Top Iron Pty Ltd

Mummaloo Project: Short Range Endemic Invertebrates

Final Report

Prepared for
Top Iron Pty Ltd
by Bennelongia Pty Ltd

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Mummaloo Project: Short Range Endemic Invertebrates

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Cover picture: Burrow of *Synothele* sp. B05

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EXECUTIVE SUMMARY

Top Iron Pty Ltd has a mineral exploration tenement (E59/1694) 61 km north-east of Wubin in the Shire of Yalgoo. The tenement contains iron ore deposits that are being considered for mining as the Mummaloo Hill Project. Geologically the Mummaloo tenement is situated in the Murchison Province of the Yilgarn.

Threat to Short Range Endemic (SRE) fauna was evaluated by a combination of desktop assessment, and pilot-scale and targeted field survey. The mygalomorph spider *Idiosoma nigrum* (listed as Schedule 1 under the *Wildlife Conservation Act*) was the subject of the targeted field survey.

The objectives of the desktop review were:

1) To determine the extent of SRE communities occurring, or likely to occur, at Mummaloo;
2) To identify likely threats to SRE fauna from mining at Mummaloo; and
3) To evaluate the likelihood of mining threatening SRE fauna species at Mummaloo.

Altogether 1750 specimens, representing 54 species, belonging to SRE Groups were recorded. All eight SRE Groups were represented; land snails, scorpions, trapdoor spiders, false scorpions, slaters, centipedes, millipedes and earthworms.

The results of an assessment of the SRE status of each species were as follows:

- None of the species were considered to be definitely an SRE nor highly likely to be an SRE; and
- Fourteen species were considered to be possible Rank 1 SREs. These comprised one species of pseudoscorpion, one millipede, two mygalomorph spiders, nine isopods and one earthworm. However, on the basis of available habitat outside Mummaloo it is considered unlikely that any of these species would be restricted to Mummaloo.

When assessing the likely threat posed by mining to the conservation of the species known only from the project area, it must be recognised that no information on the real extent of a species can be deduced from the collection of a single animal and or animals for one site. This is a common problem with SRE sampling and EPA Guidance Statement 20 proposes that habitat mapping is a method of determining whether species are likely to be found more widely. At Mummaloo, the two habitats (eucalyptus woodland and mixed species shrubland) represent large connected areas of undisturbed habitat, which extend beyond Mummaloo. It is very unlikely that species classified as possible Rank 1 SRE species in these habitats would be restricted to the Mummaloo tenement. It is highly probable that they are currently known only from Mummaloo because there has been relatively little invertebrate sampling across the Midwest.

The result of the targeted field survey found the Mummaloo population of *I. nigrum*:

1) To be widespread in the Mummaloo tenement, and also well beyond the Mummaloo tenement;
2) Represents a very small part of the total surveyed population (2.5%).

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1. INTRODUCTION

Top Iron is planning the development of iron ore deposits at their exploration tenement E59/1694 known as the Mummaloo Project. The tenement, referred to here as Mummaloo, is situated 61 km north-east of Wubin in the Shire of Yalgoo in the Murchison Province of the Yilgarn Craton (Figure 1). The typical components and activities associated with the Mummaloo project are likely to include:

- Shallow open cut mining pits – nominally 6 m deep;
- Stockpiles and waste storage areas;
- Construction of administration offices, accommodation and access roads;
- Development of a dry processing plant and power station; and
- Laydown and fuel storage areas.

Short Range Endemic (SRE) species are defined in the Environmental Protection Authority's (EPA) 2009 Guidance Statement No. 20 as '*terrestrial and freshwater invertebrates that have naturally small distributions of less than 10,000 km^2'.* In practice, assessment of risk to SRE species in Western Australia is focussed on eight groups of terrestrial invertebrates (the SRE Groups) that are characterised by having high proportions of SRE species. The SRE Groups include some families of land snails (Gastropoda), scorpions (Scorpionida), trapdoor and wall crab spiders (Araneae), false scorpions (Pseudoscorpionida), slaters (Isopoda), centipedes (Chilopoda), millipedes (Diplopoda) and megadrile earthworms (Oligochaeta) (EPA 2009). Their restricted ranges are often the result of events that fragmented historically broader distributions such as the extensive flooding of inland Australia during the Cretaceous and progressive climatic aridification since the Miocene (Harvey 2002). As a result of drying, faunal groups originally associated with historically damp conditions tend to be restricted to relictual islands of cooler more humid habitats such as caves, rock piles, springs, southern slopes, vegetated gorges and drainage channels (Harvey 2002; EPA 2009). Over time, habitat fragmentation has sometimes led to speciation and an array of distinct taxa where previously there was one species. In addition to restricted ranges, SREs are characterised by limited capacity for dispersal, confinement to discontinuous habitats, slow growth rates, and low fecundity; all of which make them vulnerable to disturbance (Harvey 2002; Ponder and Colgan 2002).

Information on SRE fauna at Mummaloo was compiled in three stages: firstly, a desktop review, secondly, a pilot-scale field survey, and thirdly a targeted field survey. The desktop review collated existing information on SREs, landforms and vegetation types and was used to evaluate the likelihood of SREs and other conservation-significant invertebrate species being present at Mummaloo.

The objectives of the desktop review were:

1) To determine the extent of SRE communities occurring, or likely to occur, at Mummaloo;
2) To identify any listed invertebrate species that may occur at Mummaloo and to determine whether such species actually occur there; and
3) To evaluate the likelihood of mining threatening SRE and other conservation-significant invertebrate species at Mummaloo.

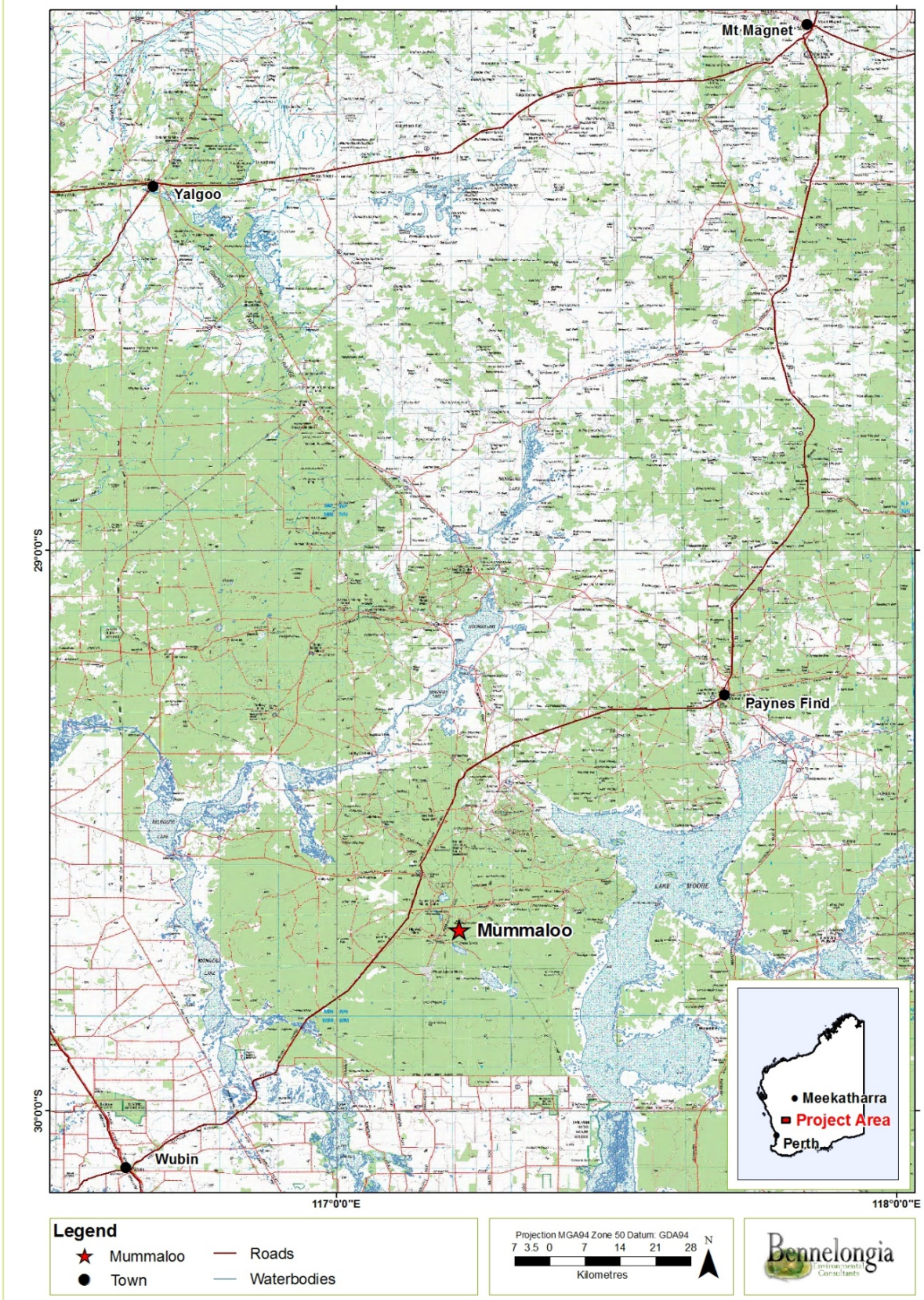

Figure 1.1. Location of the Mummaloo Project.

2. CONSERVATION FRAMEWORK

Protection for flora and fauna native to Western Australia is provided at a state and federal level. At the federal level, the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) was developed to provide a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places and deals with matters of national environmental significance (http://www.environment.gov.au/epbc/publications/pubs/epbc-act-fact-sheet.pdf).

At the state level, native flora and fauna are protected under the Wildlife Conservation Act 1950 (WC Act). The highest level of protection is afforded to Schedule 1 species. These are taxa that are rare or likely to become extinct, and are deemed in need of special protection.

Threatened fauna (Schedule 1) are further ranked according to their level of threat using IUCN Red List criteria. The Department of Environment and Conservation (DEC) assigns one of three rankings to a threatened fauna species:

1) Critically Endangered - considered to be facing an extremely high risk of extinction in the wild;
2) Endangered - considered to be facing a very high risk of extinction; and
3) Vulnerable - considered to be facing a high risk of extinction in the wild (http://www.dec.wa.gov.au/content/view/852/2010/1/1/).

Threatened wildlife listings are reviewed annually and changes can be recommended by the Threatened Species Scientific Committee (TSSC). The public is invited to submit nominations to add taxa to, or delete taxa from the current Specially Protected Fauna lists. The latest fauna listing are contained within the Wildlife Conservation (Specially Protected Fauna) Notice 2012 (http://www.dec.wa.gov.au/content/view/852/2010/).

3. DESKTOP REVIEW

A desktop review process was used to assess whether any listed invertebrate species or a significant SRE community was likely to occur at Mummaloo. Records of species belonging to SRE Groups were compiled from previous environmental impact assessments in the public domain, records of the Western Australian Museum (WAM) and published information. All available data within a 30 by 30 km search area surrounding Mummaloo (29.523-29.797°S, 117.067-117.378°E, Figure 2.1) were reviewed. The 30 by 30 km search area was smaller than often used but, in the transitional rainfall zone of south-western Australia, there is substantial turnover of vegetation on a scale of about 15 km (Burgman 1988). Many invertebrate species have ranges determined by particular plant species or plant communities (Dangerfield *et al.* 2003; Lovell *et al.* 2007) and this determined the size of the search area.

Environmental Protection Authority (EPA) (2009) guidelines and information contained in previous SRE surveys of the Yilgarn were used to determine which habitats might potentially contain SRE species (Bamford and Bancroft 2006; Crosslands Resources 2009; Ecologia 2006, 2010; Ninox 2009). Areas of potential SRE habitat were then mapped using orthophotos provided by Top Iron and 1:250,000 scale vegetation mapping (Beard 1972).

3.1. Determining SRE Status

Determining whether particular species belonging to SRE Groups actually are SREs (i.e. have ranges <10,000 km^2) can be difficult. In this report, both for the purposes of desktop assessment and analysis of field survey results, a two-stage approach was used to identify SREs. First, species recognised as SREs in available literature or by experts were treated automatically as SREs (Appendix 1). Otherwise, four attributes were used to determine whether a species was likely to be an SRE. These were the

maximum-recorded range of the species, the number of habitats in which it was recorded, and whether these habitats were expansive or well connected with other patches of the same habitats. The fourth attribute was the proportion of species in the family/genus known to be SREs (Appendix 1).

3.2. SREs in the Yilgarn

The habitats most likely to support SREs in the Yilgarn include south-facing rock faces and steep slopes, gullies, springs, deep litter beds, rocky outcrops, and undisturbed watercourses or various combinations of these features (Main 1999; EPA 2009). Such habitats support only small, localised populations and the mostly low dispersal powers of SREs lead to the populations often being isolated from each other.

Previous SRE surveys in the Yilgarn have focused on banded ironstone ranges both because they offer prospective SRE habitats and because they are the focus of mining development in the region. Most of the species reported as SREs in the Yilgarn belong to land snails of the family Camaenidae, spiders of the suborder Mygalomorphae (mostly trapdoors), scorpions belonging to the genus *Urodacus*, and millipedes of the genera *Antichiropus* and *Atelomastix* (Bamford 2006; Bamford and Bancroft 2006; Biota 2009; Biota 2011; DEC 2007; Ecologia 2010; Ninox 2009; St Barbara Limited 2009).

The number of species in SRE Groups recognised on individual ranges in previous surveys varied from 12 at Parker Range (Lindbeck and Associates 2010), to 17 at Mt Jackson (Biota 2009), 26 at Deception Deposit (Biota 2011), and 26 at Mt Gibson (Harvey 2005; Main 2005; Slack-Smith 2006). In these surveys, no actual SRE species were identified at Parker Range, four possible SREs were recognised at Mt Jackson, three at Deception Deposit and none from Mt Gibson. Thus, the proportion of actual or possible SRE species within the SRE Groups at the Yilgarn sites surveyed appears to be relatively low and variable (0-18%). Previous surveys suggest that ironstone ranges of the Yilgarn may, but do not always, provide habitats for SRE species. However, it is possible that these results reflect differences in survey effort and the degree of precaution used in applying criteria to SRE status to species rather than site differences.

3.3. Habitat Characterisation

3.3.1. Vegetation and Landform

Two vegetation communities were identified at Mummaloo: 1) eucalyptus woodland; and 2) mixed species shrubland (Beard 1972, Units 141 and 552 respectively; see Figure 4.1). These two vegetation units are also widespread in the search area and extend farther south and east than the search area.

Eight other Beard vegetation units occur in the search area. Three of these units (Units 420, 437 and 495) are very extensive and well connected beyond the search area (Figure 4.1).

Review of orthophotos indicated no significant south-facing rock faces, steep slopes, gullies, or rocky outcrops at Mummaloo.

3.3.2. Mummaloo Climate

Mummaloo lies within the Avon Wheatbelt district of Western Australia, which has a semi-arid, warm Mediterranean climate. Paynes Find, approximately 60 km northeast of Mummaloo, has the nearest Bureau of Meteorology weather station. Paynes Find experiences dry hot summers, and cool, mildly wet winters. Average annual rainfall is 284 mm, ranging from a monthly average of 10.5 mm in November to 43.2 mm in June. Most rainfall occurs during winter months, with almost half the recorded average annual rainfall falling between the months of May and July (Table 3.1).

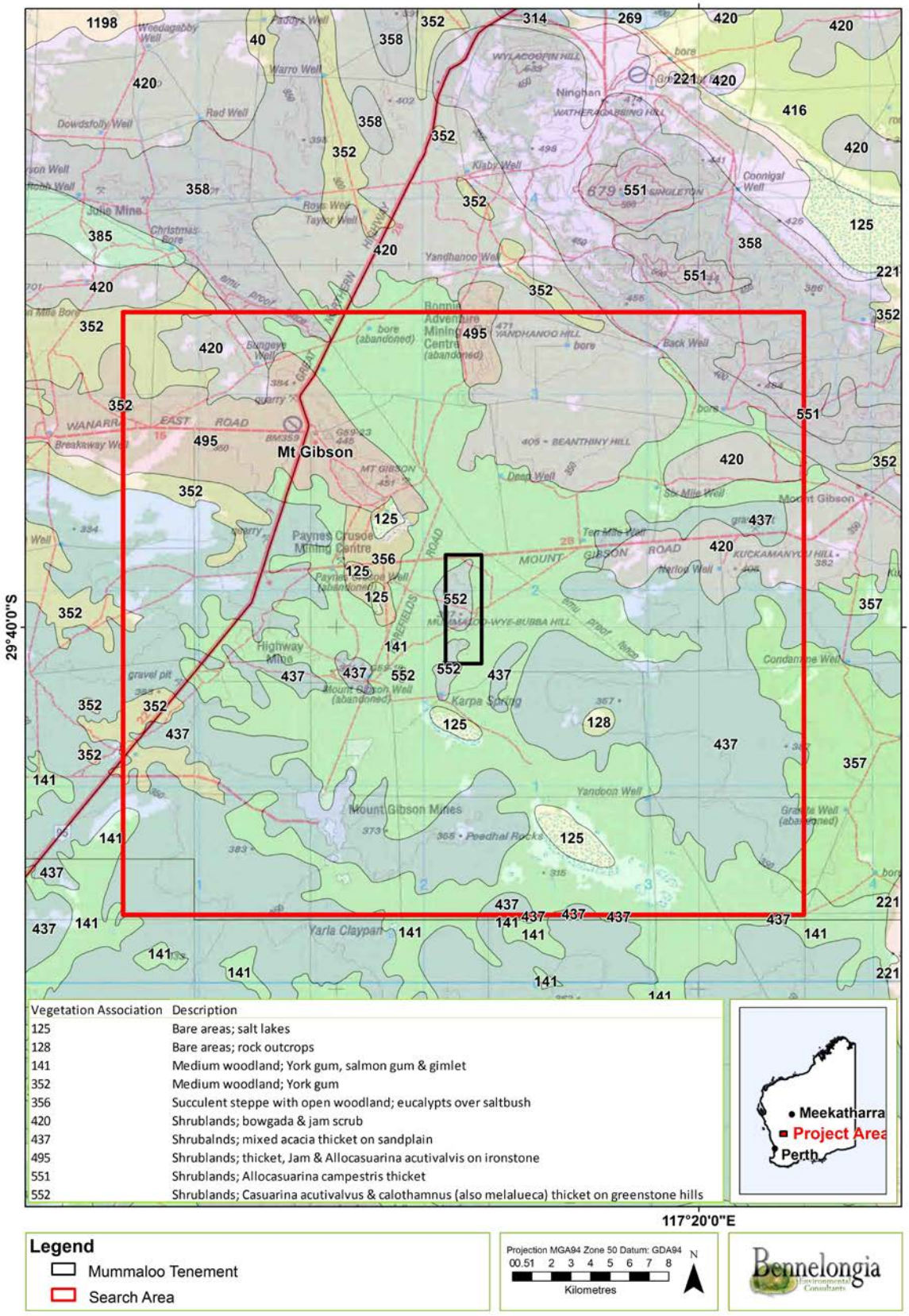

Figure 3.1. Vegetation at Mummaloo and surrounding Search Area.

Table 3.1. Climatic data for Paynes Find.

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Years
Mean maximum temperature (^{O}C)	37.3	36.3	32.9	28.4	23.2	19.3	18.3	20.1	23.7	27.5	31.6	34.9	27.8	32
Mean minimum temperature (^{O}C)	0.9	21	18.1	14.2	9.5	6.8	5.3	5.8	8	11.3	15.3	18.3	12.9	32
Mean rainfall (mm)	18.8	24	24.8	24.7	37.7	43.2	36	27.4	14.4	10.9	10.5	12.4	284	52
Mean no. of days of rain >= 1 mm	1.2	1.2	1.3	1.6	2.6	3.6	3.4	2.8	1.7	1.1	1	1	22.5	51
Mean no. of days of rain >= 25 mm	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0	0	0	0	0	0.8	51

Data courtesy of the online records of the Australian Bureau of Meteorology (2012).

3.3.3. SRE and Listed Species in the Search Area

The desktop review showed that one listed species (the trapdoor spider *Idiosoma nigrum*) and five SRE Groups have been recorded in the search area (although well outside the Mummaloo tenement, mostly to the north west associated with the Extension Hill mining project, also known as Mt Gibson; Figure 3.2). The SRE Groups are mygalomorph spiders, false scorpions, scorpions, millipedes and land snails; with at least 53 species recorded from these groups (Table 3.2). This species list comprises both described and undescribed species, with many known to be widespread. There is, however, limited information about the ranges of many species. Applying the SRE classification process outlined in Appendix 1 to the 53 species suggested that 15 of them are possible Rank 1 SRE species (Table 3.2, Appendix 1). Further information on *Idiosoma nigrum* and on the SRE potential and other conservation issues for species of each SRE Group is discussed in the sub-sections below.

3.3.3.1. Idiosoma nigrum

Idiosoma nigrum has too wide a range (southern Wheatbelt to Midwest) to be classified as an SRE species but is a Schedule 1 species under the WC Act. There was a single record of the species in the search area, 9.3 km west of Mummaloo, and WAM records showed additional occurrences to the north-west (Appendix 2).

3.3.3.2. Mygalomorph Spiders

The search area has a diverse mygalomorph fauna, with 36 species belonging to the families Actinopodidae, Barychelidae, Dipluridae, Idiopidae, Nemesiidae and Theraphosidae (Table 3.2). Twelve of the mygalomorphs (33%) were determined as possible Rank 1 SREs (Table 3.2). Possible Rank 1 SRE assignments are precautionary and there is considerable doubt that such species in fact meet SRE criteria. The assignment usually reflects the fact that the species is known from very few specimens and is probably an artefact of lack of sufficient information about the species range.

3.3.3.3. Pseudoscorpions

One described species *Synsphryonus mimulus* and one manuscript species *Austrochthonius* 'duchaci' pseudoscorpion have been recorded in the Search Area; the latter is a possible Rank 1 SRE. However, Harvey (2002) considered very few pseudoscorpions were likely to be SREs with the exception of troglobites, and *Austrochthonius* 'duchaci' is only a possible Rank 1 SRE.

3.3.3.4. Scorpions

Few scorpions are thought to be SREs (see Harvey 2002). The 12 species previously collected in the Search Area belong to three families, Bothriuridae, Buthidae and Urodacidae. Only one species listed is considered a possible Rank 1 SRE. Species of the buthid genera, *Isometroides* and *Lychas*, are typically widespread (WAM data) and are unlikely to represent SREs. The possible Rank 1 SRE is *Urodacus* 'gibson 5', which belongs to an Australian endemic genus with 20 named and many undescribed species (Koch 1977; Volschenk *and Prendini* 2008). *Urodacus* is very diverse in Western Australia and many of the recently discovered undescribed species have been probably classified as possible SREs largely because of the lack of survey data.

Table 3.2. Species collected for SRE Groups in the Search Area.

SRE status indicated according to Appendix 1. Animals identified only at higher taxonomic levels, and unlikely to represent additional species have been excluded from this list. *Status based on advice from WAM. 1 source/reference WAM records.

Higher groups	Species	Notes on Range and/or Conservation Significance	SRE Status	Source/Reference
Arachnida				
Araneae				
Actinopodidae	*Missulena* `MYG045`	>55 km	Not SRE	1
	Missulena `MYG046`	Uncertain range	R1	1
	Missulena `MYG047`	Uncertain range, >3 km	R1	1
	Missulena rutraspina	Widespread in WA and SA	Not SRE	1; ABRS (2009); Faulder (1995)
Barychelidae	*Idiommata* `yelbeni`	Uncertain range	R1	1
	Synothele durokoppin	Widespread in south WA	Not SRE	1; Raven (1994)
	Synothele `impactspins`	Uncertain range	Not SRE*	1
	Synothele `Mt Gibson sp. 1`	Uncertain range	R1	1
Dipluridae	*Cethegus* `sp. nov. (cf. *ischnotheloides*)	Uncertain range	R1	1
Idiopidae	*Aganippe* `Mt Gibson sp. 1`	Uncertain range	R1	1
	Aganippe `sp. 2`	Uncertain range, >2 km	R1	1
	Aganippe `sp. 3`	Uncertain range	R1	1
	Aganippe castellum	Widespread in central wheatbelt,	Not SRE	1; Main (2005)
	Eucyrtops `Mt Gibson sp. 1`	>20 km	Unlikely	1
	Eucyrtops `MYG147`	Uncertain range, >3 km	Not SRE*	1
	Eucyrtops `MYG148`	Uncertain range	Not SRE*	1
	Eucyrtops `MYG149`	>20 km	Unlikely	1
	Eucyrtops `MYG150`	Uncertain range, >5 km	Not SRE*	1
	Euoplos `Mt Gibson sp. 1`	>20 km	Unlikely	1
	Gaius `MYG166`	Uncertain range	R1	1
	Anidiops villosus (*ex Gaius villosus*)	Widespread in WA	Not SRE	1; Main (1957)
	Idiosoma nigrum	Widespread in south WA, Schedule 1	Not SRE	1; Main (1952)
Nemesiidae	*Aname* mainae	Widespread in WA	Not SRE	1; Raven (2000)
	Aname `Mt Gibson sp. 1`	Uncertain range	R1	1
	Aname `Mt Gibson sp. 2`	Uncertain range	R1	1
	Aname `MYG001group, MtGibson1`	>10 km	Unlikely	1
	Aname `MYG001group, MtGibson2`	Uncertain range, >2 km		1
	Aname `MYG001sl`	>10 km	Unlikely	1
	Aname tepperi	Widespread in WA and SA	Not SRE	1; ABRS (2009); Hogg (1901)
	Kwonkan `MYG058`	Uncertain range	Not SRE*	1
	Teyl `luculentus sp. Grp`	Widespread in south WA	Not SRE	1; Main (1975)
	Teyl `MYG022`	Uncertain range	Not SRE*	1
	Teyl `MYG024`	Uncertain range	Not SRE*	1
	Teyl `MYG026`	Uncertain range	Not SRE*	1
	Yilgarnia `Mt Gibson sp. 1`	Uncertain range	R1	1
Theraphosidae	*Selenotholus foelschei*	Widespread in WA and NT	Not SRE	1; ABRS (2009); Hogg (1902)
Pseudoscorpiones				
Chthoniidae	*Austrochthonius* `duchaci`	Uncertain range	R1	1
Garypidae	*Synsphyronus mimulus*	Widespread in Australia	Not SRE	1; ABRS (2009) Chamberlin (1943)
Scorpiones				
Bothriuridae	*Cercophonius granulosus*	Widespread in WA	Not SRE	1; ABRS (2009); Kraepelin (1908)
Buthidae	*Isometroides* `laverton3`	Widespread in south WA	Not SRE	1
	Lychas `adonis`	>15 km	Unlikely	1
	Lychas jonesae	Widespread in WA and SA	Not SRE	1; ABRS (2009); Glauert (1925)
Urodacidae	*Urodacus* `gibson4`	>10 km	Unlikely	1
	Urodacus `gibson5`	Uncertain range, >2 km	R1	1
	Urodacus `laverton3`	Widespread in south WA	Not SRE	1
	Urodacus `laverton5`	Widespread in south WA	Not SRE	1, Bennelongia (2011)
	Urodacus `SCO017, gibson2`	>15 km	Unlikely	1
	Urodacus hoplurus	Widespread in WA, NT and SA	Not SRE	1; ABRS (2009); Koch (1977)
Diplopoda				
Polydesmida				
Paradoxosomatida	*Antichiropus* `Mt Gibson 1`	>35 km	Not SRE*	1; Harvey (2005)
	Antichiropus `Mt Gibson 3`	>10 km	Not SRE*	1; Harvey (2005)
	Antichiropus `PM1`	Widespread in northern wheatbelt	Not SRE	1; Harvey (2005)
Mollusca				
Gastropoda				
Bulimulidae	*Bothriembryon* sp. 'Mt Gibson'	Uncertain range	R1	1
Camaenidae	*Sinumelon vagente*	Widespread in central WA	Not SRE	1; ABRS (2009); Iredale (1939)

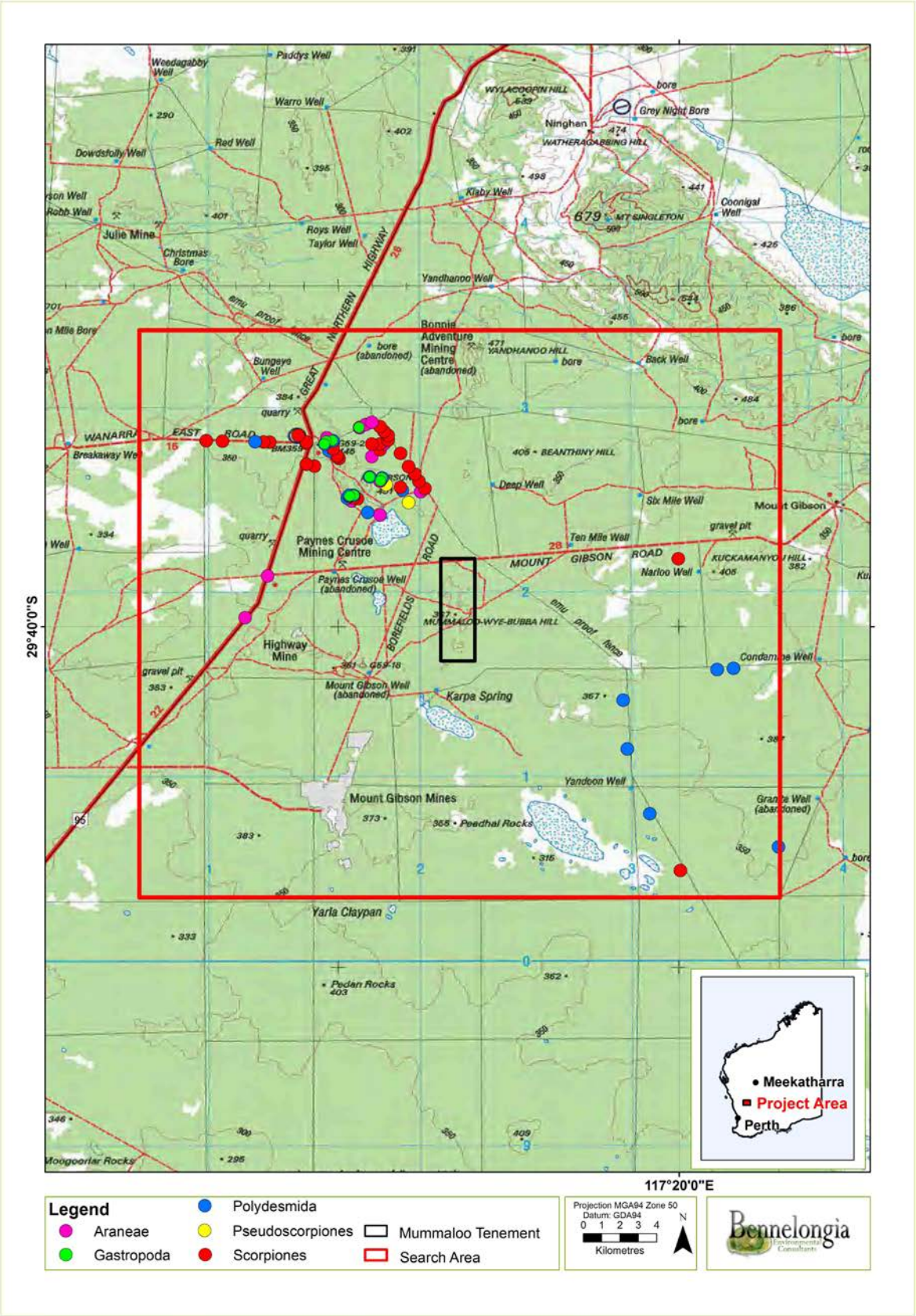

Figure 3.2. Location of specimens belonging to SRE Groups in the Search Area.

3.3.3.5. Millipedes

One family of polydesmid millipede (Paradoxosomatidae) has been recorded in the search area (Table 4.1). Polydesmid millipedes, including the genus *Antichiropus*, which is the most abundant and speciose millipede group in Western Australia, are known to contain many SRE species (Harvey 2002). However, the three species of *Antichiropus* collected (*A*. 'Mt Gibson1', *A*. 'Mt Gibson 3', *A*. 'PM1') are not regarded as SREs, based on known distributions (Table 3.2, Harvey 2005).

3.3.3.6. Snails

Two species of snail have been collected in the Search Area, *Sinumelon vagente* and *Bothriembryon* sp. 'Mt Gibson'. These species belong to the family Camaenidae and Bulimulidae, respectively; both genera and families are widespread across WA. Camaenid land snails are the most diverse land snail group in Australia, with 100 described species that actually contain more than 600 known species (Köhler 2012). *Sinumelon vagente* has a range of over 500 kms from Geraldton inland towards Kalgoorlie. The genus *Bothriembryon* is poorly represented in collections, with many specimens represented by dead shells. The lack of data makes it difficult to define the SRE status of *Bothriembryon* species but the high diversity of land snails increases to likelihood of them being SREs and *Bothriembryon* sp. 'Mt Gibson' is classified as a possible Rank 1 SRE.

3.4. Desktop Findings

The presence of *I. nigrum* in the Search Area and surrounds represents the most conservation significant finding of the desktop review given this species is listed as Schedule 1 under the WC Act. It was concluded that pilot-scale field survey was required to determine whether *I. nigrum* occurred within the tenement.

With a diverse fauna of 53 species belonging to five SRE Groups being known from the search area, and 15 (28%) of them being possible Rank 1 SRE species, it is possible that SRE species occur at Mummaloo. However, while the number and proportion of possible Rank 1 SRE were relatively large compared with nearby areas surveyed (see section 3.2), all possible SRE species were assigned only Rank 1 probability of actually being SREs. Furthermore, the two vegetation types at Mummaloo both extend beyond the tenement and also beyond the search area. Thus, it is unlikely that species are localised to Mummaloo even if they are SREs. In fact, assignments of the 15 species as possible Rank 1 SREs probably reflected the few records of the species and the precautionary approach taken in both Appendix 1 methodology and the expert advice from WAM.

Despite the apparent threat to possible SRE species at Mummaloo being low, it was concluded that pilot-scale field survey was required to confirm that there is not a significant and localised SRE fauna in the tenement.

4. SURVEY RATIONALE

The survey approach and methods used in the Mummaloo pilot survey were based on the EPA Position Statement 3 and Guidance Statement 20 (EPA 2002; EPA 2009). Guidance Statement 20 does not provide specific recommendations about appropriate sampling effort for SREs. Given the lack of landscape features within Mummaloo that were likely to support SRE, it was considered appropriate to sample only two sites intensively for SREs during the pilot-scale survey. However, to check that results from the two intensive sites were representative of the tenement as a whole, a further 16 were briefly surveyed.

The appropriate techniques for sampling *Idiosoma nigrum* are those used for SREs. Therefore, pilot-scale surveys of *Idiosoma nigrum* and SREs were undertaken together. However, because *Idiosoma nigrum* specimens were collected during the pilot-scale survey, a larger targeted survey was

subsequently undertaken to document the occurrence of the spider species within Mummaloo and in surrounding areas.

5. METHODS

5.1. Pilot-scale Surveys

Pilot-scale surveys were designed to locate *Idiosoma nigrum* and eight invertebrate groups: earthworms, land snails, scorpions, spiders, false scorpions, slaters, centipedes and millipedes.

Sampling occurred from 30 April to 3 May and 2 to 4 July 2012. Locations of the two comprehensively surveyed sites and 16 other sites are provided in Table 5.1 and Figure 5.1. Comprehensive sampling involved pitfall trapping, leaf litter sampling and hand foraging. Brief hand foraging was undertaken at the other sites (Table 5.1 and Figure 5.1).

Both the comprehensively surveyed sites were located in eucalyptus woodland, which literature and sampling records in and around the search area suggested was the most prospective habitat sites *Idiosoma nigrum* and SREs. The 16 sites, which were surveyed briefly to confirm results from the other two sites, were located in either eucalyptus woodland or mixed shrubland. Photographs of the two comprehensively sampled sites are provided in Appendix 3; a description of the vegetation at these two sites is provided in Appendix 3a.

Table 5.1. Location and habitat of survey site and survey type.

Survey Site	Latitude	Longitude	Level of Survey
Site 01	-29.6592	117.2311	Comprehensive
Site 02	-29.6711	117.2279	Comprehensive
Site 03	-29.638	117.231	Adhoc foraging
Site 04	-29.6825	117.2286	Adhoc foraging
Site 05	-29.6806	117.2285	Adhoc foraging
Site 06	-29.6771	117.2305	Adhoc foraging
Site 07	-29.6752	117.2313	Adhoc foraging
Site 08	-29.6391	117.2283	Adhoc foraging
Site 09	-29.641	117.2313	Adhoc foraging
Site 10	-29.6806	117.2296	Adhoc foraging
Site 11	-29.6771	117.2287	Adhoc foraging
Site 12	-29.6377	117.2312	Adhoc foraging
Site 13	-29.6569	117.2179	Adhoc foraging
Site 14	-29.6426	117.2364	Adhoc foraging
Site 15	-29.6753	117.2288	Adhoc foraging
Site 16	-29.6368	117.2305	Adhoc foraging
Site 17	-29.6602	117.2321	Adhoc foraging
Site 18	-29.6388	117.2304	Adhoc foraging

Sampling effort and methods at the two comprehensive survey sites consisted of:

1. Ten wet pit traps placed 20 to 100 m apart and left open for eight weeks. Each trap comprises a 300 mm length of cylindrical PVC (110 mm diameter) with a white plastic bucket lid for a roof, which was attached to, and raised 5-20 mm above the trap using metal brackets. The lid minimised the drift of debris and access by vertebrates into the traps. A tight-fitting polypropylene jar inside the trap was filled with 800 ml of propylene glycol to preserve all invertebrates that fell into the trap. The traps were placed, when possible, within accumulated litter in shady microhabitats such as beneath trees, shrubs and near logs.

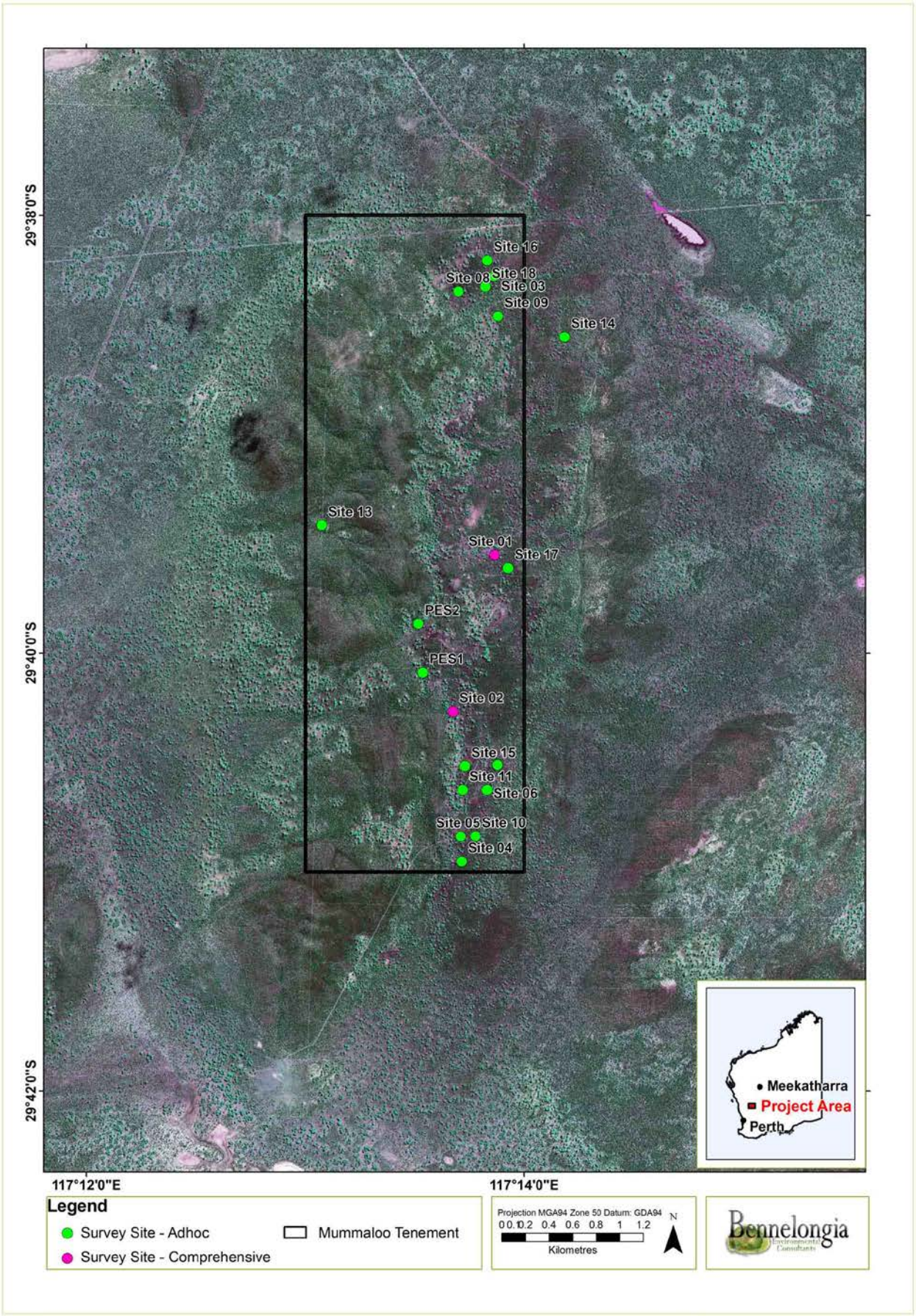

Figure 5.1. Pilot Scale Survey Sites.

2. Ten mixed soil and litter samples were collected from a representative range of microhabitats. Samples were placed in calico bags and transported live to the laboratory.

3. Hand foraging involved searching in crevices and under boulders, logs and bark in a range of microhabitats, especially where litter had accumulated. Numbers of trapdoor spider burrows were counted, representative burrows were excavated and the specimens collected to link species with burrow morphologies. When survey schedules permitted, cup traps were set at the entrances to scorpion burrows. All areas within a site that displayed some variation in habitat characteristics were searched. Invertebrates caught while foraging were preserved in 100% ethanol.

Hand foraging at the 16 other sites followed the methodology described above.

SRE specimens collected in traps and scrapes during the concurrent subterranean fauna survey (Bennelongia 2012) and via hand foraging during the vertebrate survey by Phoenix (2012) were included in the data.

5.1.1. Sample Sorting and Species Identification

The contents of the wet pit traps were washed and sieved using a base sieve of 53 µm to remove the propylene glycol and debris. Retained samples were sorted under a dissecting microscope to extract fauna specimens belonging to the target invertebrate groups.

Soil and litter samples were sorted using two sieves (16 mm and 2 mm). Litter retained by the sieves was checked for fauna, and then discarded. The component of the sample passing through the 2 mm sieve was sorted under a MagiLamp™ and all fauna present were picked out.

All animals picked from samples were identified to Order level and all specimens likely to be *Idiosoma nigrum* or belonging to target SRE groups were identified to species or morphospecies level using published and unpublished keys, unless damaged or otherwise unsuitable for identification. Specimens were dissected as required and viewed under dissecting and compound microscopes.

5.1.2. Personnel

Bennelongia surveys were undertaken by Michael Curran, Sean Bennett and Grant Pearson. Samples were sorted by Michael Curran, Sean Bennett, Jeremy Quartermaine and Jane McRae. Identifications were made by Michael Curran, Dean Main and Jane McRae with assistance from specialist taxonomists as required (Table 5.2). Phoenix surveys were undertaken by Ryan Ellis (Phoenix 2012).

Table 5.2. Specialist taxonomists that provided assistance with specimen identifications and SRE status.

SRE Group	Taxonomist	Affiliation
Earthworms	Allan Wills	DEC
Land snails	Vince Kessner	Private consultant, NT Museum
Scorpions	Erich Volschenk	Phoenix Environmental Sciences
Mygalomorphs	Mark Castanelli	WAM
Pseudoscorpions	Mieke Burger	WAM
Millipedes	Catherine Car	WAM

5.2. Targeted *Idiosoma nigrum* Survey

Four areas, including and outside of Mummaloo, were divided into grids of 100 by 100 m (Appendix 5). The grids were of similar size (approximately 9 km²) and habitat. Three of the four grids were surveyed to examine the density of *Idiosoma nigrum* outside the tenement. A random generator was used to select 12 quadrats within each grid, giving forty-eight 100 x 100 m quadrats; 12 inside the mining tenement and 36 outside. The selected quadrats were surveyed from 7 August to 16 August 2012.

Within each grid, quadrats were systematically searched for burrows by slowly walking through the habitat whilst examining the ground for evidence of spider burrows. A leaf blower was used to expose burrows.

Opportunistic foraging was carried out at an additional four quadrats where it was hypothesised that the habitat was suitable for the genus *Idiosoma* (Appendix 5).

Data on the number of burrows sighted was collected and the coordinates recorded. A representative sample of burrows were randomly selected and measured. The lid and lumen diameter was recorded and photographs of every measured burrow were taken. Using the method defined by Main (1957), three arbitrary ages classes were assigned to the burrow diameters (lid/lumen):

- Emergent – less than or equal to 1.4/1.0 (lid/lumen);
- Juvenile – between 1.4/1.0 and 2.1/1.5; and
- Adult – greater or equal to 2.1/1.5.

Information and photographs of each quadrat was compiled in order to characterise habitat, in particular landform, dominant substrate, depth and cover of litter, vegetation composition and cover, and the extent of existing disturbance. One specimen from each quadrat containing the genus *Idiosoma* was collected under WAM's licence to collect *Idiosoma nigrum* in order to confirm the presence of *Idiosoma nigrum* through visual identification or DNA analysis. Specimens were lodged with WAM.

6. RESULTS

6.1. Description of Habitat

The two vegetation types recognised at Mummaloo during desktop habitat assessment were eucalyptus woodland and mixed species shrubland. These roughly adhere to the units defined by Beard (1972) - shrublands and medium woodland (units 552 and 141 respectively). The following description of each unit was compiled following survey work (see Appendix 3a):

1. **Eucalyptus woodland**

   Upperstorey: primarily *Eucalyptus loxophleba* subsp. *supralaevis*, *E. salmonophloia* and *E. salubris;* overall cover above 15%; between 5 m to 20 m high. *Callitris collumellaris* usually present, occasionally *Casuarina obesa*.

   Understorey: 5% to 60% cover of shrub species, usually within the genera: *Eremophila*, *Acacia* and *Allocasuarina*; less than 5 m tall. Substrate was mostly clay-loam soils with a gravel or rubble overburden.

2. **Mixed species shrubland**

   Upperstorey: no more than 55% overall cover; primarily *Melaleuca stereophloia*, *Callitris collumellaris* and *Casuarina obesa*; up to 6 m tall.

   Understorey: 10% to 100% cover of shrub species, especially *Acacia anthochaera* and *Allocasuarina acutivalvis* subsp. *prinsepiana* species; up to 5 m tall. Numerous Proteaceae and Fabaceae species were present. Substrate was clay-loam and sand-loam soils with an overburden of coarse sand and gravel.

The western half of the tenement is mostly comprised of gently undulating hills compared with flatter plains in the eastern half. A few, small and disconnected rocky outcrops were present inside the tenement. However, the extent of these outcrops was too small to constitute one of the habitat types recognised in Guidance Statement 20 (EPA 2009) as SRE habitat (rocky hills or outcrops, south facing slopes, gorges).

6.2. Pilot Survey

1750 specimens belonging to SRE taxa were collected. A total of 54 species belonging to four SRE Groups were collected. This included *Idiosoma nigrum* and 14 possible Rank 1 SREs (Table 6.1 and Appendix 6). The most notable possible SRE was a new species of earthworm, *Graliophilus* sp. nov. B01, represented by six specimens from the two comprehensively sampled sites.

Mygalomorphs spiders and slaters were the richest SRE Groups, each comprising 12 species. Seven pseudoscorpion species, six snails, five millipedes, three scorpions and three geophilomorph centipedes species were collected.

6.2.1. *Trapdoor Spiders*

Eight genera and twelve species of mygalomorph spiders were collected, including two formally described species. These were *Missulena rutraspina*, which is widespread in the Pilbara, and *Idiosoma nigrum,* widespread in the south west of WA and a Schedule 1 species (Appendix 6).

Two species were considered to be possible Rank 1 SREs, namely *Aurecocrypta* nr 'chichester' and *Aganippe* sp. B04 (Table 6.1 and Appendix 6). These two species are each represented by one and two animals collected from a single site, respectively. The morphologically similar *Aurecocrypta* 'chichester' is a widespread species, extending from the Pilbara down towards Kalgoorlie (Mark Castalanelli, WAM, pers. comm.) and it is possible that *Aurecocrypta* nr 'chichester' also has a wide range.

Table 6.1. Species collected from SRE Groups that were classified as possible SREs.

Group	Species	# Animals	# Habitats	Sites	Range (km)	Rank
Arachnida						
Araneae						
Barychelidae	*Aurecocrypta* nr 'chichester'	1	1	Site 01	0	R1
Idiopidae	*Aganippe* sp. B04	2	1	Site 02	0	R1
Pseudoscorpionida						
Chthoniidae	*Austrochthonius* sp. B03	37	1	Site 01, Site 02	1.4	R1
Diplopoda						
Polyzoniida						
Siphonotidae	Siphonotidae sp. B02	3	1	Site 01, Site 02	1.4	R1
Crustacea						
Isopoda						
Armadillidae	*Acanthodillo*? sp. B04	49	1	Site 01, Site 02	1.4	R1
	Acanthodillo? sp. B05	16	1	Site 01, Site 02	1.4	R1
	Acanthodillo? sp. B06	2	1	Site 01, Site 02	0	R1
	Acanthodillo? sp. B07	49	1	Site 01, Site 02	1.4	R1
	Buddelundia sp. B29	3	1	Site 01	0	R1
	Cubaris sp. B05	5	1	Site 01, Site 02	1.4	R1
	Cubaris sp. B06	1	1	Site 01	0	R1
Platyarthridae	*Trichorhina* sp. B12	44	1	Site 01, Site 02, Site 15 (and bores MUM145, MUMUNK01, MUMUNK02)	3.1	R1
	Trichorhina sp. B13	6	1	Site 01	0	R1
Oligochaeta						
Megascolecidae	Graliophilus sp. nov. B01	6	1	Site 01, Site 02	1.4	R1

During the pilot-scale survey, it was believed (based on burrow and morphological characteristics) that two species of the genus *Idiosoma* had been collected at Mummaloo; namely, *Idiosoma nigrum* and an undescribed species, listed at the survey time as *Idiosoma* sp. B01. Species defining characters were apparent and there are also differences in burrows (Appendix 7). But these features are quite subtle when compared to other twig lining trapdoors of different genera. Species boundaries of *Idiosoma nigrum* are yet to be defined via morphological or molecular approaches and a WAM research program is currently underway. Given the conservation significance of *I. nigrum*, specimens of *Idiosoma* sp. B01 and *Idiosoma nigrum* were sent for molecular analysis at WAM to confirm whether two species were in fact present at Mummaloo.

As the molecular analysis was not complete at the time of the targeted survey both *I. nigrum* and *Idiosoma* sp. B01 were included in the targeted survey. However, as described under Section 6.3 below it was subsequently found that the two species are genetically different and it should be noted that *Idiosoma* sp. B01 is not listed as conservation significant under legislation (and has not been ranked as a possible or definite SRE), whereas *Idiosoma nigrum* is listed as Schedule 1 under the WC Act.

6.2.2. Pseudoscorpions

Seven species of pseudoscorpion were collected with one being considered to be a possible Rank 1 SRE, *Austrochthonius* sp. B03 (see Table 6.1 and Appendix 6). It was collected in high abundance at two sites that are in the widespread eucalyptus woodland (Beard Unit 141).

6.2.3. Scorpions

Three scorpion species were identified and none was classified to be an SRE.

6.2.4. Centipedes

The three geophilomorph centipedes were collected and none was considered to be an SRE, although the group contain some SREs (Harvey 2002). Five other non-SRE centipedes species were collected from the families Scolopendromorpha and Scutigeromorpha.

6.2.5. Millipedes

Five millipede species were collected and one, Siphonotidae sp. B02, was considered a possible Rank 1 SRE (Table 6.1 and Appendix 6). The Siphonotidae family is likely to be highly diverse but the fact only family level identification highlights the lack of information about the group (Car *et al.* 2012). Two widespread species of *Antichiropus* were recorded (Appendix 5).

6.2.6. Land Snails

All six gastropod species collected are known to occur widely beyond Mummaloo and were not considered SREs (Appendix 6).

6.2.7. Isopods

Of the twelve species of isopod specimens, nine were considered to be possible Rank 1 SREs (Table 6.1). The nine possible Rank 1 SREs species were all collected from single sites, with four species comprising less than 10 animals. The remaining three non-potential SRE species were represented by multiple specimens from multiple habitats (Appendix 6). Isopods are highly diverse and abundant, but many are primarily active at night and during periods of rain and cold weather, which may lead to species not being collected from areas where they occur.

6.2.8. Oligochaetes

A single species of the family Megascolecidae was collected. It is an undescribed species with no other known records and was considered a possible Rank 1 SRE (Table 6.1).

6.3. Targeted Survey

Altogether, 159 burrows of *Idiosoma nigrum* were recorded during the pilot and targeted surveys (two animals were recorded during the pilot-scale survey; see Appendix 8 and Appendix 9). In addition, 260 burrows of *Idiosoma* sp. B01 were found (as described in Section 6.2.1 above - this species is not listed as conservation significant under legislation, but was included in the targeted survey given the results of genetic analysis were not available at the time of the targeted survey). The *Idiosoma nigrum* recorded during the study have a range of 22 km (Appendix 8). *Idiosoma* sp. B01 was also widely distributed both within and outside Mummaloo and has not been ranked as possible or definite SRE (Appendix 6).

Idiosoma nigrum collected at Mummaloo during the pilot scale survey was found to be 20% divergent from *Idiosoma* sp. B01 (Mark Castalanelli, WAM, pers. comm.) at the gene COI. This result confirms the morphological and burrow characteristic differences and provides genetic confirmation that the two species are different. More animals from the targeted survey have been submitted for molecular analysis and will be reported in a follow up report when available. It is expected the results will confirm the initial field results and previous specimen molecular analysis.

In the 52 quadrats, which includes four adhoc quadrats, *Idiosoma nigrum* was recorded at 14 locations. This comprised two records in eucalyptus woodland and twelve records in mixed species shrubland. Twelve of the 14 quadrats were outside Mummaloo and only four animals (2.5% of the 159 *Idiosoma nigrum* collected) were recorded inside Mummaloo (this includes the two animals recorded in the pilot survey at Site 03; Appendix 8 and Appendix 9).

Data on numbers of burrows and age classes of *Idiosoma nigrum* show Grid 02, situated about 0.5 km east of Mummaloo, contained the most abundant population of the spiders (an average of 7.1 animals per quadrat; Figure 6.1), with very active recruitment occurring (Figure 6.2 and Appendix 8). All grids outside the tenement were more abundant than Mummaloo, which recorded an average of 0.3 animals (Figure 6.1). Grid 03 recorded an average of 2.3 animals per quadrat and Grid 01, located roughly 1 km west of Mummaloo, recorded 0.7 animals per quadrat (Figure 6.1, Figure 6.2 and Appendix 8).

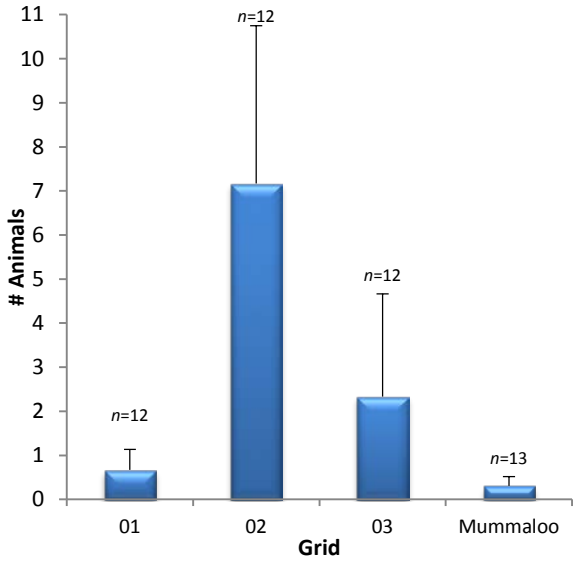

Figure 6.1. Average *I. nigrum* animals by grid. Mummaloo grid includes animals recorded in pilot survey (at Site 03).

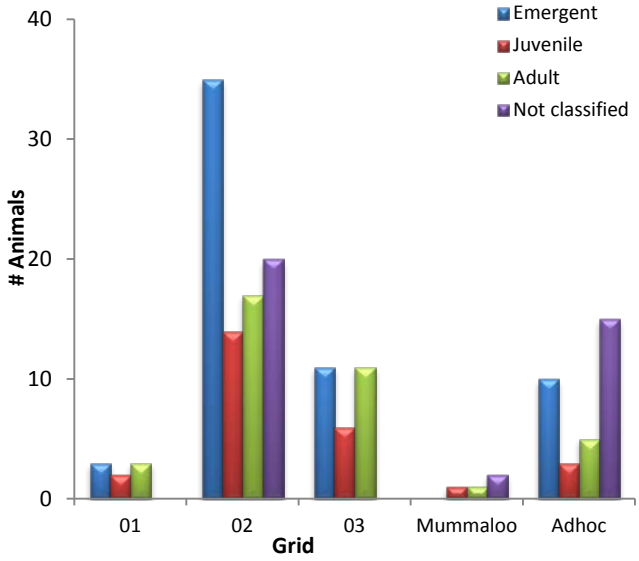

Figure 6.2. Age histogram of *I. nigrum* by grid.

DISCUSSION

6.4. Pilot Survey

It is likely that most, if not all, of the 14 possible Rank 1 SREs collected at Mummaloo will not meet Harvey's (2002) range criterion for SREs. Little is known about the range or biology of any of the 14 species. However, irrespective of whether they are SREs, it is likely that all 14 species have ranges extending beyond Mummaloo. There are three lines of evidence supporting this premise:

1) The two vegetation types at Mummaloo (eucalyptus woodland and mixed species shrubland) both have wide occurrence in region and extend continuously from Mummaloo into adjacent areas. Species with strong associations with either vegetation type will be widespread;
2) Mummaloo lacks strongly defined features such as rocky outcrops that are large enough to support the entire range of a species. At Mummaloo, the rocky outcrops are very poorly defined and intergrade into the surrounding areas;
3) Mummaloo occupies a total area of 895 ha. This is less than 0.1% of the maximum range that qualifies a species to be classified as an SRE (Harvey 2002). More importantly, very few terrestrial fauna species in WA have ranges this small, although some plant species do.

In WA, earthworms are highly diverse with small ranges (Allan Wills, DEC, pers. comm.). Furthermore, many appear to exhibit cryptic diversity only revealed by molecular genetics (e.g. Buckley *et al.* 2011). These traits make them likely to contain SRE species (Harvey 2002, EPA 2009). However, few species have been described in WA (see Michaelsen 1907; Jamieson 1971) due to the lack of both systematic surveys and mature animals, which are needed to facilitate taxonomic studies. The undescribed species *Graliophilus* sp. B01 was collected from a relatively low rainfall area (Abbott 1994). In WA, species turnover of earthworms is driven by geomorphology (Abbott and Wills 2002), rainfall (Abbott 1985) and localised conditions like aspect, soil fertility and vegetation (Wills and Abbott 2003). The discovery of a new species is most likely due to the lack of systematic surveys in the Midwest. *Graliophilus* sp. B01 was collected in a habitat with very good connectivity.

The lack of available taxonomic information does create a level of ambiguity when determining whether a species is in fact an SRE. The number of possible Rank 1 SREs identified at Mummaloo appears to represent a moderately significant community, although as stated it is unlikely that any of these species are restricted to Mummaloo and again the lack of previous surveys has likely contributed to their possible Rank 1 rating.

Surveys at Jack Hills (located about 400 km north) by Ecologia (2009) collected seventeen SRE taxa, nine of which were Mygalomorphs. Of the seventeen taxa, three were regarded as possible SRE species. During a more recent survey 200 km east at the Deception Deposit an estimated 26 species from groups known to support SREs were recorded (Biota 2011), again only three species were considered possible SREs. At Weld Range, 45 species were collected and four were classified as possible SREs (Ecologia 2010). To the east 280 km, 58 SRE taxa were recorded on an ironstone range (Banded Iron Formation, BIF) (Bennelongia 2011). Of these, 19 were considered possible SREs.

Mummaloo may appear diverse in comparison to the abovementioned locations, especially given that a pilot survey was conducted at Mummaloo and full-scale surveys were conducted at the reported locations. However, comparisons with other survey work can be problematic, given that survey effort, and the degree of precaution used in applying SRE status criteria to species, may vary.

The number of species identified as possible Rank 1 SREs through the pilot survey, is very similar to that recorded during the desktop review (see Table 3.2). The number of possible Rank 1 SREs at Mummaloo

closely resembles the proportions observed in other surveys in the vicinity (Ecologia 2009; Bennelongia 2011; Biota 2011). The main point of difference is that these project locations contain BIF ranges, which are absent at Mummaloo. In the southwest, Midwest and Goldfields regions of WA, BIF ranges are known to be highly restricted habitats with highly diverse flora and fauna (DEC 2007). Mummaloo is primarily comprised of plains with some low undulating hills, with two vegetation communities that are widespread and continuous inside and, importantly, are well connected and extensive beyond Mummaloo. Further to this, it is likely that the number of species identified as possible Rank 1 SREs at Mummaloo is an overestimate and on the basis of available habitat outside Mummaloo these species are most likely to have wider ranges.

6.5. Targeted Survey

Idiosoma nigrum was discovered at Wongan Hills in 1952 (Main 1952). It has since been recorded throughout the central and northern Wheatbelt and further north in the Midwest at the Jack Hills Iron Ore Project (Crossland Resources 2009). Recent genetic work on *I. nigrum* indicates that it may be a species complex but results have been difficult to interpret because the species also exhibits strong population subdivision over small areas (15 km at Weld range; Ecologia 2010). WAM is currently undertaking further studies on the taxonomy of the species (Mark Castalanelli, WAM, pers. comm.). At present all animals recognized as *Idiosoma nigrum* have the protection afforded to Schedule 1 species.

Of the 15 quadrats were *I. nigrum* was recorded, it was mostly present in mixed species shrubland, but more abundant in the three quadrats with eucalyptus woodland. Anecdotal evidence suggested that this species prefers areas of vegetation heterogeneity (Brad Durrant, Biologic, pers. comm.), i.e. where eucalyptus woodland and mixed species shrubland mix.

Mummaloo does not appear to be an important area for the conservation of *Idiosoma nigrum*. Of all the total number of animals collected in the four survey quadrats, only 2.5% came from Mummaloo. This is likely to represent a very small percentage of the overall local regional population.

7. CONCLUSION

Altogether 1750 specimens, representing 54 species, belonging to SRE Groups were recorded. All eight SRE Groups were represented; land snails, scorpions, trapdoor spiders, false scorpions, slaters, centipedes, millipedes and earthworms.

The results of an assessment of the SRE status of each species were as follows:

- None of the species was considered to be definitely an SRE nor highly likely to be an SRE; and
- Fourteen species were considered possible Rank 1 SREs. These comprised one species of pseudoscorpion, one millipede, two mygalomorph spiders, nine isopods and one earthworm. However, on the basis of habitat connectivity extending outside Mummaloo, it is considered unlikely that any of these species would be restricted to Mummaloo.

When assessing the likely threat posed by mining to the conservation of the species known only from the project area, it must be recognised that no information on the real extent of a species can be deduced from the collection of a single animal and or animals for one site. This is a common problem with SRE sampling and EPA Guidance Statement 20 proposes that habitat mapping is a method of determining whether species are likely to be found more widely (EPA 2009). At Mummaloo, the two habitats eucalyptus woodland and mixed species shrubland represent large connected areas of undisturbed habitat, which extend beyond Mummaloo. It is very unlikely that species classified as possible SRE species in these habitats would be restricted to Mummaloo. It is most likely that they are currently known only from Mummaloo because there has been relatively little invertebrate sampling across the Midwest.

The result of the targeted field survey found the Mummaloo population of *I. nigrum*:

1) To be widespread in the Mummaloo tenement, and also well beyond the Mummaloo tenement;
2) Represents a very small part of the total surveyed population (2.5%).

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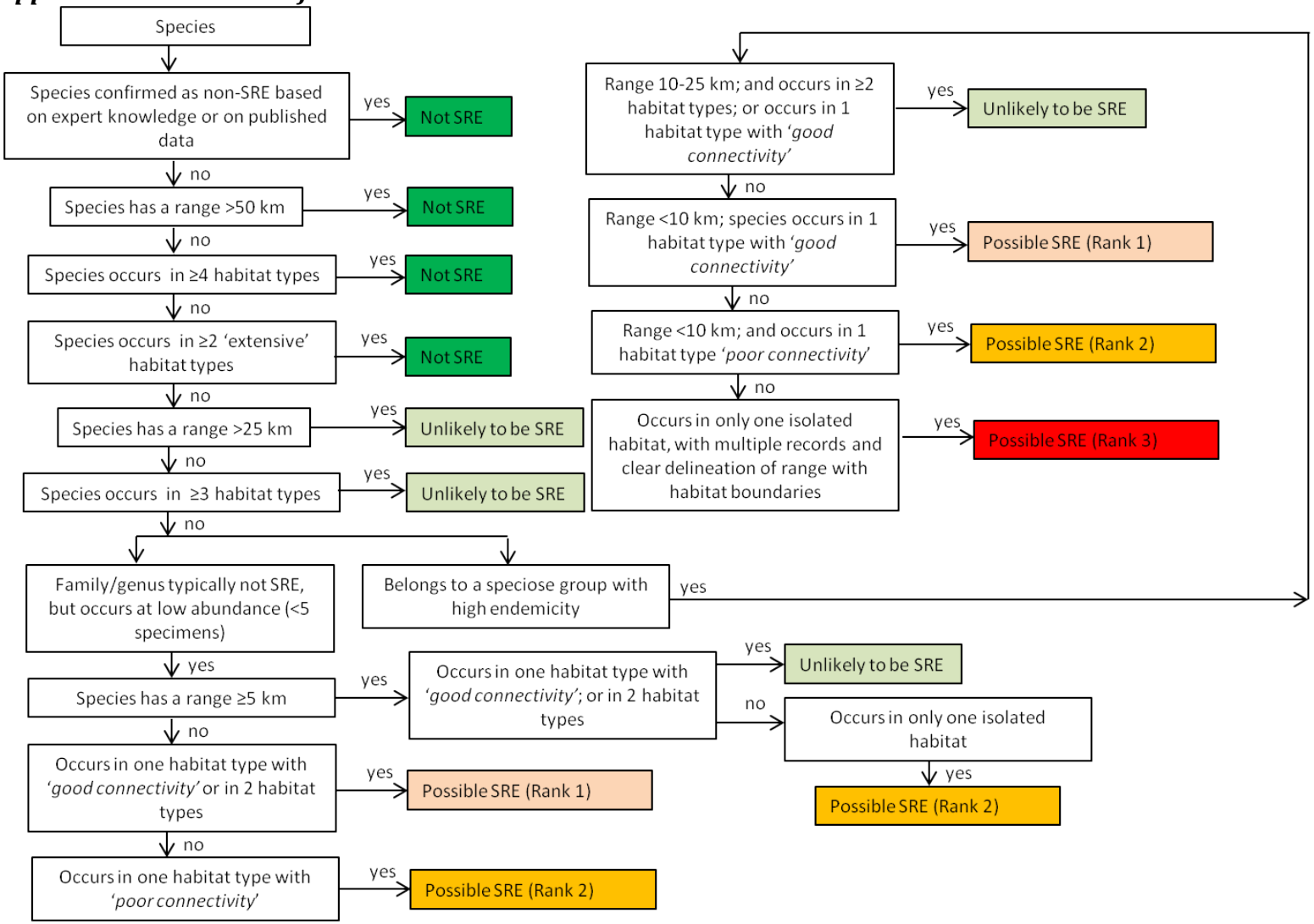
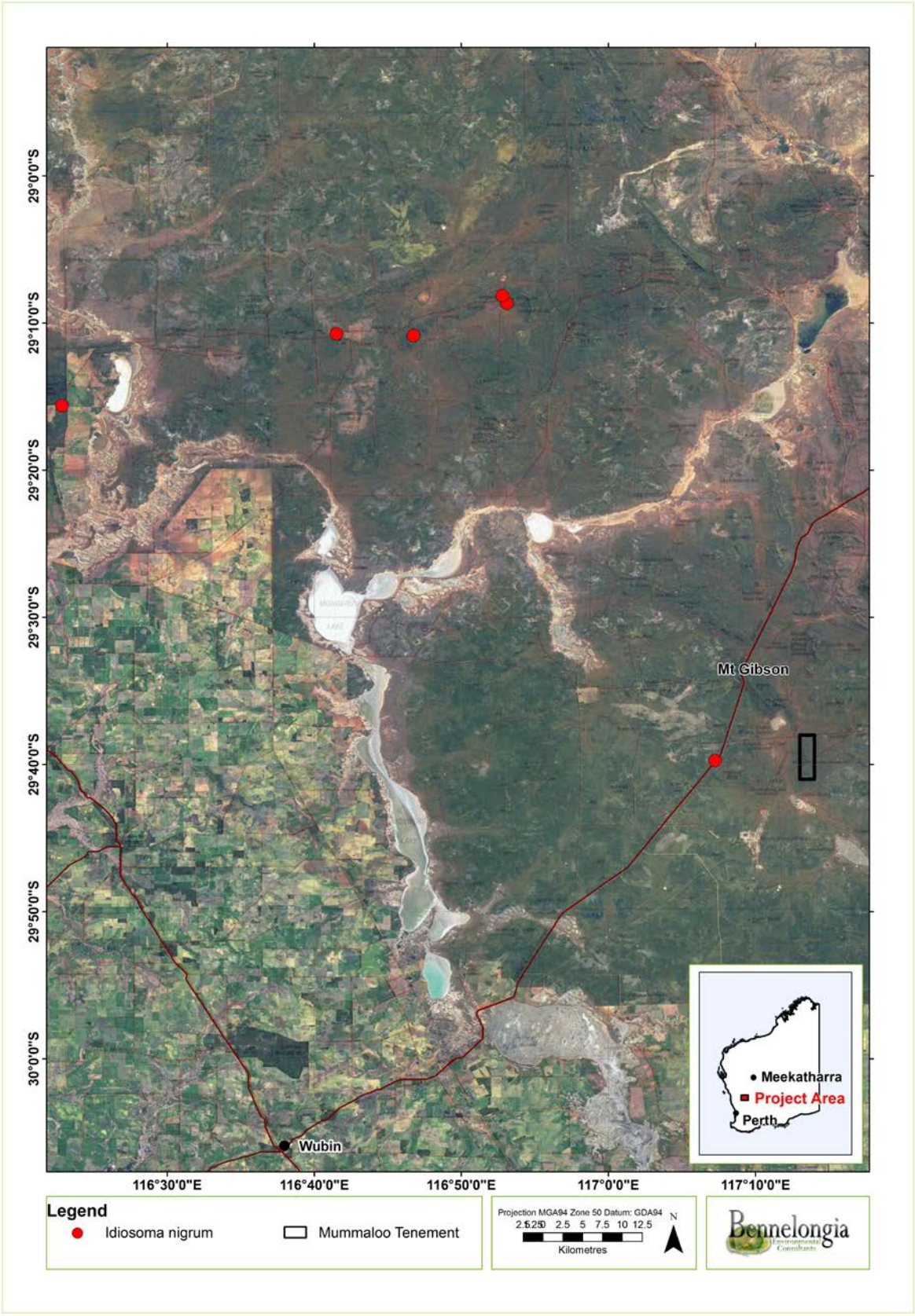
APPENDICES

Appendix 1. Flow Chart of Criteria Used to Assess SRE Status



Appendix 2. WAM Records of Idiosoma nigrum in the Vicinity of Mummaloo



Appendix 3. Site Photographs from Pilot and Targeted Surveys

Pilot Survey - Comprehensive Sites

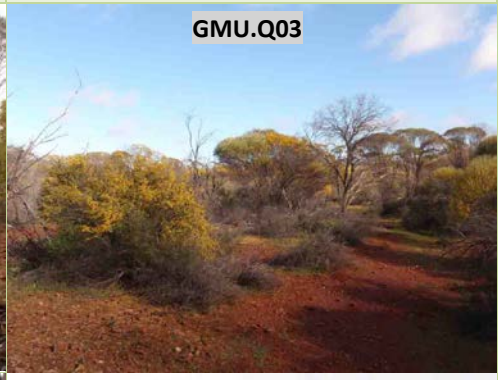
Site 01	Site 02
	

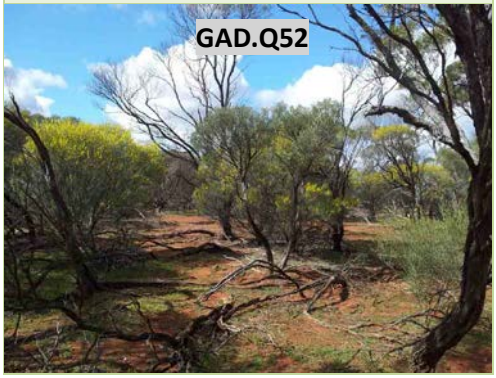
There are no photos of the 16 adhoc sites or the two vertebrate sites (Phoenix 2012).

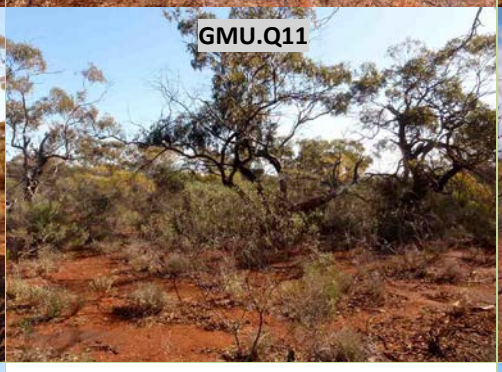
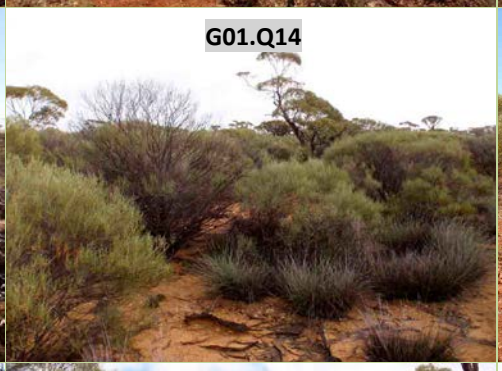
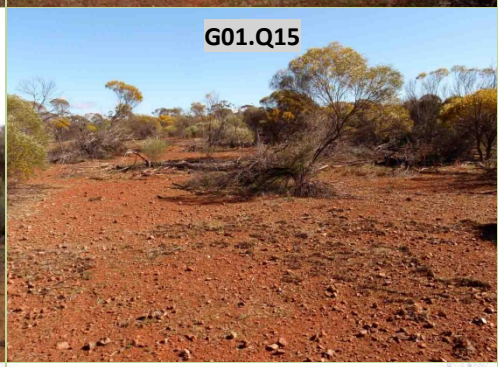
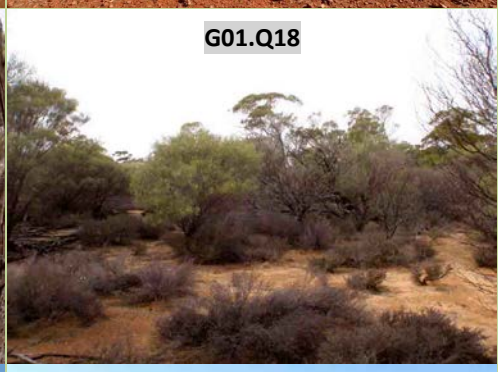
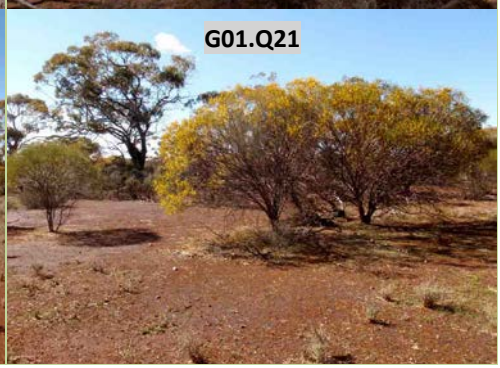
Appendix 3a. Habitat Description of Comprehensive Sites (Pilot Survey).

Lifeform	Flora Species	Site 01 (% cover)	Site 02 (% cover)
Herb/grass	*Atriplex sp. Eremophila granitica?, Maireana georgei, Olearia muelleri, Philotheca brucei, Ptilotus obovatus*	7	19
Shrub	*Acacia andrewsii, A. aneura, A. anthocahera, A. assimilis subsp. assimilis, A. erinacea, A. tetragonophylla*	35	40
Shrub	*Alyxia buxifolia, Dodonaea inaequifolia, Eremophila oldfieldii subsp. angustifolia, Eremophila oppositifolia subsp. angustifolia, Exocarpus aphyllus, Grevillea paradoxa, Santalum spicatum, Scaevola spinescens, Senna artemisioides var. filifolia, Callitris columellaris,*	10	7
Tree	*Casuarina obesa*	10	1
Tree	*Eucalyptus loxophleba subsp. supralaevis*	10	15
Tree	*Eucalyptus salmonophloia*	5	15

Targeted Survey – Quadrats

Site	Site	Site
GMU.Q01 	GMU.Q02 	GMU.Q03 
GMU.Q04 	GMU.Q05 	GMU.Q06 

Site
GAD.Q52 

Site	Site	Site
 GMU.Q07	 GMU.Q08	 GMU.Q09
 GMU.Q10	 GMU.Q11	 GMU.Q12
 G01.Q13	 G01.Q14	 G01.Q15
 G01.Q16	 G01.Q17	 G01.Q18
 G01.Q19	 G01.Q20	 G01.Q21

Site	Site	Site
G01.Q22 	G01.Q23 	G01.Q24 
G02.Q25 	G02.Q26 	G02.Q27 
G02.Q28 	G02.Q29 	G02.Q30 
G02.Q31 	G02.Q32 	G02.Q33 
G02.Q34 	G02.Q35 	G02.Q36 

Site	Site	Site
 G03.Q37	 G03.Q38	 G03.Q39
 G03.Q0	 G03.Q41	 G03.Q42
 G03.Q43	 G03.Q44	 G03.Q45
 G03.Q46	 G03.Q47	 G03.Q48
 GAD.Q49	 GAD.Q50	 GAD.Q51

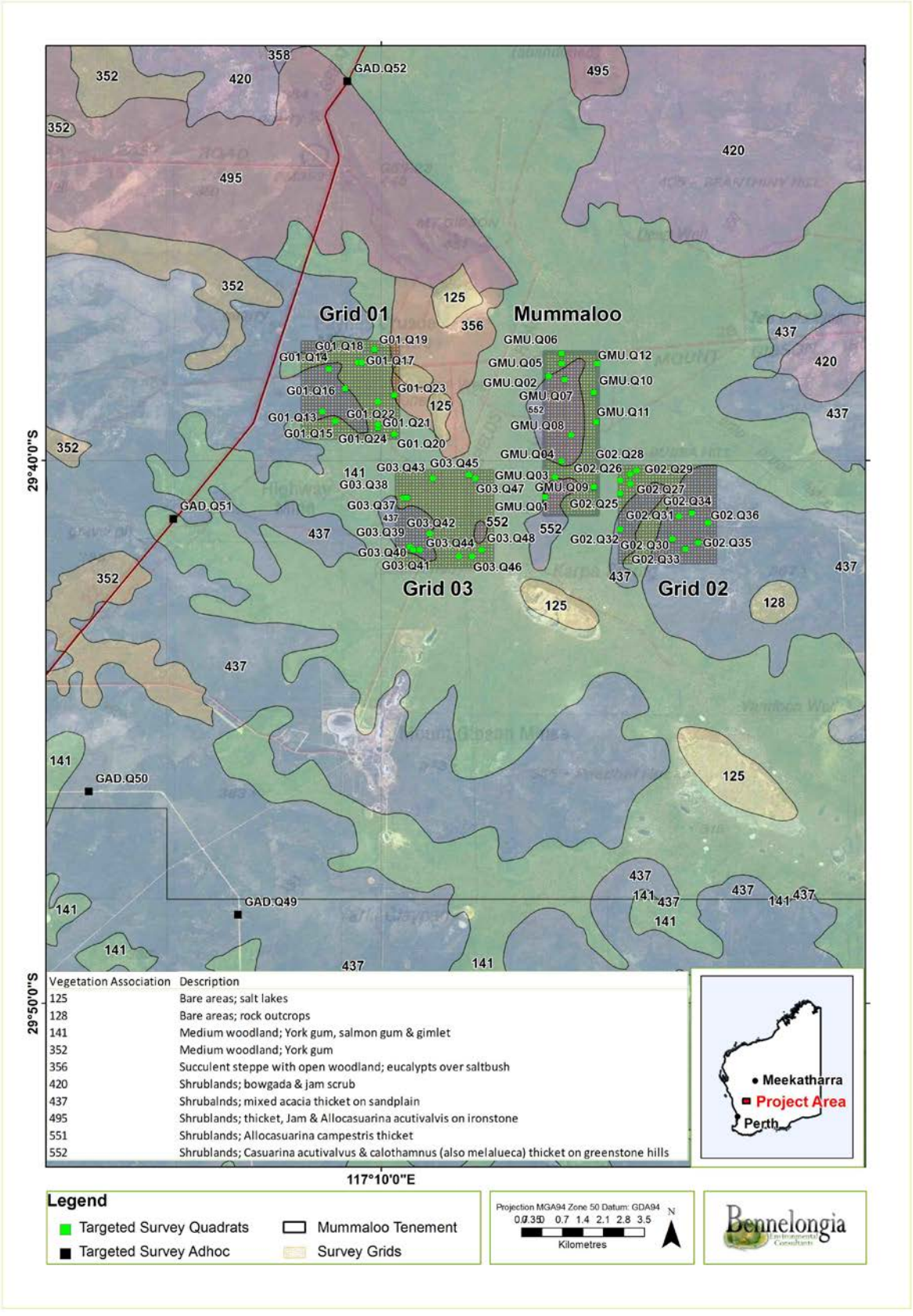
Appendix 4. Sample Sites with Coordinates and Habitat Details

Site Code	Level of Survey	Sample Date(s)	Latitude	Longitude	Vegetation Type
Pilot Survey					
Site 01	comprehensive	01/05 – 03/07/2012	-29.659194	117.23108	1
Site 02	comprehensive	02/05 – 04/07/2012	-29.671111	117.22791	1
Site 03	adhoc foraging	04/07/2012	-29.638	117.23102	1
Site 04	adhoc foraging	30/04/2012	-29.682527	117.22858	1
Site 05	adhoc foraging	30/04/2012	-29.680638	117.2285	1
Site 06	adhoc foraging	30/04/2012	-29.677083	117.2305	1
Site 07	adhoc foraging	30/04/2012	-29.675194	117.23130	1
Site 08	adhoc foraging	01/05/2012	-29.639138	117.22833	2
Site 09	adhoc foraging	01/05/2012	-29.641027	117.23133	1
Site 10	adhoc foraging	30/04/2012	-29.680611	117.22963	1
Site 11	adhoc foraging	30/04/2012	-29.677083	117.22866	1
Site 12	adhoc foraging	01/05/2012	-29.637666	117.23122	1
Site 13	adhoc foraging	01/05/2012	-29.656944	117.21791	2
Site 14	adhoc foraging	02/05/2012	-29.642611	117.23641	1
Site 15	adhoc foraging	30/04 – 02/07/2012	-29.675277	117.22883	1
Site 16	adhoc foraging	01/05 – 02/07/2012	-29.636777	117.23052	1
Site 17	adhoc foraging	01/05 – 02/07/2012	-29.660194	117.23211	1
Site 18	adhoc foraging	01/05 – 02/07/2012	-29.638777	117.23038	1
PES1*	adhoc foraging	28/05/2012	-29.66815	117.22561	1
PES2*	adhoc foraging	28/05/2012	-29.664444	117.22527	1
Targeted Survey					
G01.Q13	quadrat	08/08/2012	-29.65105	117.14926	2
G01.Q14	quadrat	07/08/2012	-29.63805	117.15126	2
G01.Q15	quadrat	08/08/2012	-29.65405	117.15326	2
G01.Q16	quadrat	08/08/2012	-29.64405	117.15626	2
G01.Q17	quadrat	07/08/2012	-29.63605	117.16026	2
G01.Q18	quadrat	07/08/2012	-29.63605	117.16126	2
G01.Q20	quadrat	08/08/2012	-29.65605	117.16626	1
G01.Q21	quadrat	08/08/2012	-29.65505	117.16626	2
G01.Q22	quadrat	07/08/2012	-29.64805	117.16626	1
G01.Q23	quadrat	08/08/2012	-29.64605	117.17126	2
G01.Q24	quadrat	09/08/2012	-29.65805	117.17126	1
G02.Q25	quadrat	09/08/2012	-29.67625	117.24073	2
G02.Q26	quadrat	10/08/2012	-29.67225	117.24073	2
G02.Q27	quadrat	10/08/2012	-29.67325	117.24373	2
G02.Q28	quadrat	10/08/2012	-29.67025	117.24373	2
G02.Q29	quadrat	10/08/2012	-29.66925	117.24573	2
G02.Q30	quadrat	11/08/2012	-29.69025	117.25673	2
G02.Q31	quadrat	09/08/2012	-29.68325	117.25873	2
G02.Q32	quadrat	11/08/2012	-29.68726	117.24073	2
G02.Q33	quadrat	11/08/2012	-29.69325	117.26073	2
G02.Q34	quadrat	09/08/2012	-29.68225	117.26273	2
G02.Q36	quadrat	09/08/2012	-29.68525	117.26773	2
G03.Q37	quadrat	13/08/2012	-29.67759	117.17416	2
G03.Q38	quadrat	13/08/2012	-29.67759	117.17516	2
G03.Q39	quadrat	13/08/2012	-29.69259	117.17616	2
G03.Q42	quadrat	12/08/2012	-29.68859	117.18216	2
G03.Q43	quadrat	13/08/2012	-29.67159	117.18316	1

Site Code	Level of Survey	Sample Date(s)	Latitude	Longitude	Vegetation Type
G03.Q44	quadrat	12/08/2012	-29.69559	117.19116	1
G03.Q45	quadrat	12/08/2012	-29.67059	117.19416	1
G03.Q47	quadrat	12/08/2012	-29.67159	117.19616	1
G03.Q48	quadrat	11/08/2012	-29.69359	117.19816	2
GAD.Q49	quadrat	16/08/2012	-29.80547	117.12328	2
GAD.Q50	quadrat	16/08/2012	-29.76764	117.07749	2
GAD.Q51	quadrat	16/08/2012	-29.68405	117.1034	1
GAD.Q52	quadrat	16/08/2012	-29.54969	117.15692	2
GMU.Q01	quadrat	13/08/2012	-29.67728	117.21765	2
GMU.Q02	quadrat	15/08/2012	-29.64028	117.21865	2
GMU.Q03	quadrat	14/08/2012	-29.67128	117.22065	2
GMU.Q04	quadrat	14/08/2012	-29.66628	117.22265	2
GMU.Q05	quadrat	15/08/2012	-29.63628	117.22265	1
GMU.Q06	quadrat	15/08/2012	-29.63328	117.22265	1
GMU.Q07	quadrat	15/08/2012	-29.64128	117.22365	2
GMU.Q08	quadrat	14/08/2012	-29.65828	117.22565	2
GMU.Q09	quadrat	14/08/2012	-29.67428	117.23265	2
GMU.Q10	quadrat	15/08/2012	-29.64528	117.23265	2
GMU.Q11	quadrat	15/08/2012	-29.65428	117.23333	1
GMU.Q12	quadrat	16/08/2012	-29.63628	117.23365	2

Vegetation type 1 = eucalyptus woodland; and 2 = mixed species shrubland. * Phoenix (2012).

Appendix 5. Locations Sampled for *Idiosoma nigrum* In Targeted Survey.



Appendix 6. SRE Taxa Results of Pilot Survey

All specimens collected from SRE Groups with SRE status indicated according to Appendix 1. All possible SREs are also listed in Section 6.1. Includes specimens from targeted survey and subterranean fauna assessment (Bennelongia 2012) where they pertain to pilot survey species.

Group	Species	# Animals	# Habitats	Sites	Literature and notes	Range (km)	SRE Status
Arachnida							
Araneae	*Aganippe* sp. B04	2	1	Site 02	No data	0	R1
	Aganippe sp. B07 'yilgarnia'	34	2	G01.Q20, G01.Q23, G01.Q24, G02.Q31, G03.Q44, Site 01	No data	9.6	No
	Aname 'MYG001 group'	13	1	G03.Q45, GMU.Q06, Site 01, Site 02	Widespread (WAM data)	-	No
	Aname 'tepperi group' or relative	8	2	G01.Q16, GMU.Q04, Site 01, Site 02	Widespread (WAM data)	-	No
	Aurecocrypta nr 'chichester'	1	1	Site 01	No data	0	R1
	Cethegus sp. B02	23	2	G01.Q14, G01.Q17, G01.Q18, G03.Q47, GMU.Q05, GMU.Q06, Site 15, Site 01, Site 17	No data	8.6	No
	Conothele sp. B05	12	2	G01.Q14, G01.Q18, G02.Q27, G02.Q31, G02.Q32, G02.Q36, Site 01, Site 02	No data	12.6	No
	Idiopidae sp.	4	2	G02.Q32, G02.Q34, Site 01	Juveniles	0	-
	Idiosoma nigrum	159	2	G01.Q14, G01.Q23, G02.Q26, G02.Q27, G02.Q28, G02.Q29, G02.Q31, G02.Q34, G02.Q36, G03.Q43, GAD.Q49, GAD.Q50, GAD.Q51, GMU.Q12, Site 03	Widespread (WAM data)	22	No
	Idiosoma sp. B01	260	2	G01.Q20, G01.Q21, G01.Q22, G01.Q24, G02.Q25, G03.Q45, G03.Q47, GAD.Q52, GMU.Q01, GMU.Q08, GMU.Q09, GMU.Q11, Site 01, Site 02	No data	16	No
	Missulena rutraspina	1	1	Site 01	Widespread (WAM data)	-	No
	Missulena sp. B05	11	2	G01.Q22, G01.Q23, G01.Q24, G02.Q25, GMU.Q06, GMU.Q09, Site 01, Site 02	No data	8	No
	Synothele sp. B05	27	2	G01.Q20, G01.Q23, G01.Q24, G02.Q27, G02.Q30, G02.Q31, G02.Q36, G03.Q44, Site 01, Site 02	No data	10.4	No
Pseudoscorpionida	*Austrochthonius* sp. B03	37	1	Site 01, Site 02	No data	1.4	R1
	Austrohorus sp. B03	1	1	Site 02	Family widespread (WAM)	-	No
	Beierolpium 8/4 sp. B05	5	1	Site 01, Site 02	Family widespread (WAM)	-	No
	Geogarypus taylori	1	1	Site 02	Widespread (WAM)	-	No
	Indolpium sp. B10	6	1	Site 01, Site 02	Family widespread (WAM)	-	No
	Olpiidae (nr *Austrohorus*) sp. B04	1	1	Site 01	Family widespread (WAM)	-	No
	Sternophoridae sp. B01	7	1	Site 01, Site 02	Family widespread (WAM)	-	No
Scorpionida	*Cercophonius granulosus*	1	1	PES2	Widespread (WAM data)	-	No
	Lychas 'hairy tail'	1	1	Site 01	Widespread (WAM data)	-	No
	Urodacus sp. B05	16	2	G01.Q15, G02.Q33, Site 01, Site 02, Site04, Site 05, Site 06, Site 07, Site 08, Site 09	No data	12	No
Chilopoda						7.6	No
Geophilomorpha	Mecistocephalus sp. B06	17	2	G01.Q18, G01.Q22, G03.Q39, GMU.Q03, Site 01, Site 02	No data	7.6	No
	Orphnaeus nr *brevilabiatus*	5	1	Site 01, Site 02	Widespread (Bennelongia data)	-	No
	Sependophilus sp. B02	5	2	G01.Q18, G01.Q24, GMU.Q04, GMU.Q07, Site 02	No data	0	No
Scolopendromorpha	*Arthrorhabdus* sp.	1	1	Site 02	Not SRE (Harvey 2002)	0	No
	Cormocephalus nr *rubiceps*	2	1	Site 02	Not SRE (Harvey 2002)	0	No
	Cryptops sp.	3	1	Site 02	Not SRE (Harvey 2002)	0	No
	Cryptops sp. B33 (nr australis)	1	1	GMU.Q09	Not SRE (Harvey 2002)	0	No
	Scolopendra nr *laeta*	3	1	Site 01, Site 02	Not SRE (Harvey 2002)	0	No
Scutigeromorpha	Scutigeromorpha sp.	2	1	MUM137, Site 01	Not SRE (Harvey 2002)	0	No
Diplopoda						0	
Polydesmida	*Antichiropus* 'Mt Gibson 1'	3	1	Site 01	Widespread (WAM data)	-	No
	Antichiropus 'Mt Gibson 3'	16	1	Site 02	Widespread (WAM data)	-	No
	Antichiropus sp.	38	2	G01.Q23, G03.Q38, G03.Q39, GMU.Q02, GMU.Q03, GMU.Q04, GMU.Q09, Site 01, Site 02, PES1	Immatures, likely *Antichiropus* 'Mt Gibson 1' or *A.* 'Mt Gibson 3'	7	-
Polyxenida	Polyxenidae sp. B07	2	1	Site 01, Site 02	Not SRE (Harvey 2002)	0	No
	Synxenidae sp. B04	10	1	Site 01, Site 02	Not SRE (Harvey 2002)	0	No

Group	Species	# Animals	# Habitats	Sites	Literature and notes	Range (km)	SRE Status
Polyzoniida	Siphonotidae sp. B02	3	1	Site 01, Site 02		1.4	R1
Gastropoda							
Orthurethra	*Gastrocopta bannertonensis*	82	2	G03.Q39, Site 01, Site 02	Widespread (WAM data)	-	No
	Pupoides beltianus	8	1	Site 01, Site 02	Widespread (WAM data)	-	No
	Pupoides contrarius	25	1	Site 01, Site 02	Widespread (WAM data)	-	No
Sigmurethra	*Sinumelon vagente*	389	2	G01.Q15, G01.Q18, G01.Q20, G01.Q22, G03.Q39, GMU.Q04, Site 01, Site 02, Site 10, Site 11, Site 12, Site 13, Site 14, Site 16, Site 18	Widespread (WAM data)	-	No
	Succinea sp.	31	2	G01.Q15, G01.Q20, G03.Q38, GMU.Q05, Site 01, Site 02	No data	7.7	No
	Westralaoma experta	153	2	G03.Q39, GMU.Q09, Site 01, Site 02	Widespread (WAM data)	-	No
Crustacea							
Isopoda	*Acanthodillo*? sp. B04	49	1	Site 01, Site 02	No data	1.4	R1
	Acanthodillo? sp. B05	16	1	Site 01, Site 02	No data	1.4	R1
	Acanthodillo? sp. B06	2	1	Site 01, Site 02	No data	1.4	R1
	Acanthodillo? sp. B07	49	1	Site 01, Site 02	No data	1.4	R1
	Buddelundia sp. B29	3	1	Site 01	No data	0	R1
	Buddelundia sp. B30	37	2	G01.Q13, G01.Q22, G03.Q38, GMU.Q03, GMU.Q04, GMU.Q07, Site 01, Site 02, Site 16, PES1	No data	8	No
	Buddelundia sp. B31	11	2	GMU.Q10, Site 01, Site 02, PES1	No data	3.1	No
	Cubaris sp. B05	5	1	Site 01, Site 02	No data	1.4	R1
	Cubaris sp. B06	1	1	Site 02	No data	0	R1
	Philosciidae sp. B19	58	2	G01.Q15, G03.Q38, G03.Q39, G03.Q42, GMU.Q03, GMU.Q04, MUM096, MUM135, Site 01, Site 02	No data	8.1	No
	Trichorhina sp. B12	44	1	Site 01, Site 02, Site 15, MUM145, MUMUNK01, MUMUNK02	No data	3.1	R1
	Trichorhina sp. B13	6	1	Site 01	No data	0	R1
Oligochaeta							
Megascolecidae	*Graliophilus* sp. nov. B01	6	1	Site 01, Site 02	New species (Allan Wills, DEC, pers. comm.)	1.4	R1

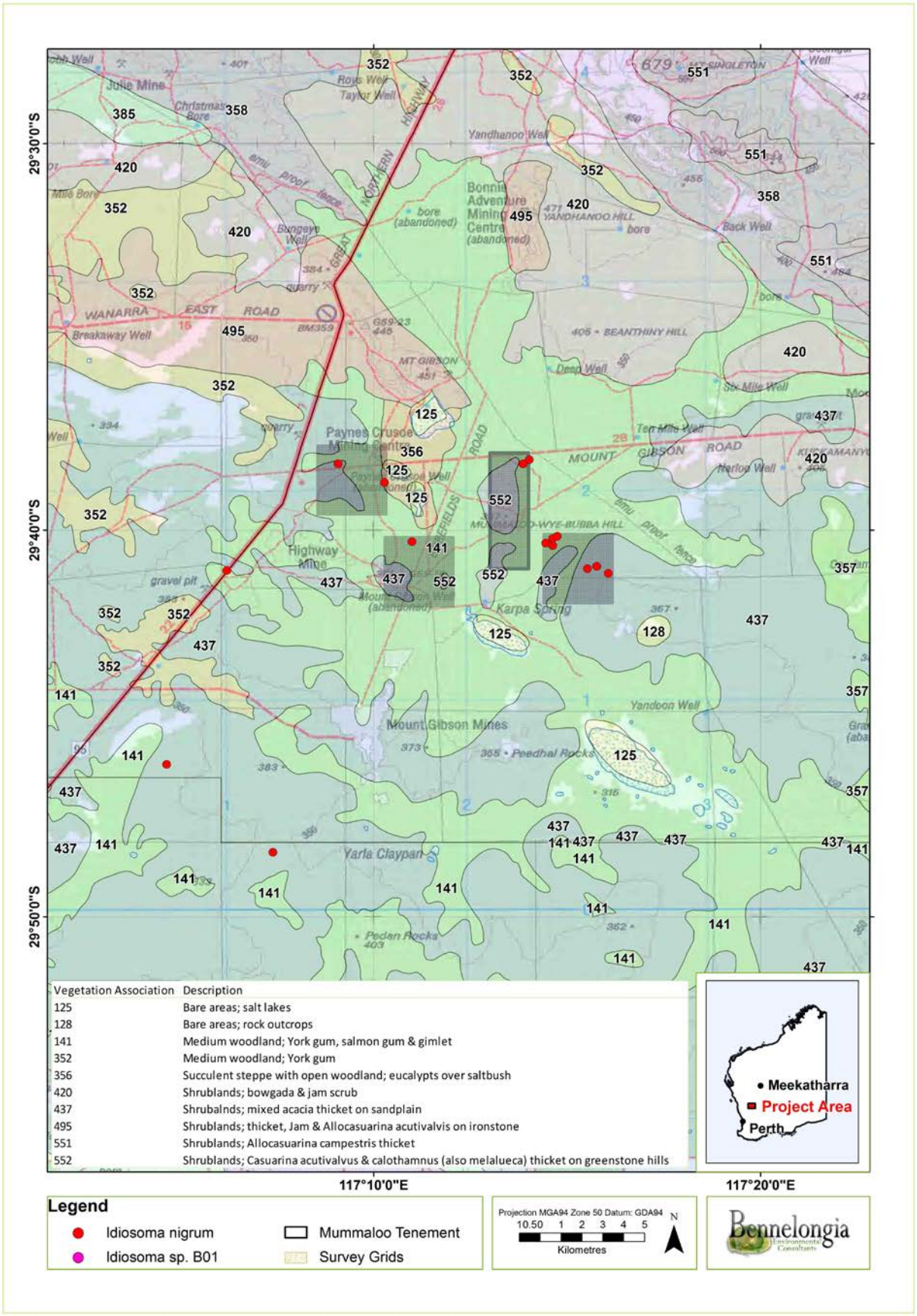
Appendix 7. Idiosoma Burrow Characteristics

Idiosoma nigrum

***Idiosoma* sp. B01**

The most notable difference can be observed in the lid and entrance. When viewing the profile of burrows, *Idiosoma nigrum* is convex and *Idiosoma* sp. B01 is concave. Both species have a beard or moustache type arrangement of leaves around the lid entrance.

Appendix 8. Map of Idiosoma Records



Appendix 9. Measured Burrows of Idiosoma nigrum

Grid	Site Name	Latitude	Longitude	Lid	Lumen	Age Class
01	G01.Q14	-29.63905556	117.15125	2.00	1.75	Adult
01	G01.Q14	-29.639	117.1507222	1.69	1.04	Juvenile
01	G01.Q14	-29.63858333	117.1503889	2.79	1.75	Adult
01	G01.Q14	-29.63855556	117.1511667	0.74	0.51	Emergent
01	G01.Q14	-29.63869444	117.1511389	2.20	1.64	Adult
01	G01.Q23	-29.64652778	117.1706667	1.02	0.69	Emergent
01	G01.Q23	-29.6465	117.1707222	1.01	0.62	Emergent
01	G01.Q23	-29.64658333	117.1703611	1.46	1.05	Juvenile
02	G02.Q26	-29.67263889	117.2400833	2.09	1.62	Adult
02	G02.Q26	-29.67263889	117.2400833	1.13	0.83	Emergent
02	G02.Q26	-29.67263889	117.2400833	2.20	1.85	Adult
02	G02.Q26	-29.67263889	117.2400833	1.39	1.25	Juvenile
02	G02.Q26	-29.67263889	117.2400833	1.10	0.79	Emergent
02	G02.Q26	-29.67263889	117.2400833	1.72	1.19	Juvenile
02	G02.Q26	-29.67263889	117.2400833	0.84	0.66	Emergent
02	G02.Q26	-29.67263889	117.2400833	1.22	0.94	Emergent
02	G02.Q26	-29.67263889	117.2400833	0.81	0.62	Emergent
02	G02.Q26	-29.67263889	117.2400833	-	0.93	Emergent
02	G02.Q26	-29.67263889	117.2400833	1.21	0.84	Emergent
02	G02.Q26	-29.67263889	117.2400833	2.31	1.91	Adult
02	G02.Q26	-29.67263889	117.2400833	1.12	0.81	Emergent
02	G02.Q27	-29.67358333	117.2430556	2.30	1.90	Adult
02	G02.Q27	-29.67358333	117.2430556	1.40	0.99	Emergent
02	G02.Q27	-29.67391667	117.2429167	2.15	1.75	Adult
02	G02.Q28	-29.67097222	117.24325	1.57	1.21	Juvenile
02	G02.Q28	-29.67069444	117.243	2.36	1.86	Adult
02	G02.Q28	-29.67066667	117.2429722	1.37	1.10	Juvenile
02	G02.Q28	-29.67044444	117.2435278	2.30	1.76	Adult
02	G02.Q28	-29.67108333	117.2427222	2.18	1.60	Adult
02	G02.Q28	-29.67108333	117.2427222	1.21	0.88	Emergent
02	G02.Q29	-29.66955556	117.2451111	1.71	1.16	Juvenile
02	G02.Q29	-29.66955556	117.2451111	0.99	0.68	Emergent
02	G02.Q29	-29.66963889	117.2453611	1.13	0.75	Emergent
02	G02.Q29	-29.66963889	117.2453611	2.58	1.86	Adult
02	G02.Q29	-29.66963889	117.2453611	1.00	0.64	Emergent
02	G02.Q29	-29.66963889	117.2453611	1.36	1.00	Emergent
02	G02.Q29	-29.66963889	117.2453611	1.03	0.73	Emergent
02	G02.Q29	-29.66963889	117.2453611	1.62	1.12	Juvenile
02	G02.Q29	-29.66963889	117.2453611	1.46	1.12	Juvenile
02	G02.Q29	-29.66963889	117.2453611	1.04	0.69	Emergent
02	G02.Q29	-29.66963889	117.2453611	1.57	1.06	Emergent
02	G02.Q29	-29.66963889	117.2453611	0.97	0.61	Emergent
02	G02.Q29	-29.66963889	117.2453611	2.16	1.76	Adult
02	G02.Q29	-29.66963889	117.2453611	1.98	1.49	Juvenile
02	G02.Q29	-29.66963889	117.2453611	0.93	0.66	Emergent
02	G02.Q29	-29.66963889	117.2453611	1.03	0.76	Emergent
02	G02.Q29	-29.66963889	117.2453611	1.08	0.85	Emergent
02	G02.Q29	-29.66963889	117.2453611	1.72	1.33	Juvenile
02	G02.Q31	-29.68330556	117.2583889	1.39	0.87	Emergent
02	G02.Q34	-29.68288889	117.2622778	2.51	1.93	Adult

Grid	Site Name	Latitude	Longitude	Lid	Lumen	Age Class
02	G02.Q34	-29.68288889	117.2622778	2.42	1.84	Adult
02	G02.Q34	-29.683	117.2620556	1.07	0.94	Emergent
02	G02.Q34	-29.683	117.2620556	1.97	1.77	Adult
02	G02.Q34	-29.683	117.2620556	1.69	0.86	Emergent
02	G02.Q34	-29.683	117.2620556	1.31	1.16	Juvenile
02	G02.Q34	-29.68277778	117.2618611	1.59	1.17	Juvenile
02	G02.Q34	-29.68277778	117.2618611	1.15	0.86	Emergent
02	G02.Q34	-29.68277778	117.2618611	1.59	1.16	Juvenile
02	G02.Q34	-29.68277778	117.2618611	1.05	0.58	Emergent
02	G02.Q34	-29.68277778	117.2618611	1.07	0.63	Emergent
02	G02.Q34	-29.68277778	117.2618611	1.02	0.66	Emergent
02	G02.Q34	-29.68277778	117.2618611	1.69	1.13	Juvenile
02	G02.Q34	-29.68277778	117.2618611	2.51	1.81	Adult
02	G02.Q34	-29.68277778	117.2618611	1.02	0.67	Emergent
02	G02.Q34	-29.68277778	117.2618611	0.92	0.57	Emergent
02	G02.Q34	-29.68277778	117.2618611	0.85	0.51	Emergent
02	G02.Q34	-29.68277778	117.2618611	2.48	1.98	Adult
02	G02.Q34	-29.68277778	117.2618611	0.92	0.62	Emergent
02	G02.Q34	-29.68277778	117.2618611	0.95	0.55	Emergent
02	G02.Q34	-29.68277778	117.2618611	0.92	0.60	Emergent
02	G02.Q34	-29.68277778	117.2618611	0.95	0.58	Emergent
02	G02.Q34	-29.68277778	117.2618611	20 burrows		Not Classified
02	G02.Q36	-29.68605556	117.2675	2.55	1.96	Adult
02	G02.Q36	-29.686	117.2674167	2.11	1.77	Adult
02	G02.Q36	-29.68594444	117.2673611	1.64	1.31	Juvenile
03	G03.Q43	-29.67244444	117.1994444	1.32	0.91	Emergent
03	G03.Q43	-29.67244444	117.1994444	1.00	0.77	Emergent
03	G03.Q43	-29.67244444	117.1994444	0.89	0.60	Emergent
03	G03.Q43	-29.67244444	117.1994444	1.09	0.84	Emergent
03	G03.Q43	-29.67244444	117.1994444	1.00	0.77	Emergent
03	G03.Q43	-29.67244444	117.1994444	1.43	1.06	Juvenile
03	G03.Q43	-29.67244444	117.1994444	2.17	1.67	Adult
03	G03.Q43	-29.67225	117.1996111	0.91	0.70	Emergent
03	G03.Q43	-29.67225	117.1996111	2.21	1.81	Adult
03	G03.Q43	-29.67225	117.1996111	1.42	1.08	Juvenile
03	G03.Q43	-29.67225	117.1996111	2.67	1.86	Adult
03	G03.Q43	-29.67225	117.1996111	1.03	0.74	Emergent
03	G03.Q43	-29.67225	117.1996111	1.99	1.61	Adult
03	G03.Q43	-29.67225	117.1996111	2.17	1.63	Adult
03	G03.Q43	-29.67225	117.1996111	2.31	1.97	Adult
03	G03.Q43	-29.67225	117.1996111	2.35	1.72	Adult
03	G03.Q43	-29.67225	117.1996111	2.12	1.65	Adult
03	G03.Q43	-29.67225	117.1996111	1.15	0.73	Emergent
03	G03.Q43	-29.67225	117.1996111	2.65	2.03	Adult
03	G03.Q43	-29.67225	117.1996111	1.66	1.32	Juvenile
03	G03.Q43	-29.67225	117.1996111	2.33	1.91	Adult
03	G03.Q43	-29.67225	117.1996111	1.45	1.22	Juvenile
03	G03.Q43	-29.67225	117.1996111	1.20	0.94	Emergent
03	G03.Q43	-29.67225	117.1996111	1.65	1.27	Emergent
03	G03.Q43	-29.67225	117.1996111	1.39	1.10	Juvenile
03	G03.Q43	-29.67225	117.1996111	1.63	1.15	Juvenile

Grid	Site Name	Latitude	Longitude	Lid	Lumen	Age Class
03	G03.Q43	-29.67225	117.1996111	2.04	1.69	Adult
03	G03.Q43	-29.67225	117.1996111	1.04	0.82	Emergent
Adhoc	GAD.Q49	-29.80547222	117.1232778	1.50	1.05	Juvenile
Adhoc	GAD.Q49	-29.80547222	117.1232778	2.51	1.73	Adult
Adhoc	GAD.Q50	-29.76764	117.07749	1.14	0.74	Emergent
Adhoc	GAD.Q50	-29.76764	117.07749	2.38	1.72	Adult
Adhoc	GAD.Q50	-29.76764	117.07749	1.12	0.62	Emergent
Adhoc	GAD.Q51	-29.68419444	117.1198333	1.10	0.69	Emergent
Adhoc	GAD.Q51	-29.68419444	117.1198333	0.89	0.61	Emergent
Adhoc	GAD.Q51	-29.68405556	117.1198056	2.00	1.49	Juvenile
Adhoc	GAD.Q51	-29.68413889	117.1198056	1.31	0.94	Emergent
Adhoc	GAD.Q51	-29.68413889	117.1198056	2.04	1.63	Adult
Adhoc	GAD.Q51	-29.68413889	117.1198056	2.59	1.89	Adult
Adhoc	GAD.Q51	-29.68413889	117.1198056	2.21	1.87	Adult
Adhoc	GAD.Q51	-29.68413889	117.1198056	0.92	0.56	Emergent
Adhoc	GAD.Q51	-29.68413889	117.1198056	1.53	1.21	Juvenile
Adhoc	GAD.Q51	-29.68413889	117.1198056	0.90	0.56	Emergent
Adhoc	GAD.Q51	-29.68413889	117.1198056	1.01	0.68	Emergent
Adhoc	GAD.Q51	-29.68413889	117.1198056	0.96	0.63	Emergent
Adhoc	GAD.Q51	-29.68413889	117.1198056	0.99	0.67	Emergent
Adhoc	GAD.Q51	-29.68419444	117.1197778	15 burrows		Not classified
Mummaloo	GMU.Q12	-29.63638889	117.2328889	2.60	2.04	Adult
Mummaloo	GMU.Q12	-29.63638889	117.2328889	1.70	1.26	Juvenile
Mummaloo	Site 03	-29.638	117.23102	2 burrows		Not classified