cyanoleuca	magpie-lark
	Campephagidae	
	Coracina novaehollandiae	black-faced cuckoo-shrike
	Artamidae	
	Artamus personatus	masked woodswallow

Order	Taxon	Vernacular
	Artamus cyanopterus	dusky woodswallow
	Cracticidae	
	Cracticus torquatus[%]	grey butcherbird
	Cracticus tibicen[%]	Australian magpie
	Corvidae	
	Corvus bennetti	little crow
	Corvus coronoides[%]	Australian raven
	Hirundinidae	
	Hirundo neoxena[%]	welcome swallow
	Hirundo nigricans	tree martin
	Zosteropidae	
	Zosterops lateralis[%]	grey-breasted white-eye (silvereye)
	Sylviidae	
	Acrocephalus australis	Australian reed warbler
	Megalurus gramineus	little grassbird
	Cincloramphus cruralis	brown songlark
	Estrildidae	
	Stagonopleura oculata	red-eared firetail
	Motacillidae	
	Anthus australis	Australian pipit

* Vulnerable - State legislation
** Endangered - State Legislation
SP Specially Protected - State Legislation
P4 Priority 4 - State Legislation
§ Vulnerable - EPBC Act
§§ Endangered - EPBC Act
[%] Observed in the study area

9.4 Appendix D

Order	Family	Species
Spirostreptida	**Iulomorphidae**	*Atelomastix brennani**
		*Atelomastix grandis**
		Samichus `Le Grand`
		Samichus `sp. 7`
Polydesmida	**Paradoxosomatidae**	*Antichiropus `LeGrand east`*
		Antichiropus `LeGrand west`
		Antichiropus `pasley`
Sphaerotheriida	**Sphaerotheriidae**	*Epicyliosoma sarahae**
Araneae	**Archaeidae**	*Zephyrarchaea' 'marki'*

* Vulnerable - State legislation

9.5 Appendix E

Trap site	Datum	Start Latitude	Start Longitude	End Latitude	End Longitude
Pit line 1	WGS84	-34.0078	122.1412	-34.0081	122.1414
Pit line 2	WGS84	-34.0063	122.1411	-34.0065	122.1408
Pit line 3	WGS84	-34.0073	122.1426	-34.0071	122.1429
Pit line 4	WGS84	-34.0066	122.1433	-34.0065	122.1436
Pit line 5	WGS84	-34.0084	122.1430	-34.0086	122.1427
Elliot line 1-3	WGS84	-34.0070	122.1430	-34.0078	122.1412
Elliot line 2	WGS84	-34.0070	122.1401	-34.0057	122.1416
Elliot line 4	WGS84	-34.0068	122.1448	-34.0064	122.1426
Elliot line 5	WGS84	-34.0093	122.1433	-34.0078	122.1442
Camera trap 1	WGS84	-34.0067	122.1407		
Camera trap 2	WGS84	-34.0063	122.1411		
Camera trap 3	WGS84	-34.0065	122.1439		
Camera trap 4	WGS84	-34.0084	122.1430		
Camera trap 5	WGS84	-34.0085	122.1429		

9.6 Appendix F

Site 1

Site 2

Site 3

Site 4

Site 5