Biota Environmental Sciences

Baby Hope Downs Deposit Targeted Fauna Survey

Prepared for Rio Tinto

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1.0 Summary

1.1 Background

The Baby Hope Downs iron ore deposit is located adjacent to the existing Hope Downs 1 iron ore mine, approximately 75 km northwest of Newman in the Pilbara region of Western. Rio Tinto has undertaken an Order of Magnitude study of the Baby Hope Downs iron ore deposit, as well as extensive drilling in the area, and is in the process of seeking environmental approval to develop the site. Conceptual developments that may be constructed in this study area comprise mine pits, waste dumps, topsoil stockpiles and other general infrastructure.

To support an environmental assessment, Rio Tinto required an assessment of fauna values of the Baby Hope Downs deposit study area. The scope of the required assessment was informed by an earlier desktop review conducted for previous expansions of the existing Hope Downs 1 operations (Biota 2009a). This concluded that the habitats within and adjoining the Hope Downs area support a fauna community that is typical of the Hamersley Ranges, well documented by existing data, and that most components of the expected assemblage would not be of elevated conservation significance (Biota 2009a). The exceptions to this finding were the potential occurrence of the Northern Quoll, Orange Leaf-nosed Bat and Pilbara Olive Python, which are all specially protected at State and Federal levels.

In addition, potential Short Range Endemic (SRE) fauna and troglobitic fauna, were not considered during the majority of past surveys for the existing Hope Downs 1 operations, meaning that there are limited data to assess potential impacts on these faunal groups at Baby Hope Downs. The Biota (2009a) desktop review concluded that it is likely that potential SRE and troglobitic fauna occur within both the existing Hope Downs operations area and adjacent areas that had not been previously surveyed. These findings, and the outcomes of a targeted survey of a separate expansion to the existing Hope Downs operations (Biota 2011a), set the scope for the current study.

1.2 Methodology

The targeted field survey was conducted over eight days from September 9 to 16, 2013. A combination of survey techniques best suited to detecting the target conservation significant species was implemented. All work was undertaken in accordance with relevant EPA Guidance Statements (EPA 2002, 2004, 2007, 2009, 2013a, EPA and DEC 2010).

Systematic sampling using cage traps and large and medium Elliott traps was conducted at four sites located in specific targeted habitats that were determined most likely to support the Northern Quoll (*Dasyurus hallucatus*). Traps were deployed for a total of 960 trap nights within the study area. Non-systematic sampling focusing on searching for evidence of the Pilbara Olive Python (*Liasis olivaceus barroni*) was conducted at the systematic sampling sites.

Motion cameras were deployed at four sites adjacent to the systematic sampling sites in areas determined as likely habitat for the Northern Quoll. Cameras were typically set up in rocky overhangs and alcoves where Northern Quoll would be likely to forage if present.

Bat sampling was conducted at four sites in proximity to the systematic sampling sites using echolocation call recorders. The sites were selected primarily on their suitability as potential fly-through habitats for the Orange Leaf-nosed Bat (*Rhinonicteris aurantius*).

Ten SRE terrestrial invertebrate search sites were surveyed, including five sites that were located outside of the potential disturbance area as contextual sites. Specific invertebrate groups targeted during this survey included mygalomorph spiders, pseudoscorpions, millipedes, terrestrial snails and scorpions. Mygalomorph spiders and scorpions were targeted by visually locating and excavating burrows. Pseudoscorpions were searched for under peeling bark of trees and shrubs and beneath rocks. Millipedes were searched for under leaf litter and logs. Aestivating land snails

were targeted by collecting dead snail shells and digging under spinifex hummocks and in drainage gullies. Molecular (DNA) analysis was used to determine putative taxa within the Mygalomorphae. Specimens of Mygalomorphae collected from the study area were sequenced for variation at the COXI gene and compared to reference sequences from a database of specimens collected from the broader Pilbara region.

Twenty-five drillholes were sampled for troglofauna. Troglofauna were sampled using custom-built litter colonisation traps suspended within drillholes located within the study area. A series of colonisation traps were suspended at intervals to allow coverage of fracture zones and cavities. Traps were left in the ground for six weeks. Fauna specimens were recovered from the traps using specially designed Tullgren funnel units. Fauna specimens were identified by morphology to order level using dissecting microscopes. Specimens of confirmed troglobites were further identified using molecular techniques, through comparison of their DNA sequences with reference sequences from previous collections at Hope Downs and the broader Pilbara.

1.3 Results

1.3.1 Fauna Landforms and Habitats

Of the habitats present, the narrow and broad gorges were considered to be the landform unit representing the habitat of highest faunal value in the study area, but their attributes are typical of similar habitat types in the wider locality.

The gorges in the study area have the potential to provide habitat for both the Northern Quoll and Pilbara Olive Pythons. The Orange Leaf-nosed Bat also has the potential to forage over the majority of the study area, but there is no evidence of any suitable roost sites for the species.

1.3.2 Threatened Vertebrate Fauna

None of the three Schedule 1 species that were targeted during this survey were recorded.

Northern Quoll (*Dasyurus hallucatus*) (State: Schedule 1; Federal: Endangered)
Has the potential to occur in the study area as it has been recorded at Hope Downs 1 previously (4 km north of the Baby Hope Downs study area). The narrow and broad gorges of the study area provide suitable habitat, with prey items such as the Common Rock Rat *Zyzomys argurus* being readily available.

Orange Leaf-nosed Bat (*Rhinonicteris aurantius*) (State: Schedule 1; Federal: Vulnerable)
Potential foraging habitat in the narrow and broad gorges in the study area, however there was no evidence of any caves deep enough for the Orange Leaf-nosed Bat to roost in.

Pilbara Olive Python (*Liasis olivaceus barroni*) (State: Schedule 1; Federal: Vulnerable)
Potential habitat for this species occurs in the narrow and broad gorges in the study area, however no semi-permanent pools were observed during the field survey.

1.3.3 Potential SRE Invertebrate Fauna

Ten potential SRE mygalomorph spiders were recorded from six sites within the study area. All of these specimens belong to the genus *Aname* (Family: Nemesiidae), with three different morphotypes identified including 'Sock' *Aname*, 'Big Angry Red' *Aname* and 'Hooded' *Aname*. Subsequent molecular analysis of the specimens aimed at determining if they represented SRE taxa revealed that the three morphotypes belonged to three known *Aname* species (N1, N16 and N37). Based on current data *Aname* sp. N1 nor *A*. sp. N16 occupy minimum spanning areas > 10000 km^2 (Biota 2012c). Therefore they are not considered SREs and are not of elevated conservation significance.

With the records from this study, *Aname* sp. N37 has a known distribution of 65 km^2, and qualifies as an SRE. The two confirmed specimens of this species were recorded from contextual sampling sites outside the study area. A further two specimens of the same morphotype were collected from the same landform and land system from inside the study area, but these failed to yield a

useable DNA sequence. Given the small distance involved and the similarity of habitats, it is possible that these two records also represent the SRE species *Aname* sp. N37.

1.3.4 Troglobitic Fauna

Schizomids were the only confirmed troglobitic taxa recorded that are of conservation significance, and all specimens collected belonged to the genus *Draculoides*. Molecular analysis revealed that three species were represented amongst the study area and Hope Downs 1 context specimens:

Draculoides sp. CI1 - Six specimens; two of which were collected from a single drillhole in the west of the study area during the current survey;

Draculoides sp. BHD1 - Two specimens; not recorded from the current study area (identified from Hope Downs 1 context specimens only); and

Draculoides sp. BHD2 - Three specimens; detected from two drillholes within the current study area only.

Reviews of geological information suggest that trogolofauna habitat in the study area is represented stratigraphically by hydrated zones in the profile, which spatially equates to surface geology units mapped locally as valley fill colluvium and Marra Mamba. These units accounted for all records of troglofauna from the Hope Downs locality.

At present, all three species identified are considered SREs, but only one, *Draculoides* sp. BHD2, is only known from the study area. Reviews of the habitat mapping completed for this study suggest it is likely suitable habitat extends northwest of the study area boundary. The records of *Draculoides* sp. BHD2 came from close to the northern margin of the study area which may suggest the species would also occur further to the immediate north.

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2.0 Introduction

2.1 Project Background

The Baby Hope Downs iron ore deposit is located adjacent to the existing Hope Downs 1 iron ore mine, approximately 75 km northwest of Newman in the Pilbara region of Western Australia (Figure 2.1). Rio Tinto has undertaken an Order of Magnitude study of the Baby Hope Downs iron ore deposit, as well as extensive drilling in the area, and is in the process of seeking environmental approval to develop the site. Future developments that may be constructed in the area comprise mine pits, waste dumps, topsoil stockpiles and other general infrastructure.

To support an environmental assessment, Rio Tinto required an assessment of fauna values of the Baby Hope Downs deposit. The scope of the required assessment was informed by an earlier desktop review conducted for previous expansions of the existing Hope Downs 1 operations (Biota 2009a). That concluded that the habitats within and adjoining the Hope Downs area support a fauna community that is typical of the Hamersley Ranges, well documented by existing data, and that most components of the expected assemblage would not be of elevated conservation significance (Biota 2009a). The exceptions to these earlier findings were the potential occurrence of the Northern Quoll, Orange Leaf-nosed Bat and Pilbara Olive Python, which are all specially protected at State and Federal levels.

In addition, potential Short Range Endemic (SRE) fauna and troglobitic fauna, were not considered during the majority of past surveys for the existing Hope Downs 1 operations, meaning that there are limited data to assess potential impacts on these faunal groups at Baby Hope Downs. The Biota (2009a) desktop review concluded that it is likely that potential SRE and troglobitic fauna occur within both the existing Hope Downs operations area and adjacent areas that had not been previously surveyed. Those findings, and the outcomes of a targeted survey of a separate expansion to the existing Hope Downs operations (Biota 2011a), set the scope for the current study.

2.2 Objectives and Scope

In 2013, Biota Environmental Sciences (Biota) was commissioned to carry out a targeted terrestrial and Phase 1 troglobitic fauna survey within an original 2,758 ha study area encompassing the Baby Hope Downs deposit. The area within which environmental approval will be sought was changed subsequent to the field survey to a smaller area of 1,652 ha centred on the deposit (see Figure 2.1).

A review of the implication of this approval boundary change was conducted and given that:

1. the revised approvals boundary was smaller and for the most part was situated within the original study area boundary;
2. with the exception of some SRE fauna contextual sites (see Section 4.4), the sampling effort from the field survey still fell within the extent of the revised approvals boundary;
3. no new land systems or fauna habitats were introduced to the study by the additional area in the northeast of the revised approvals boundary (see inset on Figure 2.1), and
4. the nature of the proposed development had not materially changed,

the sampling effort and survey data from the 2013 survey were still assessed as adequate and representative of the revised approvals area boundary. Field ground-truthing, photographs and vegetation mapping from the Biota (2014c) flora and vegetation survey subsequently confirmed that no new habitats occurred in the northeast of the revised approvals boundary (Figure 2.1).

This report therefore discusses the field survey results in context of the revised Part IV approvals boundary as shown on Figure 2.1, which is hereafter referred to as 'the study area'.

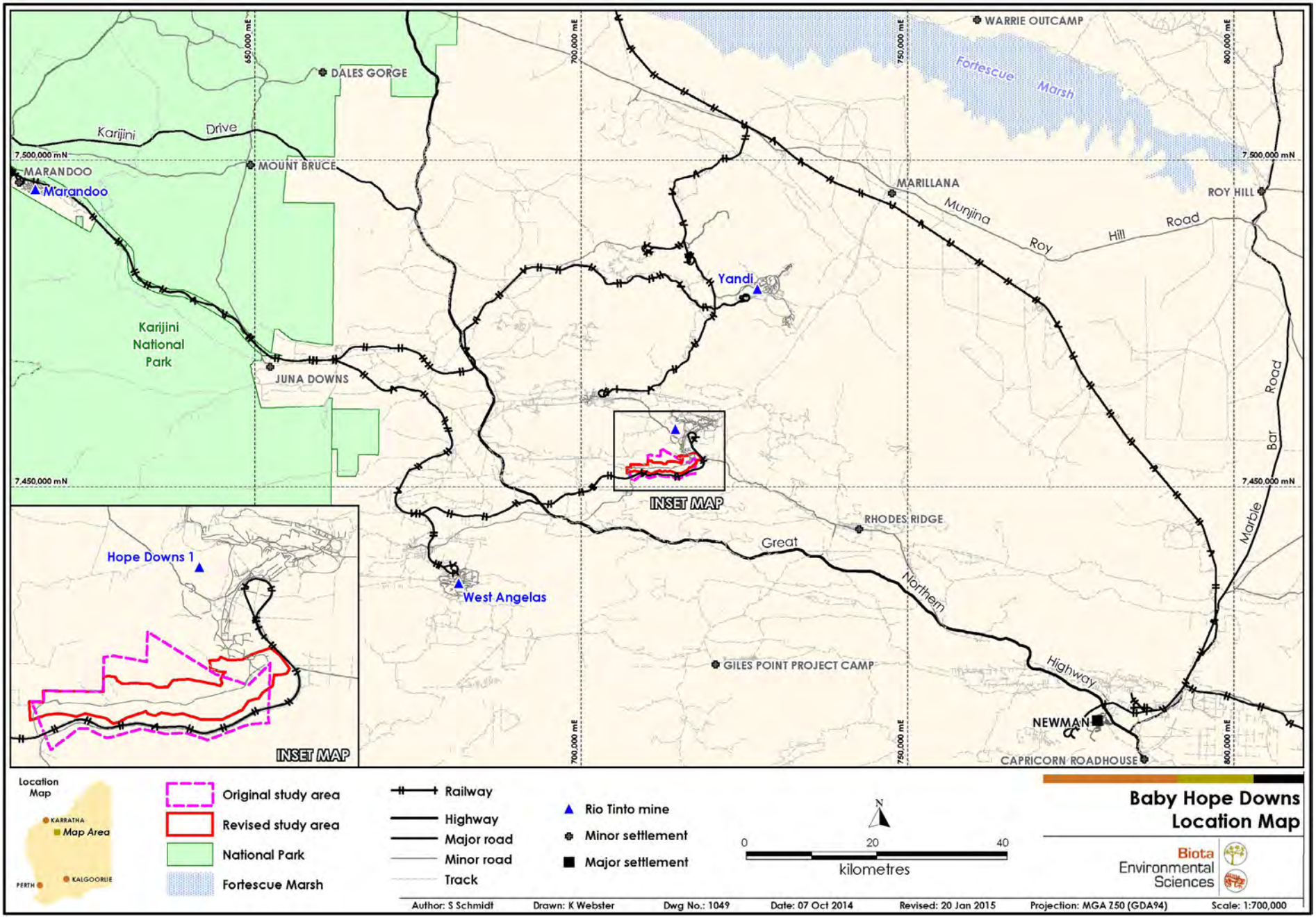

Figure 2.1: Location of the study area in relation to the Hope Downs 1 mine.

This report discusses the field survey results in context of this revised Part IV approvals boundary, hereafter referred to as 'the study area'. Figure 2.1 shows the location of the study area for this report in the context of the original study area.

The field survey was planned and implemented according to the following EPA requirements:

- Position Statement No. 3 "Terrestrial Biological Surveys as an Element of Biodiversity Protection" (EPA 2002);
- Guidance Statement No. 56 "Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia" (EPA 2004);
- Guidance Statement No 54a "Sampling Methods and Survey Considerations for Subterranean Fauna in Western Australia" (EPA 2007);
- Guidance Statement No. 20 "Sampling of Short Range Endemic Invertebrate Fauna for Environmental Impact Assessment in Western Australia" (EPA 2009);
- Technical Guide: Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment (EPA and DEC 2010); and
- Environmental Assessment Guideline for consideration of subterranean fauna in environmental impact assessment in Western Australia (EPA 2013b).

The targeted fauna survey comprised both terrestrial and subterranean components with specific objectives outlined below.

The terrestrial vertebrate targeted fauna survey objectives were to:

- conduct targeted trapping for, and recording of, key threatened vertebrate fauna species; specifically the Northern Quoll (*Dasyurus hallucatus*), Orange Leaf-nosed Bat (*Rhinonicteris aurantius*) and Pilbara Olive Python (*Liasis olivaceus barroni*);
- determine the suitability of habitat for the targeted fauna species;
- review previous biological reporting in the vicinity of the study area to identify relevant contextual records of the targeted fauna; and
- identify and assess the local and regional conservation significance of the fauna recorded and terrestrial fauna habitats in the study area.

The targeted SRE fauna survey objectives were to:

- conduct targeted surveys for invertebrate fauna groups of particular conservation significance including those supporting SREs, using methods consistent with current EPA guidance (EPA 2009);
- review the habitats within which potential SRE fauna were recorded to assess risk of small-scale spatial restrictions in distribution; and
- complete molecular analysis of relevant potential SRE specimens to determine their wider distribution from existing reference data.

The targeted troglobitic fauna survey objectives were to:

- complete Phase 1 sampling of a representative subset of available drillholes for troglofauna within the deposit, targeting prospective habitat within the ore body;
- morphologically identify the collected troglobitic and troglophilic specimens to order, or family level, where possible;
- complete molecular analysis of relevant troglobitic specimens to determine their wider distribution from previous collections in the locality and existing reference data; and
- discuss the conservation significance of the recorded troglobitic and troglophilic species and the likelihood of wider distributions.

This report was produced to document the outcomes of the survey in context of the study area boundaries and more specifically to:

- describe the methodology employed for the field surveys and specimen identifications;
- document the results of the survey with a focus on targeted fauna of conservation significance, SREs and troglofauna and their habitats;

- review previous biological reports and other literature relevant to the species and faunal groups targeted in the study area; and
- highlight any species or habitats of particular conservation significance that may represent development constraints.

2.3 Purpose of this Report

This report describes the methodology employed for the targeted fauna survey. It documents the methods and results of the survey and discusses the conservation significance of the fauna habitats and taxa targeted in the context of the study area. Its intended use is as a supporting document for the future environmental impact assessment of the proposed development, under Section 38 of the *Environmental Protection Act 1986.* Both the field survey and report are subject to specific limitations that are discussed in Section 4.8.

2.4 Targeted Taxa Overview

2.4.1 Vertebrate Fauna

Native fauna species that are rare, threatened with extinction, or have high conservation value, are specially protected by law under the State *Wildlife Conservation Act 1950*. In addition, some of these species are listed for their protection under the Federal *Environment Protection and Biodiversity Conservation (EPBC) Act 1999*. Appendix 1 details the categories of conservation significance recognised under both acts.

The three species of vertebrate fauna targeted during the current study are all listed under both State and Federal acts as detailed below.

2.4.1.1 Northern Quoll (*Dasyurus hallucatus*)

Status: The Northern Quoll is listed as Schedule 1 under the State *Wildlife Conservation Act 1950* and Endangered under the Federal *EPBC Act 1999.*

Distribution: The Northern Quoll formerly occurred across much of northern Australia but is now restricted to six main areas: the north and western top end of the Northern Territory, north of Cape York, the Atherton-Cairns area, the Carnarvon Range-Bowen area of Queensland (Menkhorst and Knight 2011), and the northwest Kimberley and Pilbara regions of Western Australia (Braithwaite and Griffiths 1994).

Ecology: The species is most abundant in open, rocky habitat and is also commonly found in gorges, breakaways and hills, particularly for denning purposes (van Dyck and Strahan 2008). It also occurs near creek lines and drainage lines, where adjacent plains and vegetated areas provide habitats for foraging and dispersal of young (van Dyck and Strahan 2008). Northern Quoll populations fluctuate on both annual and inter-annual cycles. This variability is driven by both the reproductive biology of individuals and longer-term cycles in response to regional stochastic processes such as rainfall, fire and related changes of prey populations (How et al. 2009).

2.4.1.2 Orange Leaf-nosed Bat (*Rhinonicteris aurantius*)

Status: The Orange Leaf-nosed Bat (OLNB) is listed as Schedule 1 under the State *Wildlife Conservation Act 1950* and Vulnerable under the Federal *EPBC Act 1999*.

Distribution: The OLNB is a relictual monotypic genus of the family Hipposideridae. An isolated population is found in the Pilbara region of Western Australia, although the species' wider distribution also includes the Kimberley region of Western Australia, the Northern Territory and north-western Queensland (Churchill 2008). Populations found in extreme northwest Queensland are considered to be contiguous with those in the Northern Territory and the Kimberley of Western Australia. However, populations occurring in the Pilbara bioregion of Western Australia are isolated from northern populations (Stokes 1996, Olsen 1998).

Ecology: Occurrence of this species is determined by the availability of suitable roost caves that offer high humidity and a stable temperature (Churchill et al. 2008). In the Pilbara, OLNB are thought to be restricted to caves where semi-permanent or permanent water is nearby (Stokes 1996). Foraging typically occurs over open grasslands in gorges and low hills (Biota 2013a, 2014a).

2.4.1.3 Pilbara Olive Python (*Liasis olivaceus barroni*)

Status: The Pilbara Olive Python is listed as Schedule 1 under the State *Wildlife Conservation Act 1950* and Vulnerable under the Federal *EPBC Act 1999*.

Distribution: The Pilbara Olive Python has a known distribution that coincides roughly with the Pilbara bioregion (Environment Australia 2000). The Pilbara Olive Python is currently confined to ranges in the Pilbara and islands of the Dampier Archipelago, with one isolated population known from Mount Augustus in the Gascoyne region (Bush and Maryan 2011, Department of the Environment 2014). It is known from at least 17 localities in the Pilbara and four areas where reliable populations occur: Pannawonica, Millstream, Tom Price and the Burrup Peninsula. At some of these sites, the species is considered stable and occurs in sizeable numbers (DotE 2014).

Ecology: Core habitat for the Pilbara Olive Python includes gorges, escarpments, rocky outcrops and water holes where it may find suitable prey species that utilise these environments (DotE 2014). It seeks shelter in caves, beneath boulders, in pools of water and occasionally in trees overhanging water (Bush and Maryan 2011). It is often associated with ephemeral or permanent water, but may also be recorded in rocky habitats some distance from these features (Biota 2009b). On the Burrup Peninsula, the local population was found to prefer granophyre rock piles but individuals were also occasionally recorded in the adjacent spinifex grasslands (DotE 2014). Males from this population in particular were found to travel large distances, suggesting that the species can have a large range (estimated between 88 ha and 449 ha) (DotE 2014).

2.4.2 Short-Range-Endemic Terrestrial Invertebrates

SRE invertebrates are taxonomic groups of invertebrates that exhibit naturally small distributions, (less than 10,000 km^2, as defined by (Harvey 2002). Certain groups of invertebrates are pre-disposed to short-range endemism through poor dispersal capabilities, confinement to disjunct habitats, slow reproduction and low fecundity (Harvey 2002, Ponder and Colgan 2002). Given the importance of short-range endemism to the conservation of biodiversity (EPA 2009), the assessment of such invertebrate taxa is a potentially important component of environmental impact assessment.

Examples of taxonomic groups that show high levels of short-range endemism in this respect include mygalomorph spiders, millipedes, pseudoscorpions, and both freshwater and terrestrial molluscs (EPA 2009).

2.4.3 Troglobitic Fauna

Troglobites are those fauna that occur in subterranean habitats between the superficial soil layer and the water table. The habitats in which troglofauna occur typically provide stable biophysical conditions and a similar suite of ecological processes. Such conditions include: darkness or near-darkness, stable, cool temperatures (Humphreys 2001, Paquin and Hedin 2004), high relative humidity (approaching 100%; Humphreys 2001), relatively high carbon dioxide levels, and relatively low energy levels (Humphreys 1991a). Habitats suitable for troglofauna are typically found in karstic limestone systems (at Cape Range, Barrow Island and in the Kimberley), the mesa formations of the Robe Valley (Biota 2011b, 2011b), and in banded iron formation (BIF) where troglofauna have been more recently demonstrated to occur (Biota 2009c, 2012a).

Troglobites are considered to be relictual rainforest litter fauna (Humphreys 1991b), and as such have the potential to have restricted distributions due to long periods of isolation and a lack of connectivity between populations. As a result, short-range endemism is common in this fauna, with some species only known from single cave systems (Humphreys 1991c). In particular, some of the species present within isolated landforms do not occur anywhere else based on available data results of genetic studies and specimen identification (Harvey et al. 2008, Biota 2013b).

Troglobitic orders that have been found in Pilbara landscapes include the Schizomida, Pseudoscorpiones, Araneae, Scolopendrida, Polydesmida, Diplura, Thysanura, Coleoptera and Blattodea (Biota 2006a, 2011b, 2012a).

Troglofauna commonly display similar adaptive morphological traits suited to a low light environment. These adaptations consist of reduced or lack of eyes, loss of pigment and presence of elongate appendages (Coineau 2001). A suite of superficial soil fauna, also called edaphobitic fauna, can display similar troglomorphic traits but generally do not have limited distributions (Berry 2005, Biota 2006a, Biota and Helix 2011).

3.0 Regional Context

3.1 IBRA Bioregions and Subregions

The Interim Biogeographic Regionalisation for Australia (IBRA) recognises 89 bioregions and 419 subregions (DSEWPaC 2012). The study area as a whole lies entirely within the Pilbara bioregion.

The Pilbara bioregion is divided into four subregions: Roebourne, Chichester, Fortescue Plains, and Hamersley (ordered from the northern coast to the southern edge). The study area lies entirely within the Hamersley subregion which covers an area of 5,634,727 ha[1] and is characterised as follows:

- Hamersley (PIL3): "*PIL3 is the Southern section of the Pilbara Craton. Mountainous area of Proterozoic sedimentary ranges and plateaux, dissected by gorges (basalt, shale and dolerite). Mulga low woodland over bunch grasses on fine textured soils in valley floors, and Eucalyptus leucophloia over Triodia brizoides on skeletal soils of the ranges. The climate is Semi-desert tropical, average 300mm rainfall, usually in summer cyclonic or thunderstorm events. Winter rain is not uncommon. Drainage into the Fortescue (to the north), the Ashburton (to the south), or the Robe (to the west).*"

3.2 Conservation Reserves in the Study Area Locality

The IBRA provides a national framework within which assessment of the condition of native ecosystems and their level of protection in the National Reserve System (NRS) can be undertaken. The NRS is Australia's network of protected areas, including national parks and other Government reserves, indigenous lands, and reserves run by not-for-profit conservation organisations. At the time of the regional biodiversity audit conducted by the then Department of Conservation and Land Management, the Pilbara bioregion was considered to be under-represented by the NRS, with less than 10% of the bioregion protected (Kendrick 2003). Of the four subregions within the Pilbara bioregion, the Hamersley subregion had the highest percentage of area under some form of protection.

Karijini National Park is the closest conservation reserve to the study area, with its nearest boundary approximately 38 km to the west of the study area (Figure 2.1).

3.3 Surface Geology

The study area encompasses four major geological units as mapped by the Geological Survey of Western Australia (2002) (Table 3.1, Figure 3.1). The southern half of the study area is comprised mostly of Qa "Alluvium – unconsolidated silt, sand and gravel" and Czc "Colluvium – partly consolidated quartz and rock fragments in silt and sand matrix" (Figure 3.1). The northern half of the study area is comprised mostly of the Hm "Chert and banded-iron formation with minor shale" unit.

Table 3.1: Geological units of the study area (Geological Survey of Western Australia 1990, 2001).

Unit Code	Geological Description	Area (ha)	Proportion of Study Area
Qa	Alluvium: unconsolidated silt, sand, and gravel; in drainage channels and on adjacent floodplains.	698	42.3 %
Czc	Colluvium: partly consolidated quartz and rock fragments in silt and sand matrix; old valley-fill deposits.	486	29.4 %
Hm	Chert, ferruginous chert and banded iron-formation with minor shale.	403	24.4 %
Qw	Alluvium and colluvium: red-brown sandy and clayey soil; on low slopes and sheetwash areas.	65	3.9 %
	Total:	1,652	

[1] Updated from DSEWPaC (2014) based on latest spreadsheet at http://www.environment.gov.au/land/nrs/science/capad.

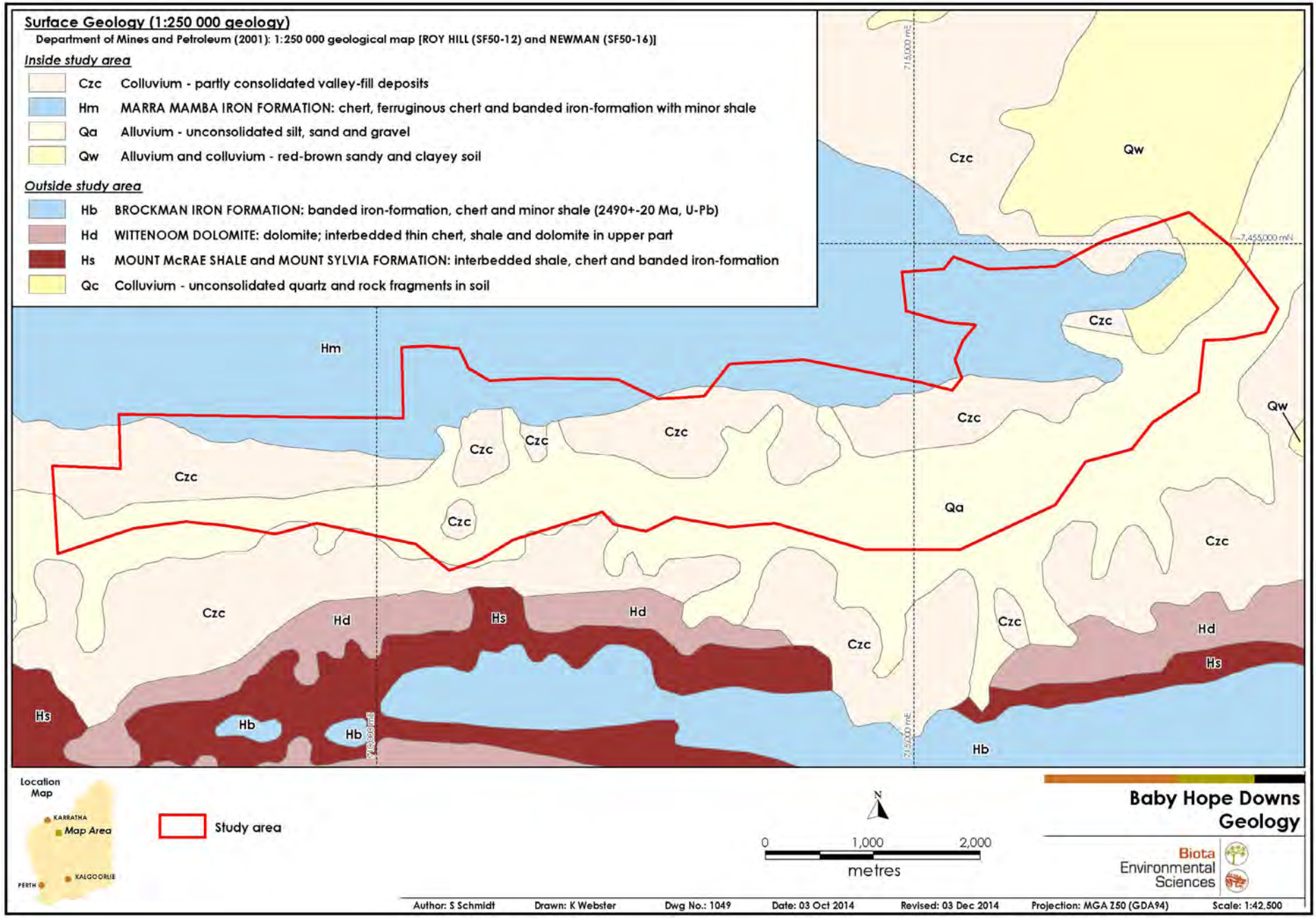

Figure 3.1: Geological units of the study area (see Table 3.1 for detailed descriptions).

3.4 Land Systems

Land systems are repeating patterns in the landscape, grouped by topography, soils and vegetation. Land systems mapping covering the study area has been prepared by Agriculture Western Australia (van Vreeswyk et al. 2004). A total of 105 land systems have been identified and mapped in the Pilbara bioregion, three of which are represented in the study area: Newman, Platform and Pindering. None of these land systems are restricted to the study area.

The northern half of the study area intersects the Newman land system, the southern half intersects the Platform land system, and a small area in the eastern part of the study area intersects the Pindering land system (Figure 3.4). Descriptions of the land systems in the study area are provide in Table 3.2, which broadly characterise the habitats of the study area.

Table 3.2: Land systems of the study area (after Van Vreeswyk et al. (2004)).

Land System	Platform	Newman	Pindering
Description	Dissected slopes and raised plains supporting hard spinifex grasslands.	Rugged jaspilite plateaus, ridges and mountains supporting hard spinifex grasslands	Gravelly hardpan plains supporting groved mulga shrublands with hard and soft spinifex.
Extent within Study Area	985 ha	508 ha	159 ha
Proportion of Study Area	59.6 %	30.8 %	9.6 %
Extent within the Subregion (Hamersley)	217,710 ha	1,853,935 ha	26,318 ha
Proportion of Total Extent within Subregion Represented in the Study Area	0.5 %	<0.1	0.6 %

3.5 Landforms and Surface Hydrology

The study area is located in the Pilbara region, within a broad shallow valley between two low ranges of hills within the Hamersley Range. The ranges and valley are orientated in an east-west direction. The study area encompasses the pediment slope, foothills and southern scarp of the range to the north and the alluvial plain of the valley floor (Figure 3.2). The hills in the north of the study area are round topped, moderately sloping and dissected by numerous shallow gorges formed by minor drainage lines. The maximum relief within the study area is approximately 80 m. The foothills are low, gently sloping and dissected by minor valleys formed by the same minor drainage lines that formed the gorges upslope. The valley is slightly sloped towards the east.

There is a major drainage line (Pebble Mouse Creek) flowing west to east through the valley as a meandering, single channel. The major drainage line floods the alluvial plain during overbank flow events after significant rainfall. Drainage from the northern ranges is composed of numerous minor drainage lines that flow off the southern scarp and coalesce at the junction of the foothills and the pediment slope, before flowing into Pebble Mouse Creek. Figure 3.2 and Figure 3.3 illustrate these landform features.

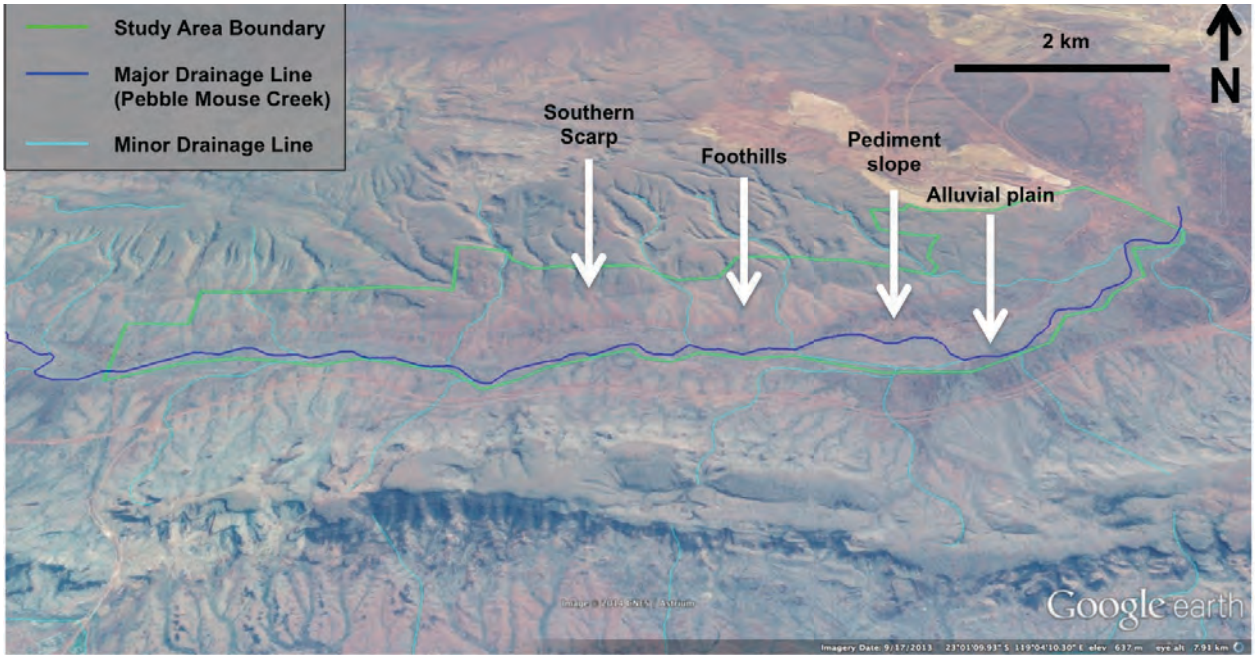

Figure 3.2; Oblique aerial image of the study area with major landforms indicated (image source GoogleEarth 2014).

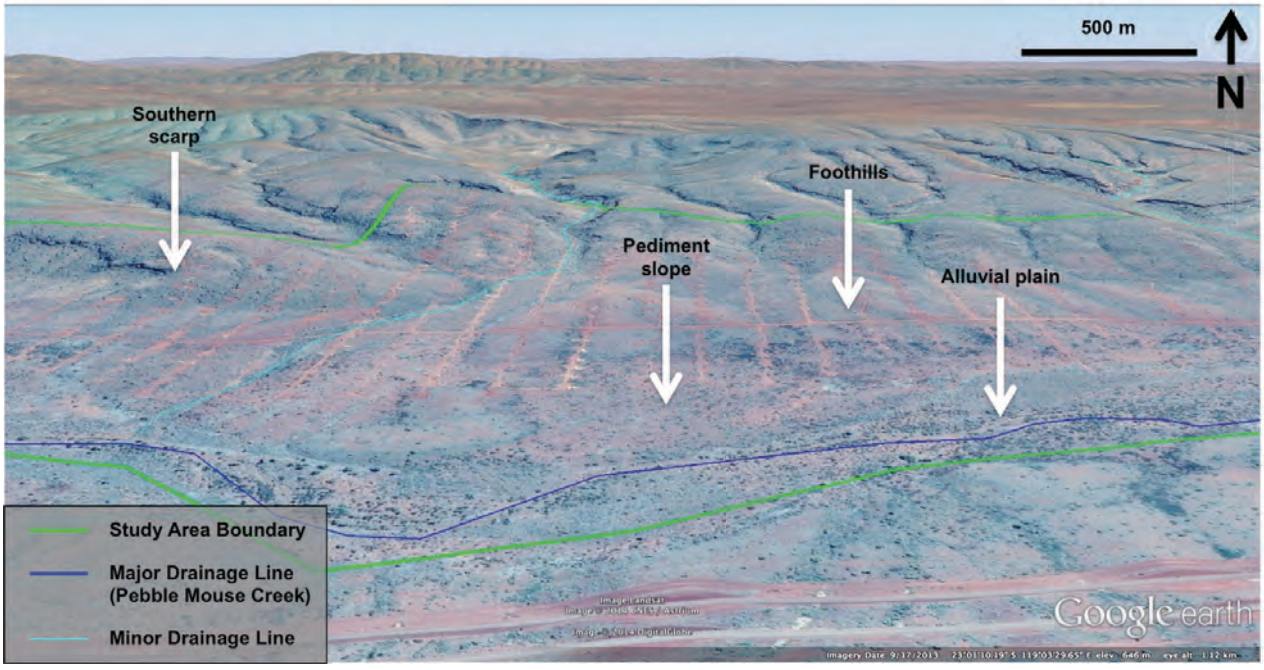

Figure 3.3; Oblique aerial image of part of the study area with major landforms indicated (image source GoogleEarth 2014).

3.6 Beard's Vegetation Mapping

Beard (1975a, 1975b) described and mapped the vegetation of the Pilbara at a scale of 1:1,000,000. The study area is located on the Hamersley Plateau, which is within the Fortescue Botanical District of the Eremaean Botanical Province as defined by Beard. The vegetation of this province is typically open, and frequently dominated by spinifex, wattles and occasional eucalypts.

Two vegetation units mapped by Beard (1975b) occur within the study area (Figure 3.4):

- Hamersley 82: Hummock grasslands, low tree steppe; Snappy Gum (*Eucalyptus* leucophloia) over Limestone Spinifex (*Triodia wiseana*).
- Hamersley 18: Low woodland; mulga (*Acacia aneura*) (Biota 2014b).

Given the broad scale of Beard's vegetation mapping, these two units provide only limited information about the vegetation occurring in the study area.

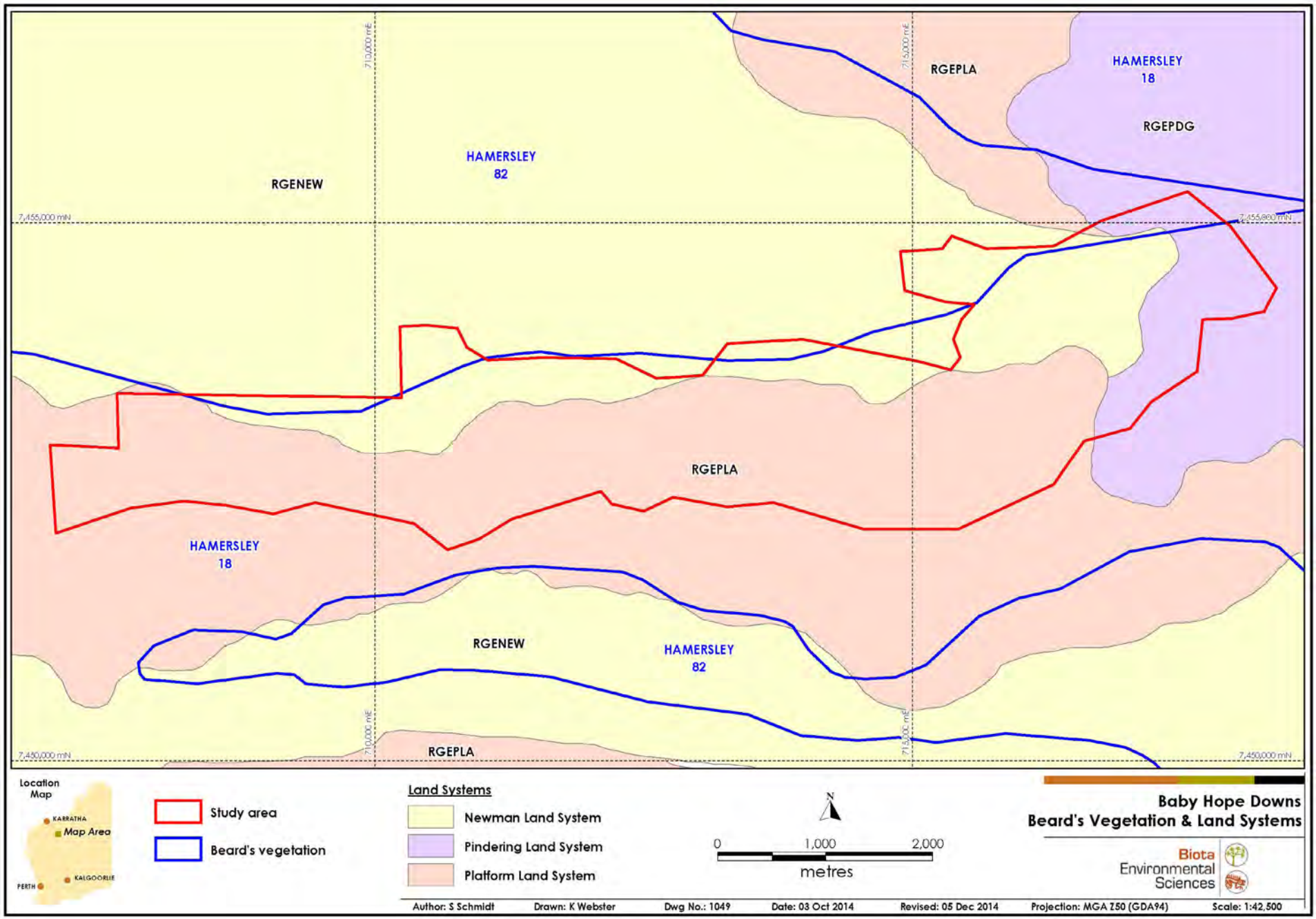

Figure 3.4: Land systems and Beard's vegetation mapping of the study area.

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4.0 Methodology

4.1 Survey Timing and Weather

The targeted terrestrial fauna survey was undertaken from September 9 to 16, 2013 and the single phase of troglofauna sampling was completed between September 12 and October 28, 2013. Data from the nearest reliable Bureau of Meteorology (BoM) station at Newman Airport (station 7176) indicate that during the targeted terrestrial survey, the minimum temperature ranged from 7.0°C to 17.6°C, while the maximum temperature ranged from 24.3°C to 32.8°C. No rain fell during the survey (Table 4.1).

Table 4.1: Daily meteorological observations for Newman Airport during the targeted fauna survey, September 2013.

Month	September 2013								Mean (°C), Total (mm)
Day	9	10	11	12	13	14	15	16	
Minimum Temperature (°C)	13.0	17.6	14.3	14.3	10.3	15.4	9.3	7.0	12.6
Maximum Temperature (°C)	31.7	32.8	31.3	28.1	30.8	24.8	24.3	28.6	29.0
Rainfall (mm)	0	0	0	0	0	0	0	0	0

Weather data for Newman Airport indicate that the mean minimum and maximum temperatures for the six months leading up to the survey were close to the long term average (Figure 4.1). Rainfall for the six months leading up to the survey was mostly below the long-term average, with the exception of June 2013 which was a much wetter than long-term average for that month (Figure 4.1).

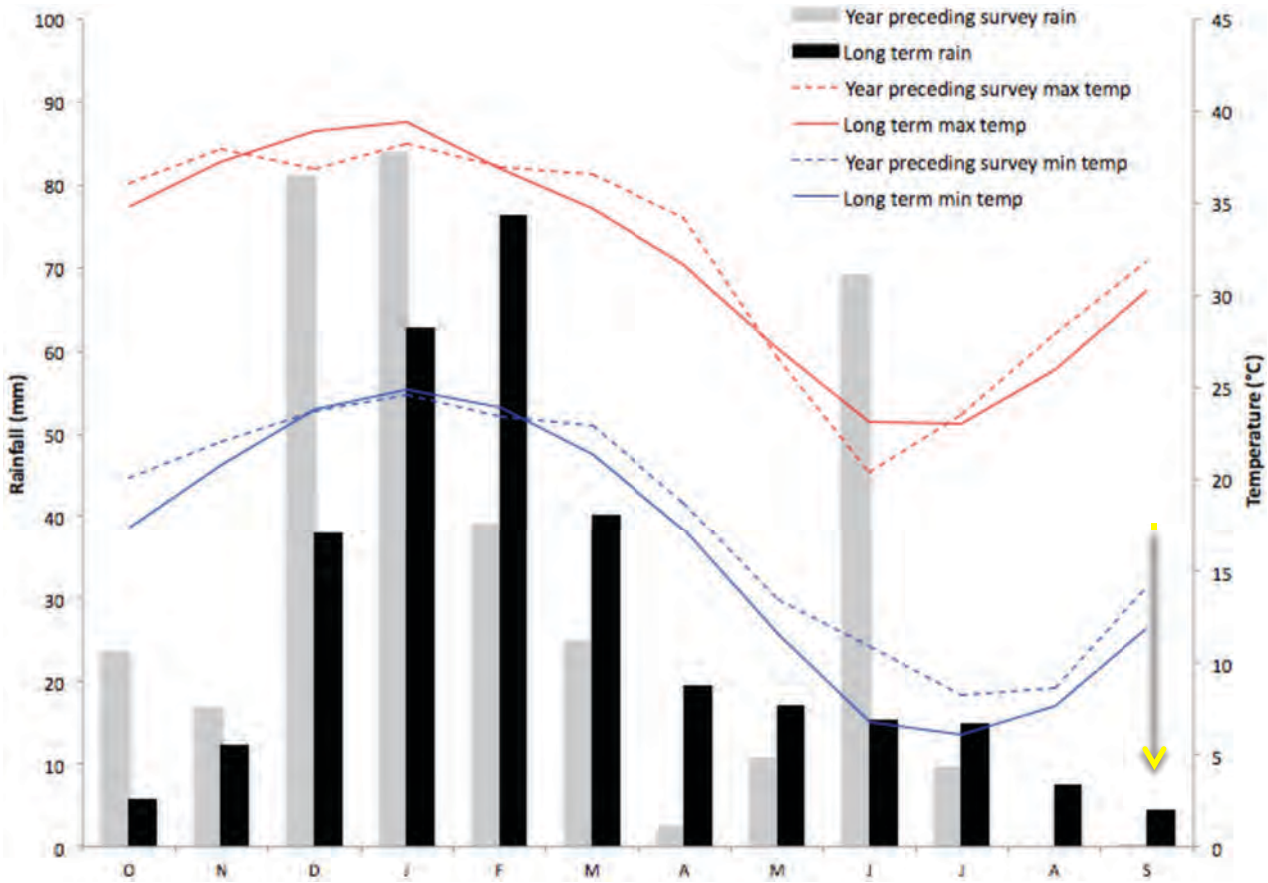

Figure 4.1: Weather preceding the survey in the context of climate data recorded at Newman Airport. Data supplied by BOM: long-term rainfall data (1971 – 2013); long-term temperature data 1996 – 2013); year preceding the survey (October 2012 – September 2013); arrow indicates survey timing.

4.2 Survey Team

The fauna survey was conducted under "Licence to Take Fauna for Scientific Purposes" No. SF009443 issued to Mr Garth Humphreys (Appendix 2). The targeted fauna survey team comprised Mr Garth Humphreys, Mr Dan Kamien, and Ms Jessica Cairnes (all of Biota). Troglofauna traps were retrieved by Jess Cairnes and Michael Delaney (also of Biota).

GIS mapping and figures was completed by Kylie Webster (Biota). Troglofauna specimen sorting and identification to order level was completed by Jess Cairnes, Penny Brooshooft, Jacinta King, Andrew Sheppard and Chris Cole (all of Biota). Morphological identification of SRE taxa was conducted by Dan Kamien and Dr Mieke Burger (Biota). Troglobitic and SRE specimens of interest were lodged with Dr Mark Harvey (WAM). Schizomids and mygalomorph spiders were identified to species level by Helix Molecular Solutions (Helix) based on variation at the COXI gene (Appendix 3 and 4). Photos of schizomids and mygalomorph spiders were taken by Dr Mieke Burger and analysis of motion camera footage was completed by Jessica Cairnes. Analysis of bat echolocation calls was completed by Mr Bob Bullen of Bat Call WA (Appendix 5).

4.3 Terrestrial Vertebrate Sampling

The survey consisted of a combination of systematic fauna sampling and targeted searches. Systematic vertebrate sampling was centred on four gorges identified as the most prospective habitat for the target species within the study area. All four sites were located in the northern part of the study area (Newman Land System).

4.3.1 Northern Quoll Sampling

Each of the four systematic trapping sites consisted of a line of four cage traps (60 cm x 20 cm x 20 cm), 15 large Elliott traps, and 21 medium Elliott traps installed along the length of a gorge. The use of varying trap types and sizes, specifically the use of for cages per site, is compliant with the referral guidelines for Northern Quoll (DSEWPaC 2011). Due to the presence of two discrete gorges, site HDT04E was split into two sub-sites. Traps were deployed for a total of 960 trap nights (Table 4.2, Figure 4.2). Traps were spaced approximately 20 m apart and were located in specifically targeted microhabitats with potential to support Northern Quoll (*Dasyurus hallucatus*). Traps were baited with a mixture of oats, peanut butter and bacon.

Table 4.2: Trapping site locations and effort (coordinates in zone 50, GDA94).

Site	Location	Date		Number of Traps			Number of Nights	Trap Nights
		Traps opened	Traps closed	Medium Elliott	Large Elliott	Cage		
HDT01E	710738mE 7453575mN	10/09/2013	16/09/2013	21	15	4	6	240
HDT02E	711552mE 7453400mN	10/09/2013	16/09/2013	21	15	4	6	240
HDT03E	712751mE 7453540mN	10/09/2013	16/09/2013	21	15	4	6	240
HDT04aE	713868mE 7453743mN	10/09/2013	16/09/2013	21	0	4	6	150
HDT04bE	713677mE 7453680mN	10/09/2013	16/09/2013	0	15	0	6	90
				Total medium Elliott trapping effort				504
				Total large Elliott trapping effort				360
				Total cage trapping effort				96
				Total trapping effort				960

A remote infrared motion sensitive camera (Bushnell) was deployed adjacent to each of the Elliott/cage trapping sites (one per site, making a total of four) (Table 4.3, Figure 4.2). Cameras were placed in rocky overhangs between boulders through which Northern Quolls might be expected to travel (Plate 4.1 to Plate 4.4). A bolus of bait was placed on the ground in front of the camera to attract animals to the desired area in view of the camera. Motion cameras were deployed for a total of 16 trap nights (Table 4.3). Cameras were set to record 30 second videos.

Table 4.3: Remote camera locations and sampling effort (coordinates in zone 50, GDA94).

Site	Location	Habitat	Date Set	Date Recovered	Sampling Effort (Nights)
HDTcamera01	710735mE 7453705mN	Rocky overhang in narrow rocky gorge with breakaways	11/09/2013	15/09/2013	4
HDTcamera02	711528mE 7453554mN	Creekline in narrow rocky gorge with breakaways	11/09/2013	15/09/2013	4
HDTcamera03	712668mE 7453610mN	Rocky overhang in broad rocky gorge with breakaways	11/09/2013	15/09/2013	4
HDTcamera04	713557mE 7453798mN	Rocky overhang in broad rocky gorge with breakaways	11/09/2013	15/09/2013	4
				Total Trap Nights	16

Plate 4.1: Site HDTcamera01.

Plate 4.2: Site HDTcamera02.

Plate 4.3: Site HDTcamera03.

Plate 4.4: Site HDTcamera04.

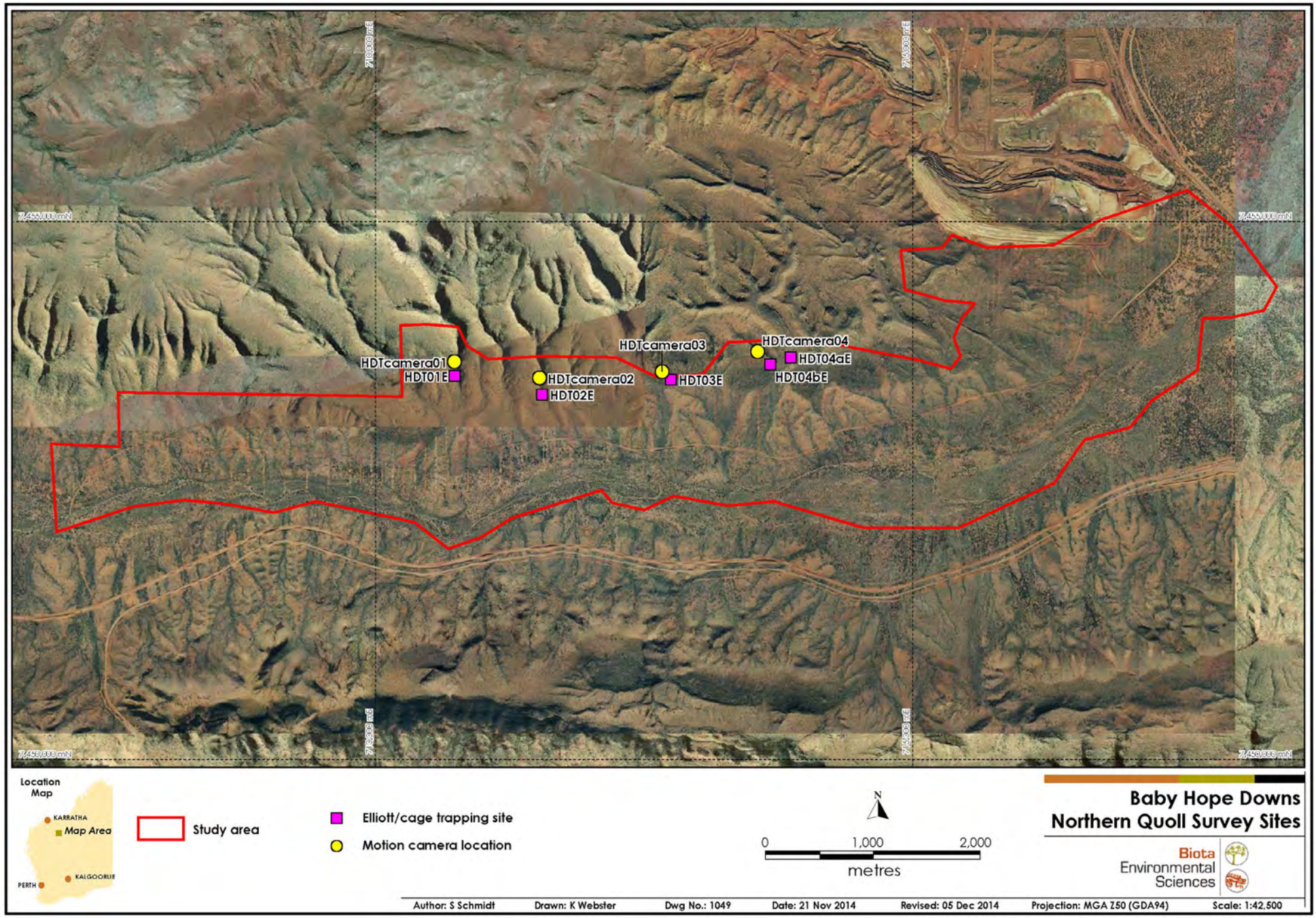

Figure 4.2: Northern Quoll trapping lines and remote camera sites.

4.3.2 Bat Sampling

Bat sampling was undertaken at four locations in proximity to each of the Elliott/cage trapping sites (Figure 4.2) using SM2BAT SongMeters, which detect and record ultrasonic echolocation calls emitted during bat flight (Wildlife Acoustics 2010).

SM2BAT SongMeters were deployed for a total of seven trap nights (Table 4.4) and were placed in locations considered likely to be used by bats, including at cave or rock shelter entrances, or in potential flyways and foraging areas in gorges (Plate 4.5 to Plate 4.8) Echolocation recording was targeted primarily at detecting the presence of the OLNB (Section 2.2). The selectable filters and triggers, jumper and audio settings used for the SM2BAT followed the manufacturer's recommendations for bat detection contained in the user manual (Wildlife Acoustics 2010).

Details of calls were analysed using methods recommended by the Australasian Bat Society (Australasian Bat Society 2006) in conjunction with available reference data (Bullen and McKenzie 2002, McKenzie and Bullen 2003, 2009). Only sequences containing good quality search phase calls were considered for identification.

Table 4.4: Bat sampling locations and effort (coordinates in zone 50, GDA94).

Site	Location	Habitat	Date		Sampling Effort (Nights)
			SM2 set	Recovered	
HDTbat01	710795mE 7453757mN	Mid-slope slope in narrow rocky gorge with breakaways	15/09/2013	16/09/2013	1
HDTbat02	711528mE 7453502mN	Mid-slope in narrow rocky gorge with breakaways	13/09/2013	15/09/2013	2
HDTbat03	712660mE 7453622mN	Mid-slope in broad rocky gorge with breakaways	11/09/2013	13/09/2013	2
HDTbat04	713865mE 7453741mE	Lower slope in broad rocky gorge with breakaways	09/09/2013	11/09/2013	2
				Total Trap Nights	7

Plate 4.5: Site HDTbat01.

Plate 4.6: Site HDTbat02.

Plate 4.7: Site HDTbat03.

Plate 4.8: SiteHDTbat04.

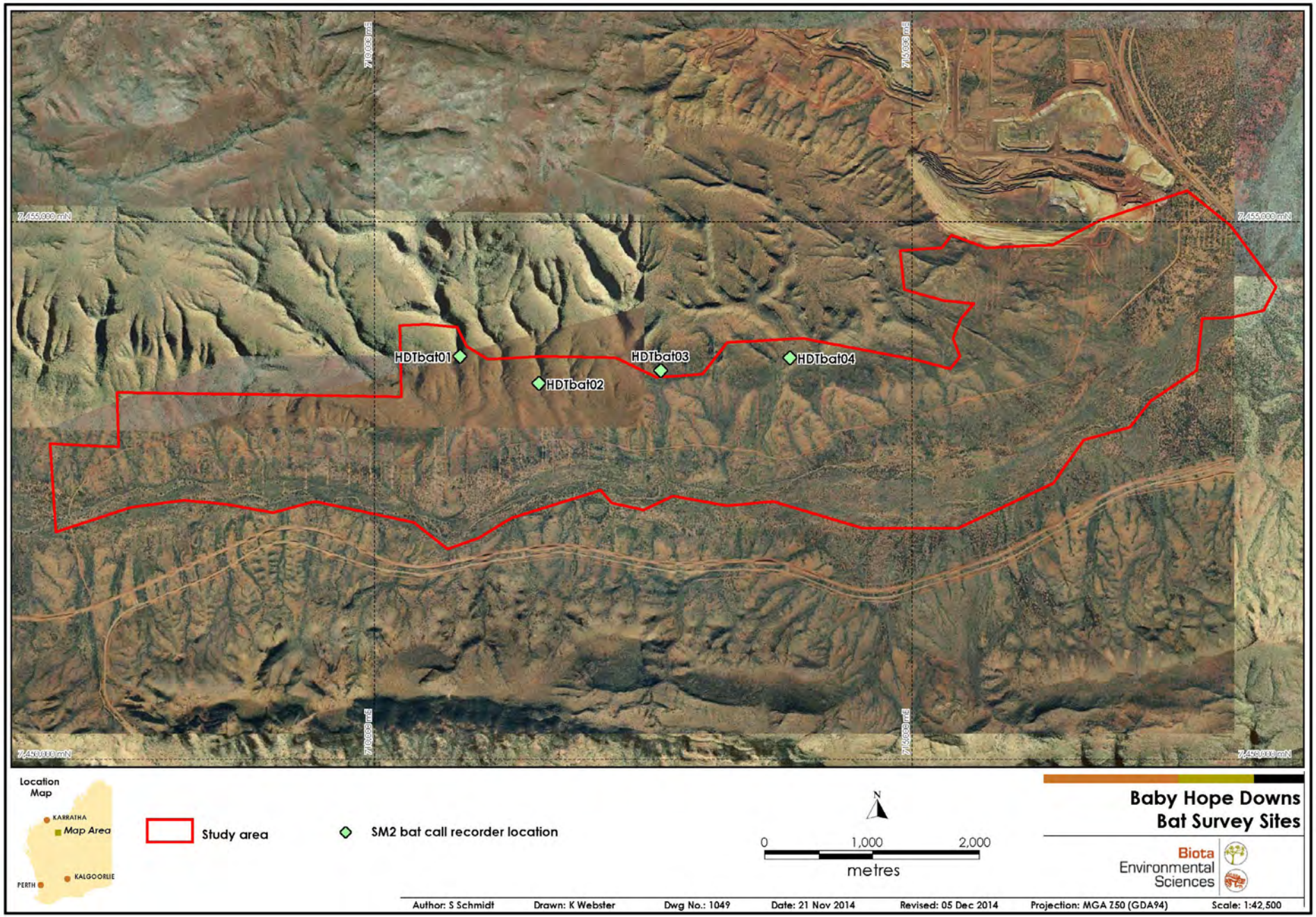

Figure 4.3: Bat sampling locations.

4.3.3 Searches for Pilbara Olive Python and Non-systematic Observations

In addition to targeted systematic trapping records, non-systematic observations of vertebrate fauna were compiled. This included observations relevant to the assessment of likelihood of occurrence of the target species made while moving through the study area and while sampling at SRE search sites (Section 4.4), including records of non-target conservation significant species as well as observations by Biota biologists made during a subsequent flora survey (Biota 2014b). Searching for evidence of the Pilbara Olive Python was a primary focus, looking for ephemeral or semi-permanent pools, but searches also targeted trace records of animals such as tracks, scats, burrows, and skin sloughs.

4.4 Potential SRE Sampling and Specimen Management

Specific invertebrate groups targeted during this survey included:

- pseudoscorpions;
- millipedes;
- terrestrial snails;
- mygalomorph spiders; and
- scorpions.

Pseudoscorpions were searched for under peeling bark of trees, shrubs and searching beneath rocks. Millipedes were searched for under leaf litter and logs. Aestivating land snails were targeted by searching for shells of dead snails to identify potential areas for targeted digging under spinifex hummocks, at the base of mulga trees and in drainage gullies.

Mygalomorph spiders and scorpions were targeted by visually locating and excavating burrows with the aim of collecting and preserving individuals in 70% ethanol for morphological description. Two legs of each individual caught were removed and placed in 100% ethanol to provide for molecular analysis by Helix.

In total, more than 24 person hours were dedicated to SRE fauna searches (Table 4.5). Mulga Plains were identified as the most prospective landform within the study area and individual search sites were chosen based on where SRE species most frequently occur (for example larger *Triodia* hummocks, mulga habitat with suitable soil profile, e.g. clay loam, rock piles and drainages). A total of ten SRE sites were sampled, including five sites that are located outside of the revised potential disturbance area (study area) to act as contextual sites (Table 4.5, Figure 4.4).

Table 4.5: SRE site location and search effort (coordinates in zone 50, GDA94).

Site	Location	Land System	Landform	Soil Type	Date	Effort (person hours)
Inside Study Area						
HDTSRE01	710028mE 7452683mN	Platform	Mulga Plain	Clay loam	12/09/2013	2.0
HDTSRE02	711217mE 7452780mN	Platform	Mulga Plain	Clay loam	12/09/2013	2.5
HDTSRE03	714413mE 7453032mN	Platform	Mulga Plain	Clay loam	13/09/2013	2.8
HDTSRE05	711529mE 7453500mN	Newman	Gorge drainage	None	13/09/2013	3.0
HDTSRE08	716529mE 7453484mN	Platform	Mulga Plain	Clay loam	15/09/2013	2.0
Outside Study Area						
HDTSRE04	715021mE 7451757mN	Platform	Mulga Plain	Clay loam	13/09/2013	3.3
HDTSRE06	716724mE 7452508mN	Platform	Mulga Plain	Clay loam	14/09/2013	3.4
HDTSRE07	717086mE 7452754mN	Pindering	Mulga Plain	Clay loam	14/09/2013	1.6
HDTSRE09	717638mE 7452826mN	Pindering	Mulga Plain	Clay loam	15/09/2013	1.5
HDTSRE10	0718574mE 7453190mN	Pindering	Mulga Plain	Clay loam	15/09/2013	2.0
					Total effort	24.1

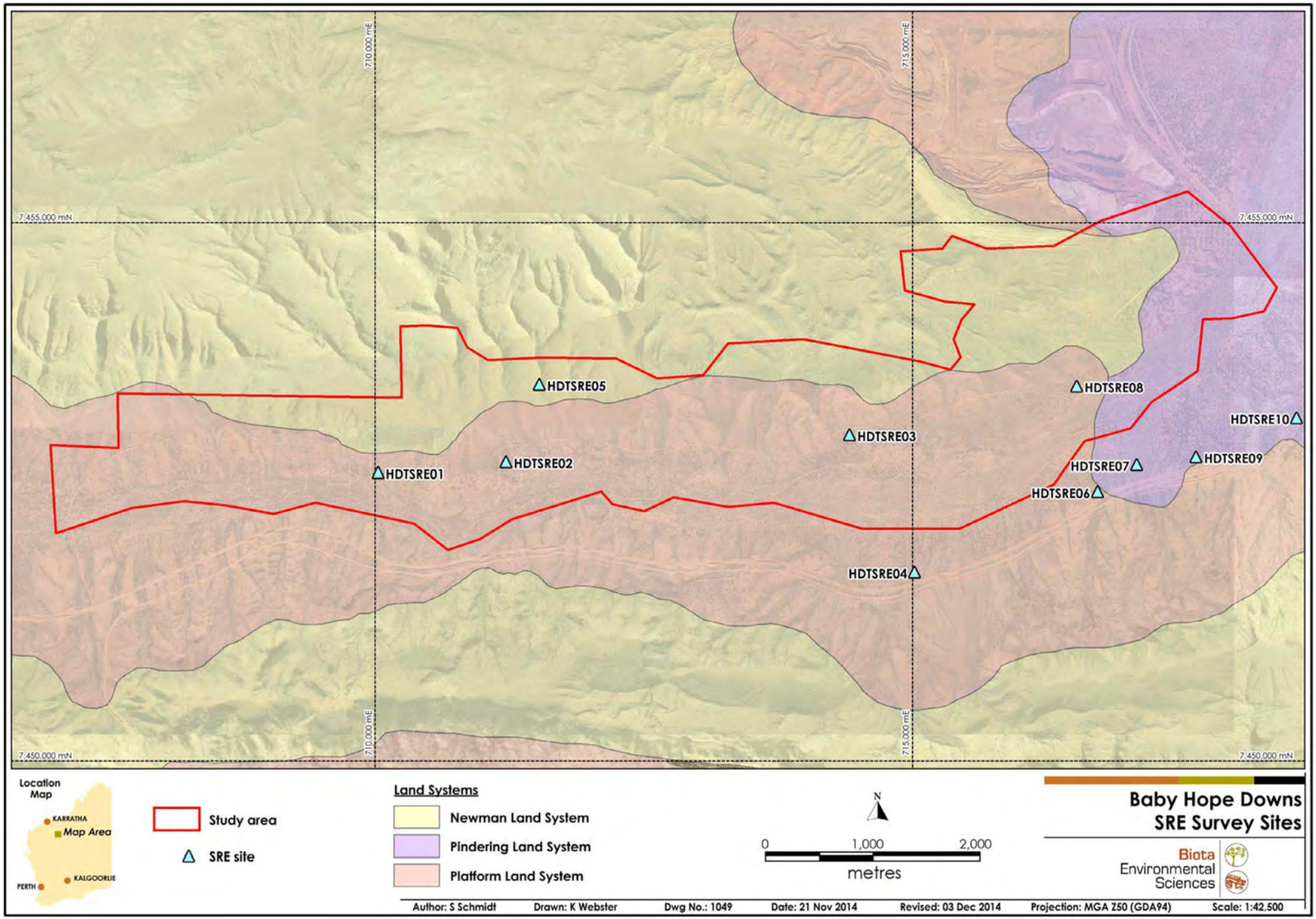

Figure 4.4: SRE sampling sites inside the study area and contextual sites outside the study area.

4.5 Phase 1 Troglofauna Sampling and Specimen Management

The first phase of troglofauna sampling for the study area was completed in accordance with the methodology and approach outlined in EPA Guidance Statement No. 54 (EPA 2003) and EPA Guidance Statement No. 54a (EPA 2007).

Troglofauna were sampled using custom-built leaf litter colonisation traps suspended within drillholes located within the study area. For each drillhole two to four traps were suspended at intervals to allow coverage of fracture zones and cavities. Traps were constructed from 60 mm internal diameter PVC irrigation pipe cut to a length of 180 mm. Each trap had a series of 20 mm holes drilled into the side, and traps remained open at the upper end. Traps were installed such that they were in contact with the interior of the sampled drillhole, facilitating fauna entry into the trap.

Leaf litter was gathered locally from the ground surface in the project area, particularly from the base of *Acacia* shrubs. The collected litter was soaked in water and irradiated in a microwave oven for two minutes on maximum power setting. This killed any surface invertebrates present and assisted in the breaking down of organic matter. Wet leaf litter was added to the traps, which were then kept in sealed containers until immediately prior to insertion into the drillholes to avoid desiccation.

After trap installation, the opening of each drillhole was sealed to maintain humidity and to avoid entry of surface fauna. After six weeks, traps were recovered and stored in zip lock bags, which aid in maintaining humidity to prevent desiccation of potential troglofauna specimens during transportation to Perth for identification. Twenty-five drillholes, all located inside the study area, were successfully sampled during the survey (Figure 4.5). A total of 85 traps were installed, but only 73 of those could be retrieved due to some drillholes being blocked or rehabilitated between trap installation and retrieval (Table 4.6).

Fauna specimens were recovered from the traps using specially designed Tullgren funnel units. Leaf litter from each trap was placed in a sieve under an aluminium lamp containing a 25-watt globe. This created a temperature of approximately 30°C at the surface of the leaf litter. A funnel situated below the sieve collected the fauna as they fell, directing them into an attached vial of 100% ethanol. Preservation in 100% ethanol allows for both morphological and molecular analysis. Leaf litter was left in the Tullgren funnels for a period of 24 hours, after which time the leaf litter was dry and all invertebrates were separated from the leaf litter and collected as a bulk sample (one specimen vial per trap).

Fauna specimens were identified by Biota to order level using dissecting microscopes (Olympus SZ40 and SZ61, magnification up to 40x) and assigned a unique number based on drillhole name and collection date. Specimens of confirmed troglobites were sent to Helix for molecular analysis to species level, along with available reference specimens collected from the locality during previous surveys.

4.6 Troglofauna Habitat Assessment

Rio Tinto geologists supplied detailed (1:4,000 scale) surface geology mapping and associated data on the spatial extent of geological units with physical characteristics suitable to provide habitat for troglobites in the study area. This was combined with reviews of previous geological and geotechnical assessments, selected drill logs and images obtained from optical televiewer (OTV) to confirm the nature and local extent of this troglofauna habitat.

The distribution of all records of troglomorphic animals from the Phase 1 sampling were then plotted in MapInfo Professional Geographical Information System (GIS) v12 (MapInfo). The records were overlain on the potential subterranean habitat units to examine local spatial relationships between fauna occurrence and putative subterranean habitat within the study area and immediate Hope Downs locality (the extent of the detailed Rio Tinto geological mapping).

Both fauna records and local mapping of potential troglofauna habitat were then intersected with 1:250,000 regional geology units (Geological Survey of Western Australia 2001). This correlation of the available fauna records and local-scale mapping with the regional geology units provided a means of extending the mapping of troglobitic fauna habitat beyond the boundaries of the Rio Tinto geology mapping.

Lastly, MapInfo was again used to construct a digital elevation model (DEM) using contour data supplied by Rio Tinto. This was then digitally combined with aerial photography to generate isometric views of the landforms present in the study area and the wider locality. The regional geology units representing subterranean habitats in the locality were applied to this model to visualise the predicted wider distribution of troglofauna habitat on the basis of the combined spatial analysis.

As the true distribution of subterranean taxa cannot be determined from limited collection records, this approach attempted to combine multiple data sets to further inform the risk of short-range species restriction to the study area. This multi-faceted approach is consistent with the current guidance provided by EPA (2013).

Table 4.6: Drillholes sampled for troglofauna inside the study area during Phase 1 (coordinates in zone 50, GDA94).

Drillhole ID	Location		Date		Number of Traps		Depths (m)		Geology (see Figure 4.5)
	Easting (mE)	Northing (mN)	Installed	Retrieved	Installed	Retrieved	Traps	Drillhole	
RC12H1SW0178	714167	7453293	11/09/13	28/10/13	3	3	15, 30, 45	52	Qa – Alluvium
RC10H1SW013	713367	7453340	11/09/13	28/10/13	3	3	10, 20, 30	40	Czc – Colluvium
RC12H1SW0051	709962	7452939	11/09/13	28/10/13	3	3	15, 30, 45	54	Czc – Colluvium
RC12H1SW0074	710959	7453275	11/09/13	28/10/13	3	3	15, 30, 45	90	Czc – Colluvium
RC12H1SW0102	711167	7453366	11/09/13	28/10/13	3	3	15, 30, 45	58	Czc – Colluvium
RC12H1SW0124	713765	7453491	11/09/13	28/10/13	3	3	10, 20, 30	40	Czc – Colluvium
RC12H1SW0132	711562	7453296	11/09/13	28/10/13	3	3	15, 30, 45	72	Czc – Colluvium
RC12H1SW0134	711762	7453286	11/09/13	N/A[2]	3	0	15, 30, 45	90	Czc – Colluvium
RC12H1SW0144	712958	7453339	11/09/13	28/10/13	3	3	10, 20, 30	42	Czc – Colluvium
RC11H1SW0022	708959	7452990	11/09/13	28/10/13	3	3	15, 30, 50	64	Czc – Colluvium
RC11H1SW0030	710171	7452995	11/09/13	N/A[2]	3	0	15, 30, 45	58	Czc – Colluvium
RC10H1SW017	712569	7453347	11/09/13	28/10/13	3	3	10, 20, 30	40	Czc – Colluvium
RC10H1SW043	709766	7452983	11/09/13	28/10/13	3	3	15, 30, 45	52	Czc – Colluvium
RC12H1SW0008	709162	7453102	11/09/13	28/10/13	3	3	10, 20, 30	40	Czc – Colluvium
RC12H1SW0009	709572	7453165	11/09/13	28/10/13	3	3	10, 20, 30	34	Hm – MM Iron Formation
RC12H1SW0019	710157	7453240	11/09/13	28/10/13	3	3	15, 30, 45	46	Hm – MM Iron Formation
RC12H1SW0026	708360	7453289	11/09/13	28/10/13	3	3	10, 20, 30	34	Hm – MM Iron Formation
RC12H1SW0064	710761	7453339	11/09/13	28/10/13	3	3	10, 20, 30	40	Hm – MM Iron Formation
RC12H1SW0076	710357	7453040	11/09/13	28/10/13	3	3	15, 30, 45	52	Hm – MM Iron Formation
RC12H1SW0080	710346	7453485	11/09/13	N/A[1]	3	0	15, 30, 45	52	Hm – MM Iron Formation
RC12H1SW0082	710362	7453390	11/09/13	28/10/13	3	3	15, 30, 45	76	Hm – MM Iron Formation
RC12H1SW0085	710553	7453846	11/09/13	28/10/13	3	3	10, 20, 30	34	Hm – MM Iron Formation
RC12H1SW0091	710567	7453136	11/09/13	N/A[2]	3	0	15, 30, 45	166	Hm – MM Iron Formation
RC13HD10106	710266	7453895	11/09/13	28/10/13	3	3	10, 20, 30	40	Hm – MM Iron Formation
RC12H1SW0042	708663	7453287	11/09/13	28/10/13	2	2	5, 15	16	Hm – MM Iron Formation
RC12H1SW0128	711345	7453585	11/09/13	28/10/13	2	2	10, 20	24	Hm – MM Iron Formation
RC12H1SW0137	712155	7453550	11/09/13	28/10/13	2	2	10, 20	24	Hm – MM Iron Formation
RC13HD10124	710476	7453533	11/09/13	28/10/13	4	4	5, 20, 35, 50	64	Hm – MM Iron Formation
RC12H1SW0014	709958	7453291	11/09/13	28/10/13	3	3	10, 20, 30	28	Hm – MM Iron Formation
				Total	85	73			

[1] blocked;

[2] rehabilitated.

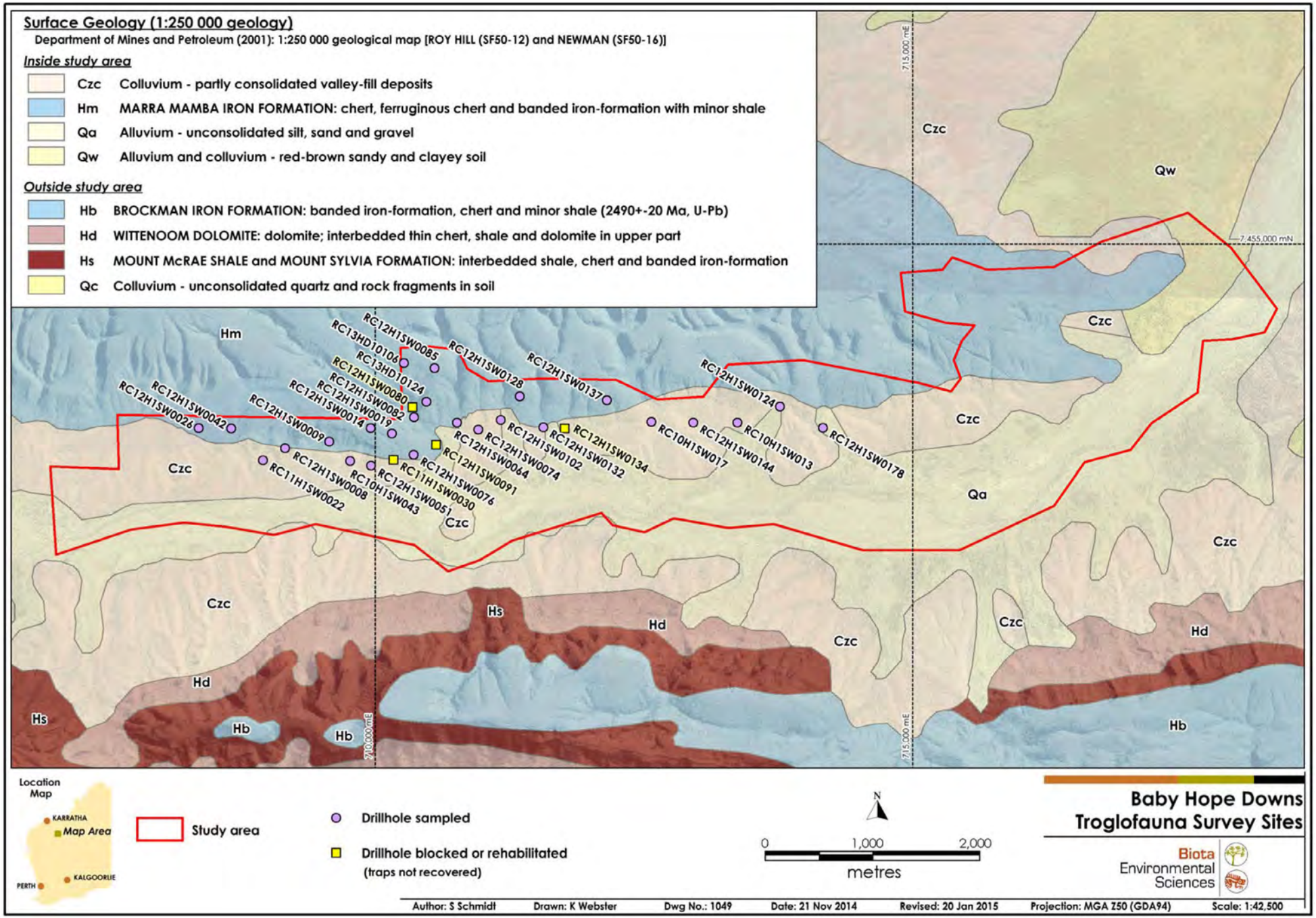

Figure 4.5: Location of drillholes sampled for troglofauna during Phase 1.

4.7 Desktop Review and Database Searches

A review of previous biological studies and other relevant literature was conducted to place the survey results for the target taxa into context. The desktop review revealed that a considerable number of terrestrial vertebrate and SRE fauna surveys (as well as one troglobitic fauna survey) have previously been conducted in the locality of the study area (within 40 km), with a tabulation of the 38 studies provided in Table 8.1 (Appendix 6).

The following databases were searched to provide further context for the survey results and to inform the assessment of likelihood of occurrence and potential impacts of conservation significant fauna and habitats of the study area:

- NatureMap Database (http://NatureMap.dpaw.wa.gov.au): a joint project of the Department of Parks and Wildlife and the Western Australian Museum (WAM). This database returns survey or specimen voucher records and represents the most comprehensive source of information on the distribution of Western Australia's flora and fauna, comprising records from the Fauna Survey Returns Database and Western Australian Threatened Fauna Database, the WAM Specimen Database, and the BirdLife Australia Atlas. The database search (Appendix 7) was conducted on 1st December 2014 and requested the return of records from a radius of 40 km from a central point within the study area, 23°01'04" S, 119°04'12" E;
- The Atlas of Living Australia (http://www.ala.org.au/): a joint project between academic collecting institutions, private individual collectors and community groups. Like NatureMap, the atlas is a record-based database, containing occurrence records, and also environmental data, images and the conservation status of species throughout Australia. The database search was conducted on 1st December 2014 and requested the return of records from a radius of 10 km from a central point within the study area, 23°01'04" S, 119°04'12" E.
- The Commonwealth *EPBC Act 1999* Protected Matters Database: This database does not only return species with records in the search area but also those for which potential habitat is present. The database search was conducted on 1st December 2014 and requested the return of records from a radius of 40 km from a central point within the study area, 23°01'04" S, 119°04'12" E (Appendix 8);
- Biota internal database of completed studies.

4.8 Study Limitations

As this study was a targeted single-phase survey only, the following limitations applied:

- It is likely that an additional phase in different seasonal timing (ideally early dry season) would augment the number of species recorded from the study area;
- Not all sections of the study area were equally ground-truthed or sampled for fauna, and parts of the study area were inaccessible by vehicle. Fauna searches and sampling were therefore conducted in habitats readily accessible for routine access and considered most likely to support targeted taxa; and
- Terrestrial invertebrate sampling was targeted at a small number of specific groups that are currently known to, or potentially, contain SRE taxa.

In addition, this survey was subject to the following limitations:

- The current taxonomic framework and ecological knowledge is limited for the majority of terrestrial SRE and troglobitic invertebrates (EPA 2009); and
- Mapping of hydrated geological units was not available at the time of this study. Subterranean habitat was therefore primarily examined by reference to surface geology mapping data, which may not always reflect underlying formations. The use of preliminary cross-sections and selected drill log data assisted with offsetting this limitation.

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5.0 Results

5.1 Landforms and Fauna Habitats

The study area comprised two well-defined fauna landscapes, each containing specific landforms (Table 5.1).

Table 5.1: Fauna landscapes and landforms of the study area.

Landscape	Landform
LANDSCAPE 1: mountainous rugged terrain comprising ridges, plateaus, steep hills with free faces.	Narrow gorge, Broad gorge
LANDSCAPE 2: contemporary drainage systems and flood plains of alluvial deposits with gently inclined slopes to flat land, below steep hills.	Mulga plain, Gorge drainage

Within each functional landform system, fauna habitats were identified on the basis of morphology, geology, vegetation that together form an ecological niche that may be inhabited by fauna assemblages or specific species.

Twelve vegetation units were described for the study area by Biota (2014b). In addition, a total of 163 ha (~10%) of the study area had been cleared and was mapped as 'Disturbance' where existing habitat has been removed. These vegetation units are described in detail in (Biota 2014b) and the intact vegetation units were associated with four broad landform categories in :

- stony hills and foothills;
- stony plains;
- drainage lines and floodplains; and
- rocky gorges and gullies.

5.2 Site Descriptions

All Elliott/cage trapping sites were sited in gorge habitats within Landscape 1 (Table 5.1) of the Newman land system (Figure 4.2). Nine of the ten SRE searches were conducted on Mulga Plains within the Platform Land System (Landscape 2; Table 5.1), with HDTSRE05 in a gorge drainage within the Newman Land System; Figure 4.4). All other habitat units present were assessed as lower prospectivity for SRE fauna. Each vertebrate trapping and SRE site is described in more detail in Table 5.2 and Table 5.3:

Table 5.2: Description of targeted vertebrate fauna search sites.

Site	Description	Photo
HDT01E	<u>Landform:</u> Narrow gorge <u>Vegetation:</u> *Eucalyptus leucophloia* scattered low trees over *Acacia* spp. open shrubland over *Triodia* sp. open hummock grassland.	

Site	Description	Photo
HDT02E	Landform: Narrow gorge Vegetation: *Eucalyptus leucophloia* scattered low trees over *Acacia* spp. scattered shrubs over *Triodia* sp. hummock grassland.	
HDT03E	Landform: Broad gorge Vegetation: *Eucalyptus leucophloia* and *Corymbia hamersleyana* scattered low trees over *Acacia* spp. scattered shrubs over *Triodia* sp. hummock grassland and *Themeda* spp. tussock grassland.	
HDT04aE	Landform: Broad gorge Vegetation: *Acacia aneura* and *Eucalyptus leucophloia* scattered low trees over *Acacia* spp. scattered shrubs over *Triodia* sp. hummock grassland and *Themeda* spp. tussock grassland.	
HDT04bE	Landform: Narrow gorge Vegetation: *Eucalyptus leucophloia* scattered low trees over *Acacia* spp. scattered shrubs over *Triodia* sp. hummock grassland and *Themeda* spp. tussock grassland.	

Table 5.3: Description of SRE search sites.

Site	Description	Photo
HDTSRE01	Vegetation: *Acacia aneura* low open woodland and *Eucalyptus* sp. scattered low trees, over *Acacia* spp. scattered low shrubs, over *Triodia* sp. hummock grassland. Soil: Sandy clay loam	
HDTSRE02	Vegetation: *Acacia aneura* low open woodland, over *Acacia xiphophylla* scattered tall shrubs, over *Acacia inaequilatera* scattered shrubs, over *Triodia* sp. hummock grassland. Soil: clay loam with degraded scald areas	
HDTSRE03	Vegetation: *Acacia aneura* low open woodland, over *Acacia* spp. scattered shrubs over *Triodia* sp. scattered hummock grasses and *Themeda* sp. scattered tussocks. Soil: clay loam with degraded scald areas	
HDTSRE04	Vegetation: *Acacia aneura* low open woodland, over *Acacia* sp. and *Eremophila* sp., scattered shrubs over *Triodia* spp. hummock grassland. Soil: sandy clay loam with degraded scald areas	

Site	Description	Photo
HDTSRE05	Vegetation: *Eucalyptus leucophloia* scattered low trees over *Acacia* spp. scattered shrubs over *Triodia* sp. hummock grassland. Soil: loam	
HDTSRE06	Vegetation: *Acacia aneura* low open woodland, over *Acacia* spp. scattered low shrubs, over *Triodia* sp. open hummock grassland. Soil: sandy clay loam with degraded scald areas	
HDTSRE07	Vegetation: *Acacia aneura* low open woodland, over *Acacia* sp. shrubs over *Triodia* sp. scattered hummock grasses. Soil: sandy clay loam with degraded scald areas	
HDTSRE08	Vegetation: *Acacia aneura* low open woodland over *Acacia* sp. open shrubland over *Triodia* sp. scattered hummock grasses. Soil: sandy clay loam with degraded scald areas	

Site	Description	Photo
HDTSRE09	Vegetation: *Acacia aneura* low open woodland, over *Acacia* sp. Scattered shrubs over *Triodia* sp. scattered hummock grasses. Soil: sandy clay loam with degraded scald areas	
HDTSRE10	Vegetation: *Acacia aneura* low open woodland, over *Acacia* sp. Scattered shrubs over *Triodia* sp. scattered hummock grasses. Soil: sandy clay loam with degraded scald areas	

5.3 Vertebrate Fauna

None of the three targeted conservation significant vertebrate fauna species were recorded during the field survey but a total of ten non-target mammal species were observed. This included two native rodent (Muridae), one kangaroo and one wallaby (Macropodidae), and six bat species (Emballonuridae and Vespertilionidae) (Table 5.4). Due to the targeted design of this survey these represent only a small proportion of the number of species potentially occurring within the study area.

Elliott/cage trapping and remote cameras: The only vertebrate species captured in Elliott and cage traps was the native rodent, *Zyzomys argurus*, the Common Rock-rat. This species was regularly caught at each of the trapping sites. In addition, *Zyzomys argurus* was recorded 27 times on the remote camera at site HDT01E (HDTcamera01, Plate 5.1), but the many consecutive triggers suggest they are all likely due to only one individual. Similarly, the same remote camera had 82 records of Rothschild's Rock Wallaby (*Petrogale rothschildi*), but many consecutive recordings appear likely to have been the same two animals each night (Plate 5.2). No other species were recorded by remote camera.

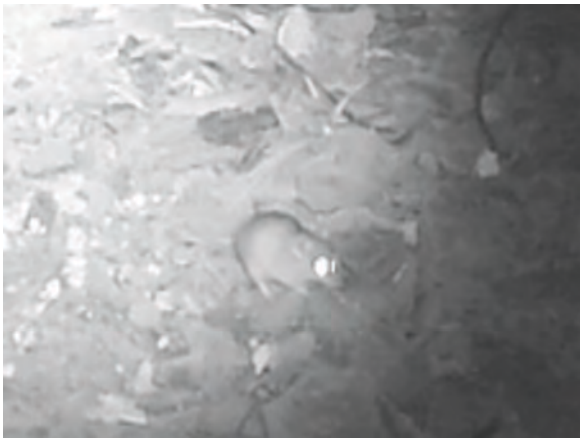


Plate 5.1: *Zyzomys argurus* recorded at HDTcamera01.

Plate 5.2: Rothschild's Rock Wallabies recorded at HDTcamera01.

Table 5.4: Mammals recorded during the targeted fauna survey.

FAMILY		MACROPODIDAE		MURIDAE		EMBALLONURIDAE		VESPERTILIONIDAE			
Species Name		*Macropus robustus*	*Petrogale rothschildi*	*Pseudomys chapmani*	*Zyzomys argurus*	*Saccolaimus flaviventris*	*Taphozous georgianus*	*Chalinilobus gouldii*	*Nyctophilus geophroyi*	*Scotorepens greyii*	*Vespadelus finlaysoni*
Common Name		Euro	Rothschild's Rock Wallaby	Western Pebble-mound Mouse	Common Rock-rat	Yellow-bellied Sheathtail Bat	Common Sheathtail Bat	Gould's Wattled Bat	Lesser Long-eared Bat	Little Broad-nosed Bat	Finlayson's Cave Bat
Site	Type of Record										
HDT01E	Trapped				12						
	Camera footage		✔		✔						
	Bat calls							✔			✔
	Scats	✔									
HDT02E	Trapped				11						
	Camera footage										
	Bat calls							✔		✔	✔
	Scats	✔									
HDT03E	Trapped				12						
	Camera footage										
	Bat calls					✔	✔			✔	✔
	Scats	✔									
HDT04aE	Trapped				10						
	Bat calls					✔	✔	✔	✔	✔	✔
	Scats	✔									
HDT04bE	Trapped				6						
	Camera footage										
	Scats	✔									
Opportunistic records				mound *							

* (Biota 2014b).

Bat sampling: Analysis of echolocation recordings collected during the survey identified six noninsectivorous bat species representing two families (Table 5.4). Bat activity on the SM2 units was variable between sites, but was generally 'Low' (as defined in Appendix 5).

Searches for Pilbara Olive Python and Non-systematic Observations: Opportunistic observations and targeted searches resulted in records of three additional vertebrate species. Scats of *Macropus robustus*, the Euro, were found at each of the systematic trapping sites during targeted searches, and two non-target conservation significant vertebrate species were recorded opportunistically:

- an Australian Bustard (*Ardeotis australis*), a Priority 4 species, was observed during the targeted fauna survey (707175mE, 7452391mN); and
- a mound of the Western Pebble-mound Mouse (*Pseudomys chapmani*) was recorded opportunistically (708723mE, 7452772mN), during a subsequent flora survey conducted by Biota (Biota 2014b).

5.4 Potential Short Range Endemic Invertebrates

Eleven potential SRE specimens were collected during the survey, including ten mygalomorph spiders and one scorpion. The scorpion was subsequently confirmed to be a representative of family Buthidae, which is unlikely to represent an SRE as this family does not include any known SRE taxa.

The ten mygalomorph spiders, all belong to the family Nemesiidae and the genus *Aname*, and were recorded from five sites both inside and outside the study area (Table 5.5; Figure 5.2).

Morphological analysis:
The differences between some of the burrows of these specimens were quite distinctive, indicating that several different species within this genus were observed. Three different morphotypes were identified including 'Sock' *Aname*, 'Big Angry Red' (B.A.R.) *Aname*, and 'Hooded' *Aname* (Figure 5.2). The morphotype 'Sock' was collected from four of the five sites, with specimens from two sites inside and two sites outside the study area. The morphotype 'Big Angry Red' was only collected once from inside the study area, while the morphotype 'Hooded' was only collected from two sites outside the study area. Plate 5.3 to Plate 5.8 show representative examples of specimens of each morphotype and their corresponding burrows.

Molecular analysis:
Six of the ten specimens were successfully sequenced (see Appendix 3). Phylogenetic analysis of these six specimens revealed the presence of three distinct genetic lineages (Figure 5.1). The three lineages likely represent three species of *Aname*, all of which have been detected previously in the Pilbara (Table 5.5; Biota 2012c). Only one of the three specimens collected inside the study area was successfully sequenced. It belonged to species N1 which was not recorded at any of the context sites outside the study area. Five of the seven remaining specimens from outside the study area were successfully sequenced and belonged to two species, N16 and N37 (Table 5.5; Biota 2012c).

Table 5.5: Mygalomorph spiders collected during the targeted fauna survey.

Site	Specimen ID	WAM Number	Land System	Molecular Species	Informal morphological name
Inside Study Area					
HDTSRE02	M20130912.HDTSRE02-1	132658	Platform	-	'Sock' *Aname*
	M20130912.HDTSRE02-2	132659	Platform	N1	'Big Angry Red' *Aname*
HDTSRE08	M20130915.HDTSRE08-1	132667	Platform	-	'Sock' *Aname*
Outside Study Area					
HDTSRE04	M20130913.HDTSRE04-1	132660	Platform	-	'Sock' *Aname*
	M20130913.HDTSRE04-2	132661	Platform	N37	'Sock' *Aname*
HDTSRE06	M20130914.HDTSRE06-1	132662	Platform	N16	'Hooded' *Aname*
	M20130914.HDTSRE06-2	132663	Platform	N37	'Sock' *Aname*
	M20130914.HDTSRE06-3	132664	Platform	-	'Sock' *Aname*
	M20130914.HDTSRE06-4	132665	Platform	N37	'Sock' *Aname*
HDTSRE07	M20130914.HDTSRE07-1	132666	Pindering	N16	'Hooded' *Aname*

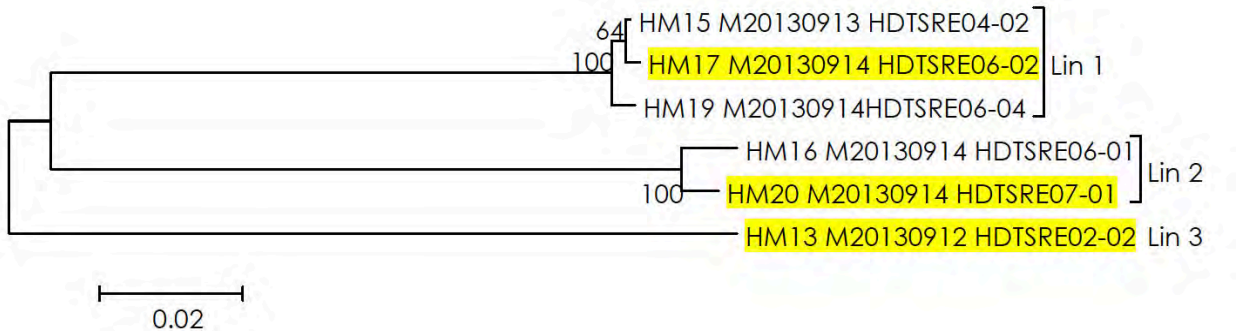


Figure 5.1: Neighbour-joining analysis of the six specimens of Mygalomorphae from Baby Hope Downs. Numbers on nodes correspond to bootstrap support (values < 50% not shown). Scale bar= genetic distance. The specimens selected to represent each lineage (labelled 1 – 3) are highlighted in yellow.

Plate 5.3: *Aname* sp. N1 ('B.A.R.' *Aname*) Specimen M20130912.HDTSRE02-2

Plate 5.4: *Aname* sp. N1 ('B.A.R.' *Aname*) burrow Specimen M20130912.HDTSRE02-2

Plate 5.5: *Aname* sp. N16 ('Hooded' *Aname*) Specimen M20130914.HDTSRE06-1

Plate 5.6: *Aname* sp. N16 ('Hooded' *Aname*) burrow Specimen M20130914.HDTSRE07-1

Plate 5.7: *Aname* sp. N37 ('Sock' *Aname*) Specimen M20130914.HDTSRE06-2

Plate 5.8: *Aname* sp. ('Sock' *Aname*) burrow M20130912.HDTSRE02-1

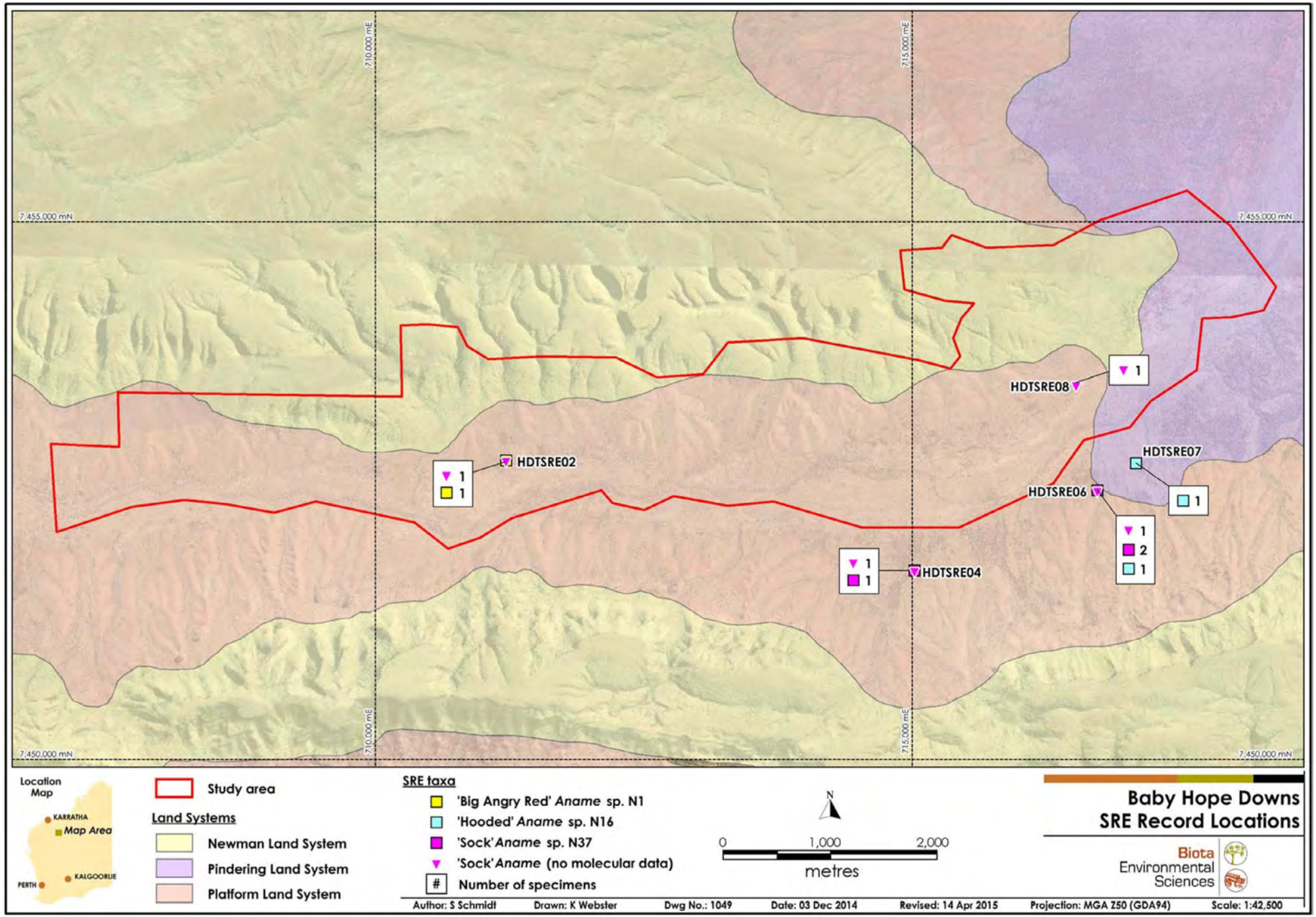


Figure 5.2: Location of SRE (Nemesiidae) records collected inside the study area and from context sites.

5.5 Troglobitic Fauna

A total of 1,317 invertebrate specimens were collected during the Phase 1 troglofauna sampling, representing 13 taxonomic orders (Appendix 9). As is common with troglofauna sampling, the majority of specimens collected were not troglobitic, but edaphobitic (deep-soil and litter dwelling). Edaphobitic taxa do not typically have restricted distributions and are not considered high risk for short range endemism (e.g. orders Acarina, Collembola, Diptera) (Harvey 2002, Berry 2005) and are not discussed further in this report, as they are not relevant to the objectives of this study.

5.5.1 Troglophilic Taxa

Three orders (Schizomida, Polyxenida and Blattodea) contained specimens displaying troglomorphic characteristics, with a total of 17 specimens recorded. These specimens were collected from eight of 29 drillholes sampled (Table 5.6). Recent studies suggest that the Polyxenida and Blattodea are generally not true troglobites, but may be better defined as troglophiles (Biota and Helix 2011, Biota 2012h). Troglophiles display troglomorphic characteristics and will utilise subterranean environments but are not restricted to them. In general, troglophiles are less prone to short-range endemism, therefore of lower conservation significances, and at relatively low risk of taxon-level impacts due to local scale developments.

Molecular analysis of subterranean Blattodea during previous studies in the Pilbara suggests that they generally have large distributions and are often proving to not be SREs (Biota 2012a, 2012h). The same can be said for the Polyxenida specimens (Biota and Helix 2011). This leaves the Schizomida as the only currently confirmed troglobites collected from the study area (Section 5.5.2).

Table 5.6: Summary of troglobitic and troglophilic taxa collected during Phase 1.

Taxonomy			Number of individuals	Drillholes
Phylum	Class	Order (Common Name)		
Arthropoda	Arachnida	Schizomida (Schizomid)	5	RC12H1SW0026, RC12H1SW0051, RC12H1SW0144
	Diplopoda	Polyxenida (Pincushion Millipede)	8	RC10H1SW013, RC12H1SW0008, RC12H1SW0042, RC12H1SW0064
	Insecta	Blattodea (Cockroach)	4	RC12H1SW0026, RC12H1SW0082
		Total:	17	

5.5.2 Troglobitic Fauna

Three of the drillholes sampled within the study area yielded a total of five troglobites All five specimens were schizomids, belonging to the family Hubbardiidae (Table 5.7). Three of the schizomids were recorded in colluvial surface geology (Czc), and two were recorded in Marra Mamba BIF (Hm), both of which are known habitats for troglofauna (Biota 2009a). Example images of a female schizomid collected from site RC12H1SW0026 are presented in Plate 5.9 and Plate 5.10. The locations of the three drillholes where the five schizomids were recorded are shown in Figure 5.4 along with the locations of six additional schizomids previously collected from the locality (Biota 2011a), which were included in the molecular analysis for context.

Morphological analysis:
Morphological characters indicate that the specimens belong to the Pilbara genus *Draculoides*, which was also recorded previously from nearby, adjacent to Hope Downs 1 (Biota 2009a).

Molecular analysis:
Molecular analysis revealed that the 11 specimens sequenced belonged to three phylogenetic lineages based on the variation at the COXI gene (Figure 5.3). Based on phylogenetic and distance analyses, the three lineages detected are likely to represent three species (Appendix 4).

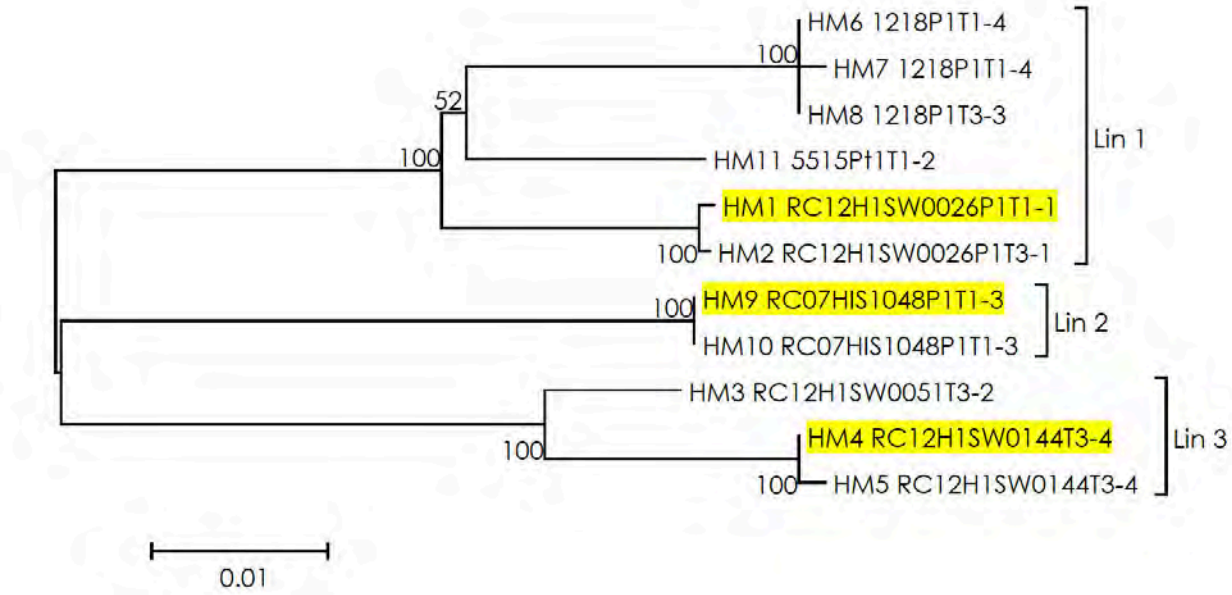


Figure 5.3: Neighbour-joining analysis of the 11 specimens of Schizomida from Baby Hope Downs. Numbers on nodes correspond to bootstrap support over 2000 iterations; values < 50% not shown. Scale bar = genetic distance. The three specimens selected to represent the three genetic lineages are highlighted in yellow.

One species was only identified from previous records collected outside the current study area (*Draculoides* sp. BHD1), another was only recorded during the current survey from inside the study area (*Draculoides* sp. BHD2), and the third was recorded from both inside and outside the study area and during both surveys (*Draculoides* sp. CI1):

Draculoides sp. CI1:
Six of the specimens sequenced belonged to this species. Two of the specimens were collected from a single drillhole in the west of the study area during the current survey. A further four specimens were collected from two different drillholes during the previous survey at Hope Downs 1. The maximum spanning distance between for this species is now 14.1 km, and the minimum spanning area covers 15.2 km^2, which qualifies it an SRE taxon. The geology differed between the collections locations, with *Draculoides* sp. CI1 found previously om Calcrete-sheet carbonate but recorded from Marra Mamba BIF during the current survey (Figure 5.4).

Draculoides sp. BHD1:
This species is not currently known from the Baby Hope Downs study arera. Two specimens of this species were previously collected from a single drillhole in colluvial material at Hope Downs 1 (Figure 5.4).

Draculoides sp. BHD2:
Three specimens of this species were collected from two drillholes in colluvial material inside the study area during the current survey (Figure 5.4). The two drillholes are 3 km apart and the species is currently only known from the study area.

Table 5.7: Troglobitic specimens collected during Phase 1.

Site (Drillhole)	Surface Geology	Order	Family	Taxon	n
RC12H1SW0026	Chert, ferruginous chert and banded iron-formation with minor shale	Schizomida	Hubbardiidae	*Draculoides* sp. CI1	2
RC12H1SW0051	Colluvium - partly consolidated quartz and rock fragments in silt and sand matrix; old valley-fill deposits	Schizomida	Hubbardiidae	*Draculoides* sp. BHD2	1
RC12H1SW0144	Colluvium - partly consolidated quartz and rock fragments in silt and sand matrix; old valley-fill deposits	Schizomida	Hubbardiidae	*Draculoides* sp. BHD2	2
				Total:	5

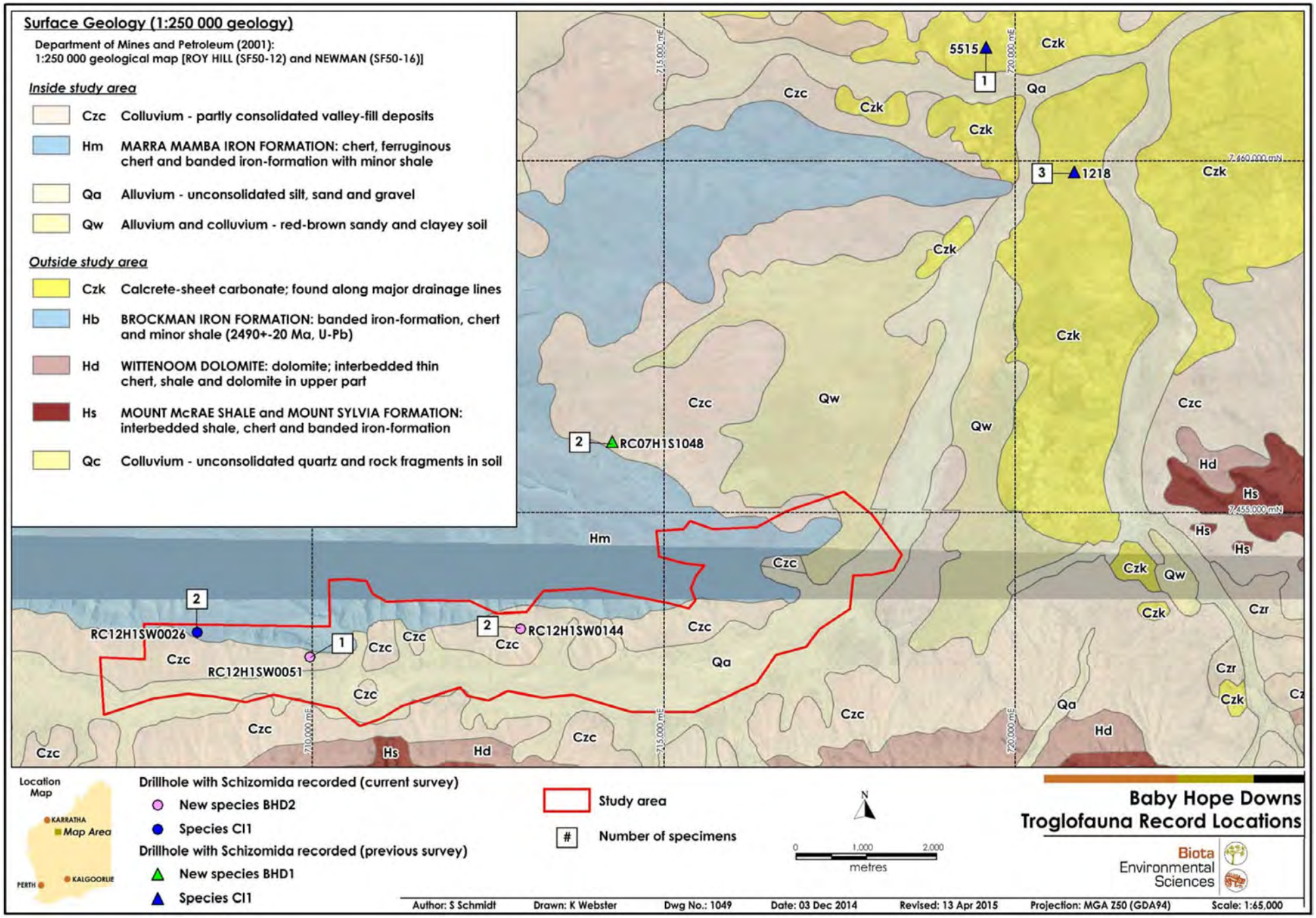


Figure 5.4: Location of sampling drillholes where Schizomida specimens were recorded during Phase 1.

Plate 5.9: Dorsal view of female schizomid collected from site RC12H1SW0026 (*Draculoides* sp. CI1).

Plate 5.10: Ventral view of female schizomid collected from site RC12H1SW0026 (*Draculoides* sp. CI1).

5.6 Troglofauna Habitat

5.6.1 Geological Setting

The Hope Downs 1 deposits, of which the Baby Hope Downs study area forms part, are associated with the Marra Mamba Iron Formation at the eastern end of the Weeli Wolli Anticline, a large-scale event fold, with the existing Hope Downs 1 operations north and south deposits located on the northern flanks of the anticlinal structures.

Mineralisation lies primarily within the Mount Newman Member of the Marra Mamba Iron Formation, with lesser amounts of mineralisation occurring in the Macleod Member and the West Angelas Member of the overlying Wittenoom Formation. The West Angelas Member of the Wittenoom Formation overlies the Marra Mamba Iron Formation, and consists predominantly of laminated pink, grey and khaki shales interbedded with lesser chert and minor BIF bands.

In addition to the bedded mineralisation, deposits of secondary surficial ironstone have accumulated as cover over the bedded Marra Mamba mineralisation, and to the north of the outcropping Marra Mamba Iron Formations. These include canga, limonite or bedded goethite, pisolite, red ochre detritals and detrital material types.

The formation and position of the Hope Downs deposits are structurally and stratigraphically controlled, with substantial faulting and folding in the more complex areas of the deposits.

5.6.2 Surface Geology and Stratigraphy

The detailed surface geology mapping provided by Rio Tinto was intersected with the locations where troglobitic schizomids were recorded (drillholes RC12H1SW0026, RC12H1SW0051 and RC12H1SW0144). The geological units mapped at this local scale were generally consistent with the regional geology mapping (Table 5.7), with records coming from Czc (colluvium) and AHmn (Marra Mamba; goethite mineralisation over Mount Newman Member) as mapped at 1:4,000 scale.

Rio Tinto geologists compiled preliminary cross-sections of the stratigraphic arrangement of geological units at depth. In some parts of the study area, the mapped surface geology is representative of subterranean habitats at depth (e.g. where Marra Mamba has surface expression), but in other areas the surface units overlie other rock types at depth that represent the habitats being used by the fauna. Past work at multiple Pilbara sites (e.g. Biota 2006b, 2012a, 2012h, 2014c) has demonstrated that hydrated zones, both mineralised and non-mineralised, are likely to constitute habitat for troglofauna due to the presence of vugs, cavities and other habitat space. The preliminary cross-sections showed evidence of intersecting hydrated material at all three drillholes where schizomids were recorded in the study area (Figure 5.5 to Figure 5.7).

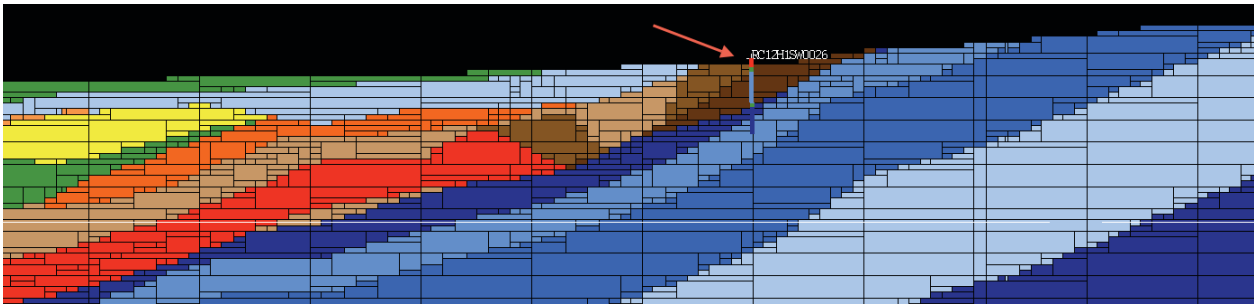


Figure 5.5: Preliminary cross-section show loation of drillhole RC12H1SW0026 (non-mineralised hydrated material shown in brown; mineralised hydrated material in red; arrow=drillhole location).

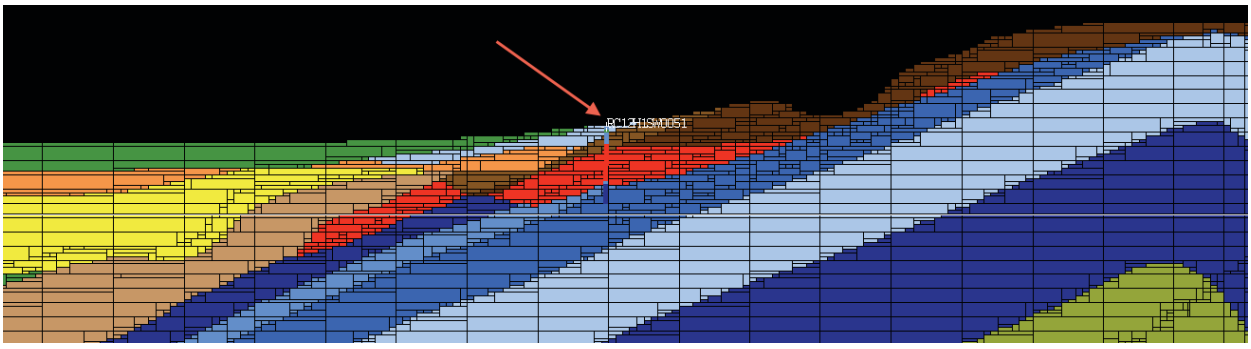


Figure 5.6: Preliminary cross-section show loation of drillhole RC12H1SW0051 (non-mineralised hydrated material shown in brown; mineralised hydrated material in red; arrow=drillhole location).

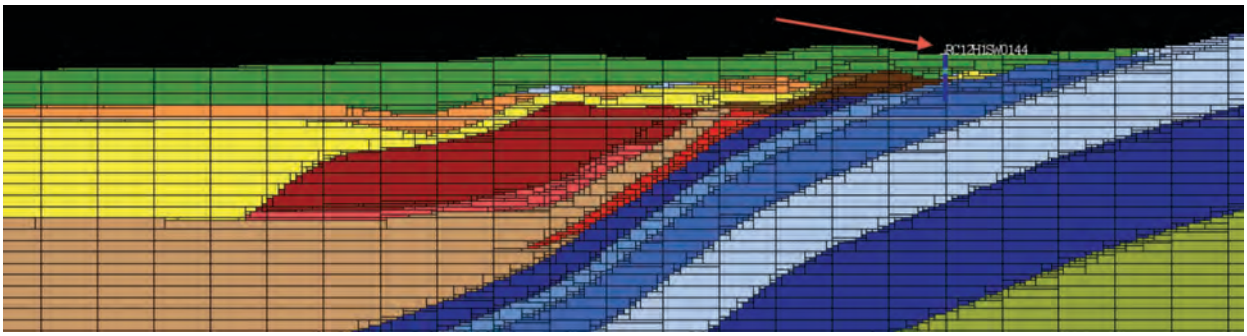
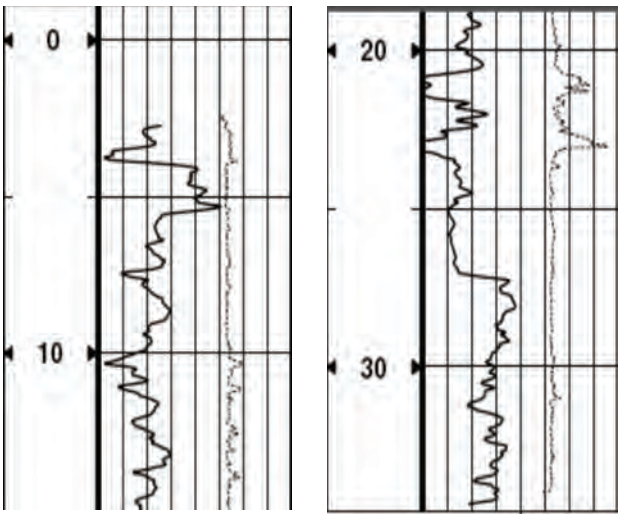


Figure 5.7: Preliminary cross-section show loation of drillhole RC12H1SW0144 (non-mineralised hydrated material shown in brown; mineralised hydrated material in red; arrow=drillhole location).

Reviews of wireline logging of the same three drillholes that intersect this core troglofauna habitat show evidence of cavities throughout much of the profile intersected (Figure 5.8 to Figure 5.10).



(A) (B)

Figure 5.9: Caliper and density logs of RC12H1SW0026 (A: 0-18 m; B: 18-35 m).

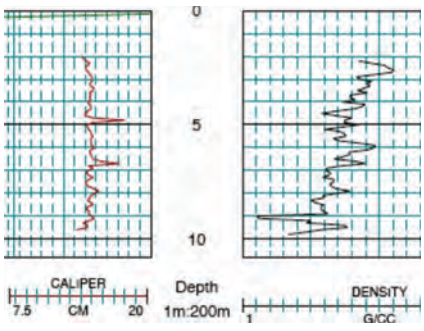


Figure 5.8: Caliper and density logs of RC12H1SW0051.

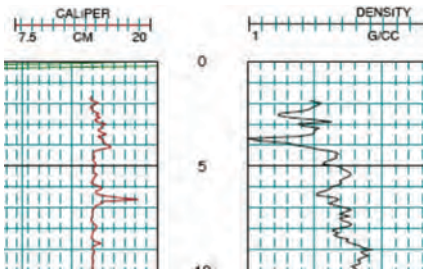


Figure 5.10: Caliper and density logs of RC12H1SW0144.

Density and caliper logs indicated the presence of both relatively superficial cavities in the approximate top 10 m of the profile, in addition to cavities deeper in the profile (e.g. Figure 5.4 (B)).

This is also consistent with Optical Tele-viewer (OTV) imagery of nearby drillholes (OTV was not available for the holes yielding schizomids), which allow for more direct visual assessment of the physical characteristics of subterranean habitats. Plate 5.11 shows representative examples of subterranean habitat in the hydrated portion of the profile, with vugs and cavities evident both in the shallower parts of the profile and some deeper zones (e.g. GD14HD10014 in Plate 5.11).

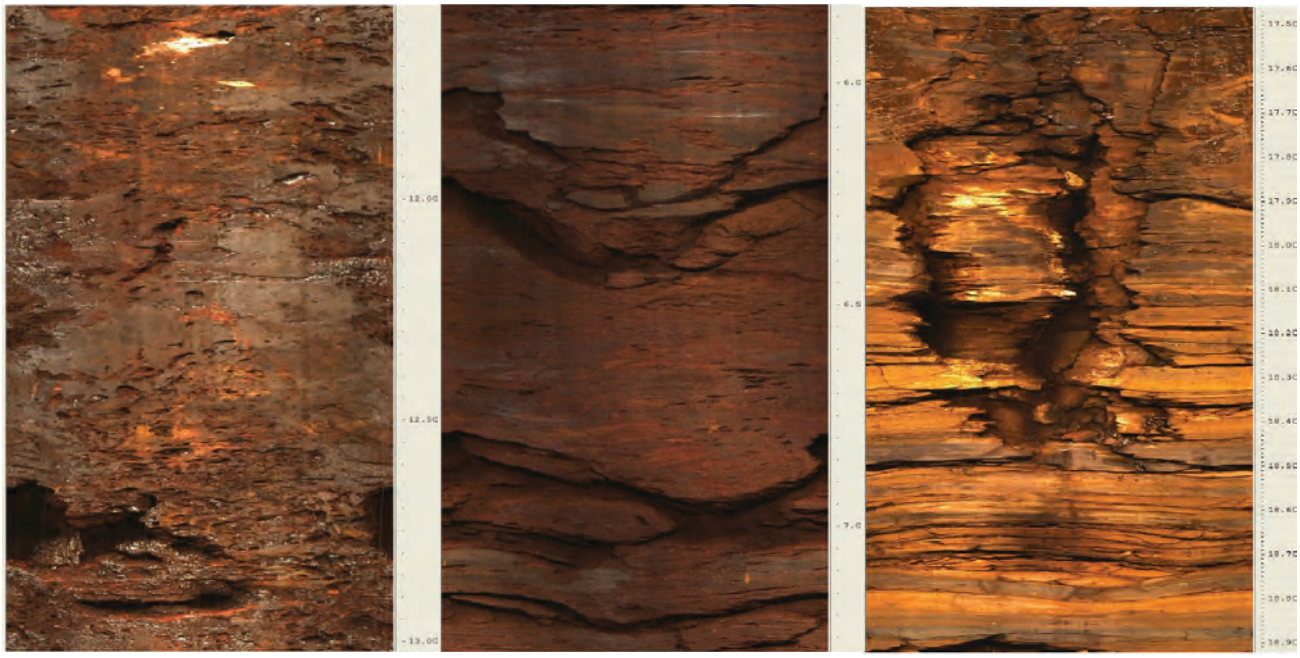


Plate 5.11: OTV imagery by depth from drillholes DD14HD10002, DD14HD10005 and GD14HD10014 (from left to right), showing cavities at varying depths in the profile (scale bars indicate depth below ground level).

5.6.3 Consolidation of Troglofauna Data and Subterranean Habitats

The currently available geological information suggests that potential troglofauna habitat in the study area is represented stratigraphically by hydrated zones in the profile, which spatially occur within surface geology units mapped locally as the valley fill unit Czc (colluvium) and the Marra Mamba unit AHmn (goethite mineralisation over Mount Newman Member). In order to provide a spatial analysis, these two units were merged to map potential troglofauna habitat within the study area.

Figure 5.11 consolidates findings from Sections 5.5.2 and 5.6: it displays all locations where troglomorphic fauna (both Schizomida and other troglomorphic taxa which utilise similar subterranean habitats) have been recorded in the study area and wider Hope Downs locality, overlain on mapping of the potential troglofauna habitat. This was also then spatially intersected with the1:250,000 regional geology unit mapping to allow extrapolation beyond the extent of the detailed Rio Tinto mapping (Figure 5.11).

This spatial analysis revealed good alignment between the distribution of the potential troglofauna habitat and the locations where troglofauna have been confirmed to occur, with all records coming from within the potential habitat polygon (Figure 5.11). The wider distribution of troglofauna habitat, and its connectivity with the study area, was also more broadly mapped as the combined Czc (colluvium – valley fill) and Hm (Marra Mamba) regional geology units This is shown in a plan view in Figure 5.11, but more informatively in the isometric views presented in Figure 5.12 and Figure 5.13.

Both the local-scale habitat mapping and the regional scale geology units strongly suggest suitable habitat extends beyond the study area boundary to the northwest (Figure 5.11). The occurrence of hydrated zones in the locality also appears to be structurally controlled and a fault runs from the study area to the northwest, consistent with this likely habitat continuity (Rio Tinto, unpublished data). The landform perspective provide by Figure 5.12 and Figure 5.13 suggests that troglofauna habitat in the area sits relatively high in the landscape, extending upward in elevation from the sloping valley fill overlying hydrated material, to Marra Mamba units higher in the profile.

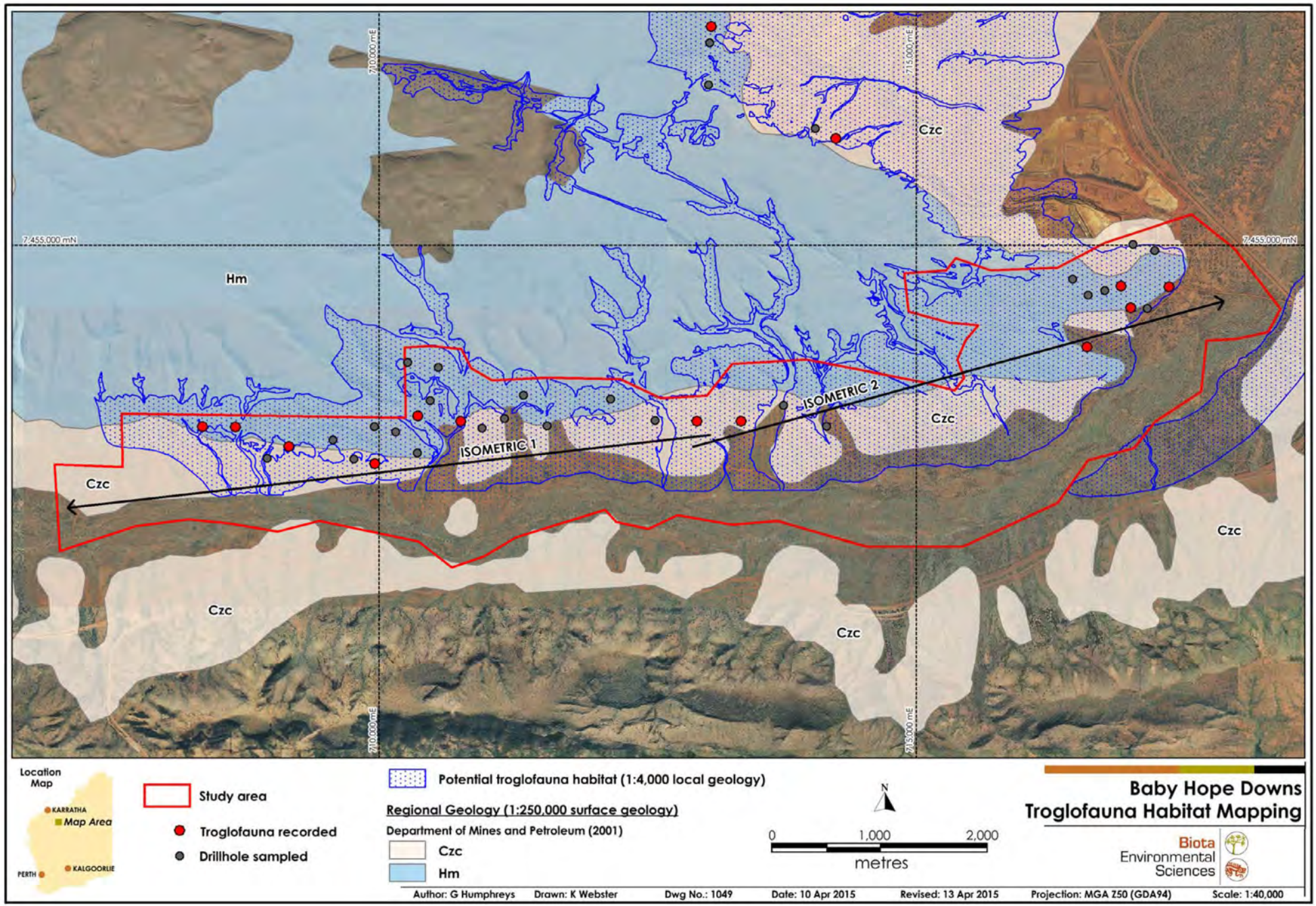


Figure 5.11: Plan view of troglofauna habitat mapping in relation to troglofauna records and Phase 1 sampling sites which yielded no records.

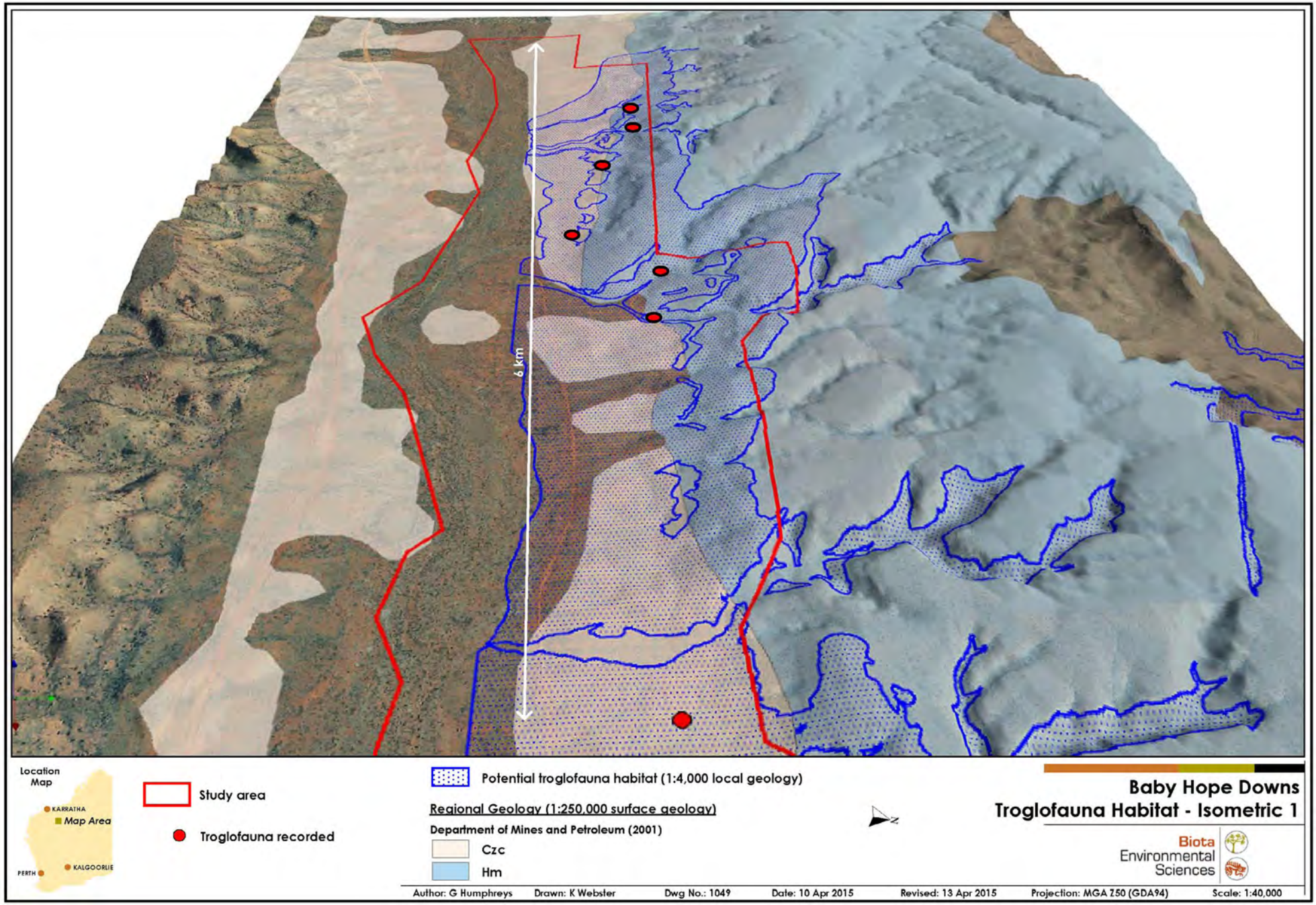


Figure 5.12: Isometric landscape view of troglofauna habitat mapping in relation to troglofauna records, looking east along the study area.

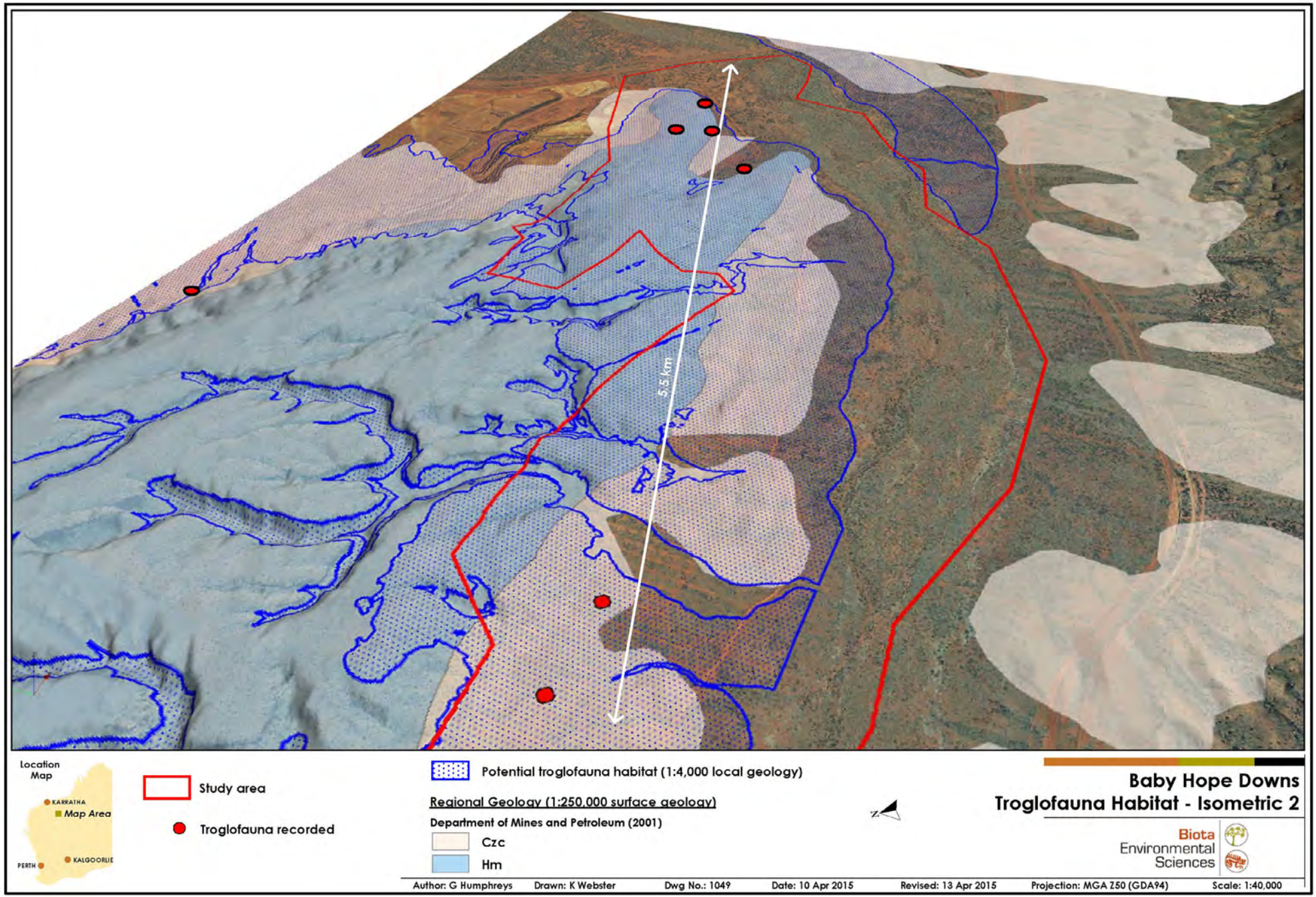


Figure 5.13: Isometric landscape view of troglofauna habitat mapping in relation to troglofauna records, looking west along the study area.

6.0 Conservation Significance

6.1 Faunal Value of Landforms within the Study Area

Two broad fauna landforms occur in the study area and have been described in Section 5.1. When considering the faunal value of the fauna habitats within the study area, the following factors were used as criteria to assess areas of higher habitat value:

- supports fauna of conservation significance;
- supports unique faunal assemblages; and
- is uncommon in the region.

Using these criteria, the narrow and broad gorges were considered to be the landform unit representing the habitat of highest faunal value, but its attributes are typical of similar habitat types in the wider locality. While the survey data indicate the species are not currently present, the gorges in the study area have the potential to provide habitat for both the Northern Quoll and Pilbara Olive Python. They are, however, typical of other similar features in the Newman land system in the central Pilbara in this respect. The Orange Leaf-nosed Bat also has the potential to forage over most of the study area, but there is no evidence of any suitable roost sites for the species.

6.2 Targeted Vertebrate Fauna

While they have the potential to occur in the study area, none of the three vertebrate species of conservation significance targeted by this study were recorded during the field survey. This was despite considerable field effort being expended via both systematic and non-systematic methods. The overall sampling effort during the field survey comprised:

- 960 Elliott and cage trap nights at four trapping sites that were specifically selected as prospective habitat for the Northern Quoll;
- 16 camera-nights of automatic camera deployment at four sites in equivalent prospective habitat;
- seven bat ultrasonic call sampling nights at four sites suitable for Orange Leaf-nosed Bat foraging; and
- traverses, searches and potential for opportunistic records of Pilbara Olive Python by the survey team over a eight-day period.

It is informative to consider this survey effort in the context of other recent studies in the region that have successfully detected the target species (Table 6.1). This provides a guide as to the typical sampling effort and time required to record the species in question when they are present.

Table 6.1: Comparative sampling effort from other nearby surveys that have recorded the target species.

Survey	Species	Effort	Records
Koodaideri Spring Monitoring Phase 1 (Biota 2014d)	*Dasyurus hallucatus*	280 trap nights	8 records; first on trap night 1
	Rhinonicteris aurantius	12 bat call sampling nights	447 calls; first on night 1
	Liasis olivaceus barroni	7-day survey duration	4 records; first on day 2
Koodaideri Spring Monitoring Phase 2 (Biota 2014e)	*Dasyurus hallucatus*	365 trap nights	16 records; first on trap night 1
	Rhinonicteris aurantius	24 bat call sampling nights	130 calls; first on night 1
	Liasis olivaceus barroni	7-day survey duration	4 records; first on day 3
	Macroderma gigas	7-day survey duration	1 record; flushed on day 2
Koodaideri Additional Lease Areas (Biota 2014d)	*Dasyurus hallucatus*	980 trap nights	2 records; first on trap night 1
	Rhinonicteris aurantius	27 bat call sampling nights	Multiple calls; first on night 2
	Macroderma gigas	8-day survey duration	Multiple calls; first on night 2

All of these comparison studies employed similar sampling effort than the current survey but recorded most, if not all, of the target species. They demonstrate that all the species of interest are readily detectable and are typically recorded within the first one to three days of surveys when present (Table 6.1). Given this information, it is unlikely that the current lack of target species records from the Baby Hope area is an artefact of sampling, and that individuals of the target taxa were not present at the time of the survey.

6.2.1 Northern Quoll (*Dasyurus hallucatus*)

While no evidence of Northern Quoll presence within the study area was found during this survey, the narrow and broad gorges in the study area represent suitable habitat for the Northern Quoll and the species may be present under suitable conditions. Individuals of this species have recently been trapped in the locality (NatureMap, Biota database; Appendix 7 and details below) and it has also been identified as likely to occur in the study area through the *EPBC Act 1999* database search (Appendix 8).

Studies that involve both the deployment of traps and automatic cameras to target the Northern Quoll also show that the species is commonly recorded on cameras when successfully trapped (e.g. at Hope Downs (Biota 2011a) and at Koodaideri (Biota 2013c), see Section 6.2). The lack of camera records of *Dasyurus hallucatus* during the current study is therefore consistent with the lack of trapped individuals. It is noteworthy that the automatic cameras deployed during the current survey routinely captured numerous records of other nocturnal and crepuscular mammals from the study area. Species included the Common Rock Rat (*Zyzomys argurus*) which was regularly recorded during the field survey at each of the trapping sites, captured in traps and on camera (Table 5.4), and is a known prey item for *D. hallucatus* in the Pilbara. Considering that the camera locations were specifically selected as prospective Northern Quoll habitat, this suggests that Northern Quoll should also have been recorded had they been present and active during the survey period.

Other surveys targeting the Northern Quoll in the locality and further southeast in the Pilbara have also generally shown a trend of very low captures or the apparent absence of the species. Biologic (2011a) conducted a targeted survey at BHP Billiton's Jinidi project to the immediate east, which involved 3,335 cage and Elliott trap nights but recorded no individuals. Similarly, Rapallo (2012) did not trap any Northern Quoll after 1,420 trap nights and obtained only a single camera record from the Lamb Creek study area in central Juna Downs station to the northwest of the current study area. A single individual was also recorded approximately 4 km north of the study area at Hope Downs by Biota (2011a) from 500 trap nights. Two targeted surveys to the northeast at Yandi have not recorded any evidence of the species, despite a total of 1,117 trap nights in different years (Biota 2009d, 2014f). A single-phase targeted survey at Juna Downs station did not record any evidence of presence of the Northern Quoll, despite 1,420 trap nights at ten sites, 134 camera-nights at 40 sites, and multiple targeted searches over a 10-day survey period in prospective habitat (Biota 2014g).

While no Northern Quolls have been captured within the study area to date, several records exist in the locality (within 40 km). These findings suggest that the species is at relatively low density in the southeast Pilbara or only sporadically expands into this locality, particularly in light of the number of individuals recorded with lower effort in areas where populations do occur (Table 6.1).

The overall distributional pattern of records in the locality suggest that the Northern Quoll is likely to be patchily distributed and at low density in the study area and surrounding locality (Figure 6.1, modified from Biota (2013d)). This is not solely a function of sampling effort, as a considerable amount of trapping has been completed in the southeast Pilbara without yielding records (null records on Figure 6.1). This is despite the representation of apparently suitable habitat for the species (see Section 5.2, Figure 6.1). It has previously been demonstrated that *Dasyurus hallucatus* can show considerable temporal variability and areas that have previously not yielded records can subsequently support newly established or expanded populations (e.g. Biota and How 2005, Biota 2006a). These fluctuations may be a function of fire ecology and frequency in the landscape, along with the importance of high and low rainfall years and drought periods and their influence on prey populations.

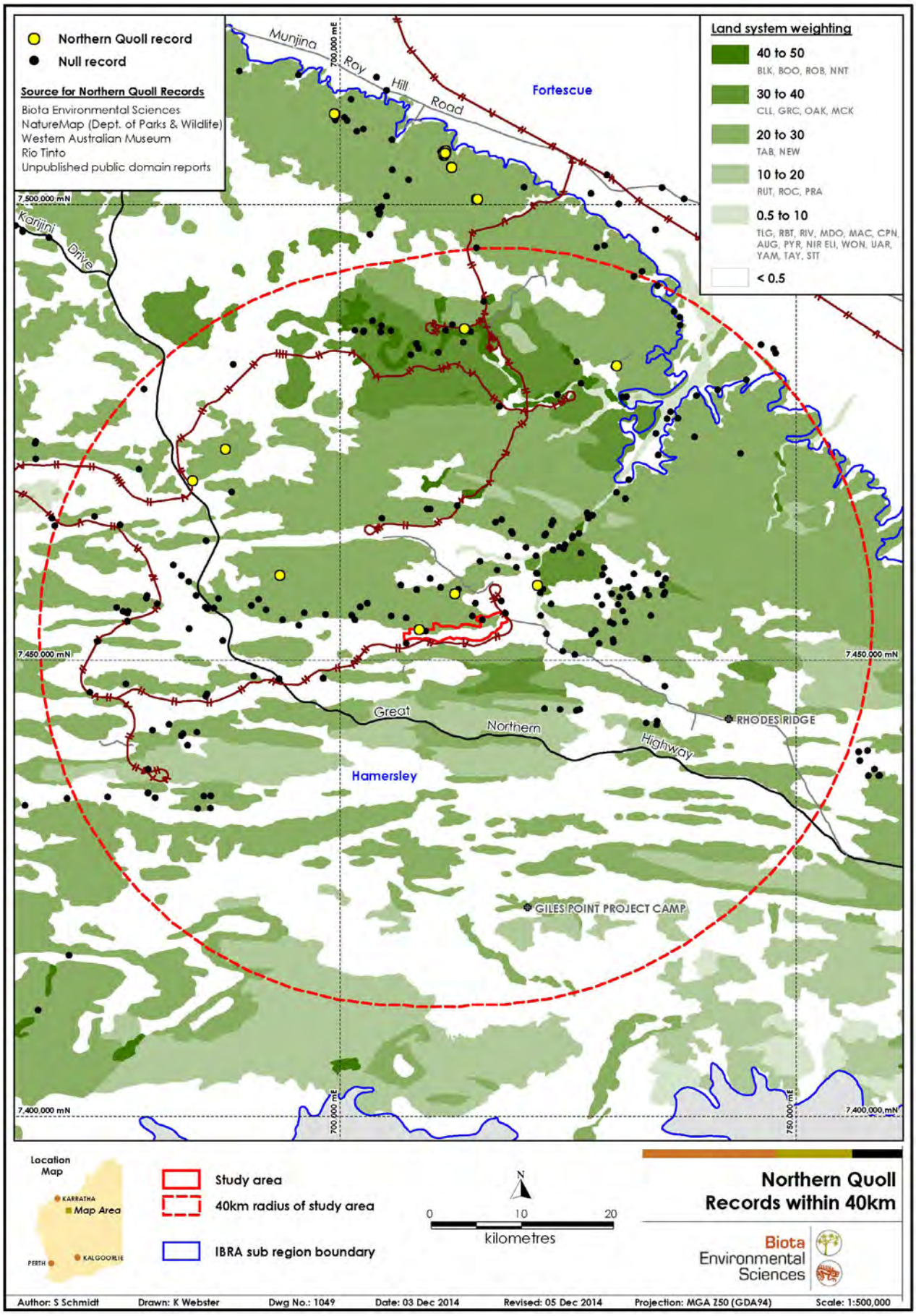


Figure 6.1: Northern Quoll (*Dasyurus hallucatus*) records from the wider Baby Hope Downs locality, showing land systems weighting for the species after Biota (2013b). Higher weighting indicates more prospective habitat.

6.2.2 Orange Leaf-nosed Bat (*Rhinonicteris aurantius*)

The review of previous studies and the database searches identified the Orange Leaf-nosed Bat as having the potential to occur in the study area (Appendix 6, 7 and 8) but no OLNB calls were recorded during the survey and no other evidence was found to suggest this specis was present in the study area. In addition, no evidence of caves deep enough to provide the right microclimate for the species to roost in were observed during the field survey. At present there are no known roosts for the species within the study area (B. Bullen, Bat Call WA, pers. comm. 2014) and there is also no known record of the Orange leaf-nosed bat from the study area. Only a few records are known from the locality (Figure 6.2): NatureMap records showed that the Orange Leaf-nosed Bat has been recorded at two locations within 20 km of the study area. The Biota internal database showed that OLNB calls have been recorded at two locations within 40 km of the study area. This is despite echolocation call sampling being conducted during the majority of the studies discussed in Section 6.2. The nearest known roost is the Koodaideri K75W adit colony (Biota 2012b), and the northeast boundary of the study area is approximately 57 km from the roost. This is outside the typical 15 km foraging distance that individuals are known to travel, and available data suggest that most individuals do not forage southwest of the ranges that host the Koodaideri deposits (Biota 2013c).

There is therefore currently no evidence to suggest that any undocumented colonies of the species occur in the study area. However, there is potential foraging habitat in the narrow and broad gorges in the study area should a roost be present in the wider locality.

6.2.3 Pilbara Olive Python (*Liasis olivaceus barroni*)

No Pilbara Olive Pythons were recorded during this study, although this species was considered likely to occur in the study area based on the results of the desktop review (Appendix 6, 7 and 8). Unlike the other species above, distributional records from the wider locality suggest that this species is moderately common (Figure 6.3 after Biota (2013b)). The Pilbara Olive Python has been recorded by Biota at one location within 10 km of the study area (Biota internal database). There are also a number of NatureMap Pilbara Olive Python records within 40 km of the study area (Figure 6.3; Appendix 7).

No semi-permanent pools were observed in the gorges in the study area during the survey. When present, such pools are a focus of targeted Pilbara Olive Python sampling as they are considered highly prospective microhabitat, but not all previous records come from habitats in close proximity to water. Two records of the Pilbara Olive Python were recorded at West Turner Syncline (Biota 2013e) in habitats similar to those observed during this survey. There is therefore potential habitat for the Pilbara Olive Python in the narrow gorges in the study area and it is likely that it will be recorded from locations within the study area with more appropriately timed sampling effort (e.g. under warmer conditions or after rain when pools are present).

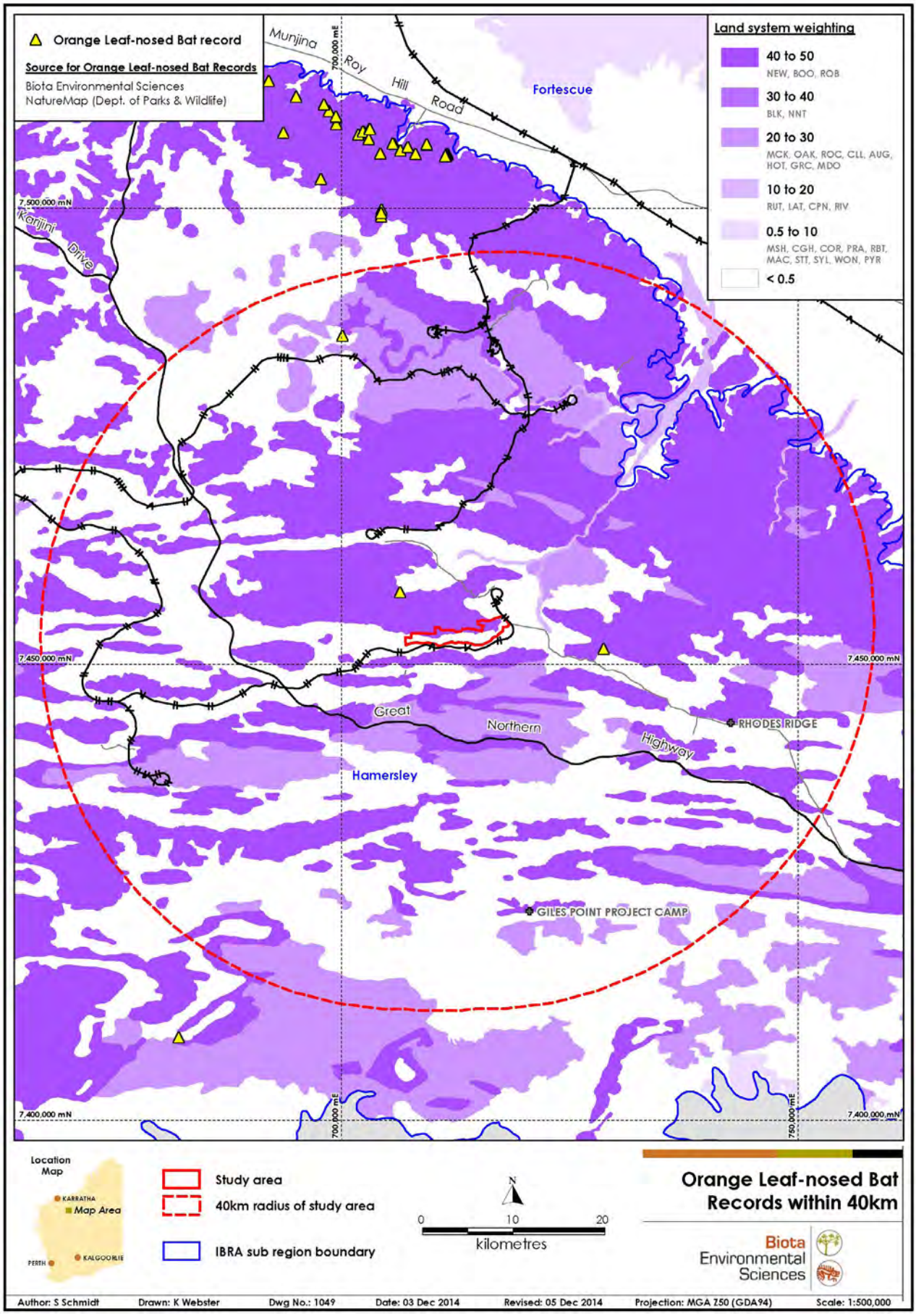


Figure 6.2: Orange Leaf-nosed Bat (*Rhinonicteris aurantius*) records from the wider Baby Hope Downs locality, showing land systems weighting for the species after Biota (2013d). Higher weighting indicates more prospective habitat.

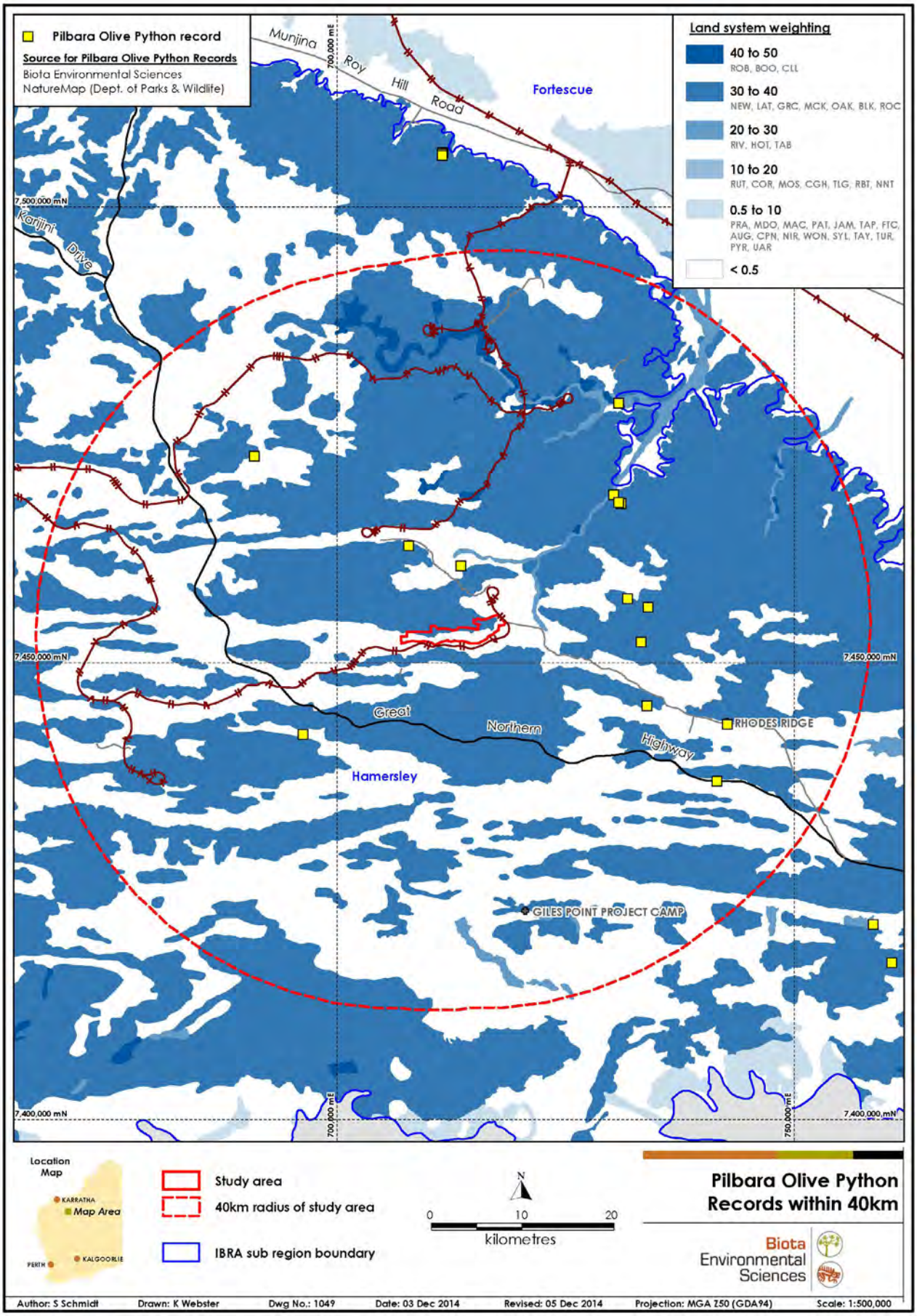


Figure 6.3: Pilbara Olive Python (*Liasis olivaceus barroni*) records from the wider Baby Hope Downs locality, showing land systems weighting for the species after Biota (2013d). Higher weighting indicates more prospective habitat.

6.3 Conservation Significant Vertebrate Fauna Recorded

The Australian Bustard (*Ardeotis australis*) was the only vertebrate species of conservation significance recorded during the targeted fauna survey, however, the Western Pebble-mound Mouse (*Pseudomys chapmani*), a further conservation significant species, was recorded during a subsequent flora survey (Biota 2014b).

6.3.1 Australian Bustard (*Ardeotis australis*)

Status: Listed as a Priority 4 species under the Department of Parks and Wildlife Priority List.

Distribution: The Australian Bustard occurs over much of Western Australia, with the exception of the more heavily wooded southern portions of the state (Johnstone and Storr 1998). It is mostly extinct from the settled districts, but common away from settlement parts of Western Australia (Pizzey and Knight 2007). Its wider distribution includes eastern Australia and New Guinea.

Ecology: This species is typically nomadic and occupies large home ranges (Marchant and Higgins 1993) in open or lightly wooded grassland, including *Triodia* hummock grasslands on sandplains, and is considered scarce to common depending on season and habitat (Johnstone and Storr 1998). It has an omnivorous diet and occurs in a relatively broad range of habitats, but is often recorded from recently burnt areas (Marchant and Higgins 1993).

Occurrence: This species was recorded opportunistically outside of the study area adjacent to the western boundary of the study area on a spinifex (*Triodia* sp.) dominated plain. This species had been recorded regularly in the local area.

6.3.2 Western Pebble-mound Mouse (*Pseudomys chapmani*)

Status: Listed as a Priority 4 species under the Department of Parks and Wildlife Priority List.

Distribution: This species is endemic to the central and eastern parts of the Pilbara including Karijini National Park (Menkhorst and Knight 2011). This species is typically found on stony hillsides with hummock grasslands (Menkhorst and Knight 2011) and is common to very common in suitable habitat within the Hamersley and Chichester subregions of the Pilbara bioregion.

Ecology: The Western Pebble-mound Mouse is well known for its behaviour of constructing extensive mounds of small stones covering areas from 0.5 to 9.0 square meters (van Dyck and Strahan 2008). This mound formation is most common on spurs and gentle slopes where suitably sized stones are present.

Active mounds are discernible by factors such as the presence of maintained turrets and lack of debris in the turrets. Inactive mounds generally display a more flattened and consolidated appearance due to the lack of routine maintenance and pebble movement. These parameters are generally used when determining likely mound status.

Occurrence: Recorded from the study area during the Biota (2014b) flora survey (see Section 5.3).

6.4 SREs of Conservation Significance

Trapdoor spiders belonging to the family Nemesiidae were the only potential SRE taxa recorded of potential conservation significance (Section 5.4). Three mygalomorph spider morphotypes belonging to the genus *Aname* (family: Nemesiidae) were recorded during the survey. Molecular analysis revealed that the three morphotypes belonged to three known *Aname* species (sp. N1, sp. N16 and sp. N37) (Table 5.5; Figure 5.2).

The single specimen collected from inside the study area that could be identified to species level belonged to *Aname* sp. N1 ('Big Angry Red') which has previously been collected from 70 locations across the Pilbara with a spanning distance of 297 km (Biota 2012c). Two other

specimens collected from outside of the study area belonged to *Aname* sp. N16 ('Hooded Aname') which is also broadly distributed throughout the Pilbara and known from 181 separate localities separated by a maximum spanning distance of 186 km. Based on current data, neither species is considered an SRE as they occupy a minimum spanning area >10000 km^2 (Biota 2012c), and are not of elevated conservation significance.

The three remaining specimens that could be identified to species level were collected from two sites south of the study area boundary and belonged to *Aname* sp. N37 ('Sock Aname').

Aname sp. N37 is known from eight specimens, each collected at a separate location, approximately 95 km northwest of Newman. These previous records were separated by a maximum spanning distance of 16 km, and occupied a minimum spanning area of 48 km^2. Based on current records *Aname* sp. N37 therefore qualifies as an SRE (Biota 2012c). It has previously been recorded from stony plains, ridges, lower slopes and alluvial floodplains. The three additional records from this survey, all collected from mulga plains within the Platform Land System, increase the known distribution of this species to 65 km^2, which means based on current records, the species still qualifies as an SRE.

A further two specimens of the same morphotype were collected from the same landform and land system from inside the study area (Figure 5.2), but these failed to yield a useable DNA sequence (Appendix 3). Given the small separation distance between the records, and the similarity of habitats, it is possible that these two records also represent the SRE species *Aname* sp. N37.

6.5 Troglofauna of Conservation Significance

Schizomids were the only confirmed troglobitic taxa recorded during the Phase 1 sampling that are of conservation significance, and all five specimens collected belonged to the genus *Draculoides* (family: Hubbardiidae) (Section 5.5). Six schizomids of this same genus were also recorded during troglofauna sampling at Hope Downs 1 in 2010 (Biota 2011a). Molecular analysis of the combined 11 specimens revealed that three species were represented amongst the specimens analysed. One of these occurred at both Hope Downs 1 and the current study area, and has also been detected previously in the Hamersley Range area (Appendix 4). The remaining two species appear to be newly recorded taxa based on the material available for comparison (Appendix 4).

Reviews of geological information suggest that trogolofauna habitat in the study area is represented stratigraphically by hydrated zones in the profile, which spatially equates to surface geology units mapped locally as valley fill colluvium and Marra Mamba. These units accounted for all records of troglofauna from the current phase of sampling.

One of the sites where schizomids were recorded previously at Hope Downs 1 was colluvium (Biota 2011a), the same surface geology unit from which some specimens came in the current study. The three specimens from the two colluvium sites where schizomids were found during the current survey belonged to a new species (*Draculoides* sp. BHD2), which has so far not been recorded outside the study area. The two specimens recorded from a single colluvium site just north of the study area in 2010 belonged to a different species (*Draculoides* sp. BHD1) that has so far only been recorded from this drillhole. The remaining six specimens belonged to a third, and apparently more widespread, species; *Draculoides* sp. CI1. This taxon may also be less habitat-specific, having been collected in Marra Mamba inside the study area as well as in calcrete carbonate habitats from two sites outside the current study area (Figure 5.4).

At present, all three species would be regarded as SREs, but only one, *Draculoides* sp. BHD2, is restricted to the study area. Reviews of the habitat mapping completed for this study suggest it is likely that suitable habitat extends northwest of the study area boundary. Given that the record of *Draculoides* sp. BHD2 came from from close to the northern margin of the study area, these factors may suggest the species would also occur further to the north.

7.0 Glossary and Acronyms

BGL	Below ground level.
Biota	Biota Environmental Sciences.
DEM	Digital elevation model.
DSEWPaC	Department of Sustainability, Environment, Water, Population and Communities.
Edaphobitic / Edaphobite	Soil dwelling fauna that can often display troglomorphic characteristics. Edaphobites are unlikely to have limited distributions and therefore unlikely to be classified as short-range endemics.
Elliott trap	A collapsible aluminium box trap.
Endemic	Native to or confined to a certain region.
EPA	Environmental Protection Authority of Western Australia.
EPBC Act	Federal *Environment Protection and Biodiversity Act 1999*.
Fauna Landscape	A collection of similar landforms with definable functioning systems. A fauna landscape will support multiple fauna habitats.
Habitat	An ecological or environmental area that is inhabited by a particular organism.
IBRA	Interim Biogeographic Regionalisation for Australia.
Isometric	A method of showing a projection or perspective in which the three principal dimensions are represented by three axes 120° apart.
Landform	A geomorphological unit, that is largely defined by its surface form and location in the landscape.
Landscape	The visible features of an area of land, including the physical elements of landforms.
Lineage	Direct descent from a particular ancestor; ancestry. The descendants of a common ancestor considered to be the founder of the line.
Opportunistic	A species recorded from non-systematic sampling methods.
OTV	Optical televiewer.
Short-Range Endemic (SRE)	A species that has a naturally small distribution and is often characterized by having poor dispersal capabilities, confinement to disjunct habitats and low fecundity.
SM2	A model of Song Meter by Wildlife Acoustics.
Systematic sampling	Sampling using trapping transects (Elliott traps) installed in a defined habitat.
Taxonomy	Theory and practice of biological classification.
Troglomorphic	Pertaining to morphological, behavioural and physiological characters that are convergent in subterranean populations (Christiansen 1962).
Troglophilic / Troglophile	Species able to live and reproduce underground as well as in the epigean environment (Goodall et al. 2000).
Troglobite / Troglofauna	Species living obligatory in caves; also blind, depigmented and often having an elongate body morphology.
WAM	Western Australian Museum.

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8.0 References

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Appendix 1

Threatened Fauna Statutory Framework

This is the content of the first appendix.

Western Australian *Wildlife Conservation Act 1950-1979*

Under the *Wildlife Conservation Act 1950-1979* classification of rare and endangered fauna are defined by the *Wildlife Conservation (Specially Protected Fauna) Notice 2012*, which recognises four distinct schedules of taxa:

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

Federal *EPBC Act 1999*

Fauna species of national environmental significance are listed under the *EPBC Act 1999*, and may be classified as 'critically endangered', 'endangered', 'vulnerable' or 'lower risk'.

Critically Endangered (CR): a taxon is Critically Endangered when it is facing an extremely high risk of extinction in the wild in the immediate future.

Endangered (EN): a taxon is Endangered when it is not Critically Endangered but is facing a very high risk of extinction in the wild in the near future.

Vulnerable (VU): a taxon is Vulnerable when it is not Critically Endangered or Endangered but is facing a high risk of extinction in the wild in the medium-term future.

Lower Risk (LR): a taxon is Lower Risk when it has been evaluated, does not satisfy the criteria for any of the categories Critically Endangered, Endangered or Vulnerable. Taxa included in the Lower Risk category can be separated into three subcategories:

1. Conservation Dependent (CD). Taxa which are the focus of a continuing taxon-specific or habitat-specific conservation program targeted towards the taxon in question, the cessation of which would result in the taxon qualifying for one of the threatened categories above within a period of five years.
2. Near Threatened (NT). Taxa which do not qualify for Conservation Dependent, but which are close to qualifying for Vulnerable.
3. Least Concern (LC). Taxa which do not qualify for Conservation Dependent or Near Threatened.

Migratory species are also protected under the *EPBC Act 1999* as species of national environmental significance (Department of Environment 2014). The list of migratory species consists of those species listed under the following international conventions:

1. Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention);
2. China-Australia Migratory Bird Agreement (CAMBA);
3. Japan-Australia Migratory Bird Agreement (JAMBA); and
4. Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA).

1.1.1 DPaW Priority Fauna

In addition, the DPaW maintains a list of fauna that are deemed a priority, but have not been assigned statutory protection under the *Wildlife Conservation Act 1950.* Species on this list are

considered to be of conservation priority because there is insufficient information available to make an assessment of their conservation status, or they are considered to be rare but not threatened and are in need of monitoring. Under this list, five categories of priority are utilised:

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

Appendix 2

Regulation 17 Licence

Job# 931

Government of **Western Australia**
Department of **Environment and Conservation**

Your ref:
Our ref:
Enquiries: Sarah Francis
Phone: 9219 9833
Fax: 9334 0242
Email: wildlifelicensing@dpaw.wa.gov.au

Mr G Humphries
PO Box 155
LEEDERVILLE WA 6903

RECEIVED
23 SEP 2013
BY:.....

Dear licensee

RE : LICENCE TO TAKE FAUNA FOR SCIENTIFIC PURPOSES

Please find enclosed licence for the Fauna survey targeting conservation significant species using Elliott traps, echolocation call recording, motion sensitive cameras, hand foraging, and opportunistic sampling, and Troglofauna survey using litter traps in existing drillholes, at the Hope Downs 1 project area, surrounding the existing Hope Downs mine, 75km north of Newman, for Rio Tinto.

(1) RETURNS

Reg.17 licence applicants are to note and fulfil the following condition associated with this licence.

'Within one month of the expiration of this licence (or at such other time or times as the Director General may determine) the holder shall furnish to the Director General a return setting out in full detail the number of each species of fauna taken during the currency of the licence, the localities where the species was/were taken and the method of handling of such fauna and disposal of specimens.
A copy of any paper or report resulting from this research should be lodged in due course with the Director General. In the case of consultants, a list of the fauna handled, the localities involved and a copy of the interpretive data prepared should be lodged.'

Fauna Survey Returns System

Returns of fauna taken under a Regulation 17 'Licence to Take Fauna' may take several forms such as a written letter, thesis, report, published paper etc. forwarded to the Senior Fauna Licensing Officer (Fauna). In addition to this, in October 2008 DEC introduced a means of collecting, collating and making fauna data available to licence holders online. This is called *Fauna Survey* and it is now compulsory for licence holders to provide information on the species observed and the locations at which they were recorded in the approved .csv file format. DEC provides the server for data storage, a website to make returns online and a return template system which must be used to submit all data. All licence holders must see the following website and use the template provided online to fill in the data using the fields specified.

ALL Regulation 17 licence holders must make returns online, in the fauna survey return data format shown on the website.

www.dec.wa.gov.au/fauna_returns

To enter your returns on line you will require your Licence Number **SF009443** and your Person Number which is **38246.** These numbers are located on the top right hand corner of the licence, this will allow you to submit your licence returns, query data from a range of sources and download query results in CSV format.

Government of **Western Australia**
Department of **Environment and Conservation**

Your ref:
Our ref:
Enquiries: Sarah Francis
Phone: 9219 9833
Fax: 9334 0242
Email: wildlifelicensing@dpaw.wa.gov.au

If you have any queries regarding your licence, please contact Wildlife Licensing on (08) 9219 9833 or wildlifelicensing@dpaw.wa.gov.au.

Yours sincerely

.....
for Jim Sharp
A/DIRECTOR GENERAL

18 September 2013

DEPARTMENT OF PARKS AND WILDLIFE

Department of
Parks and Wildlife

Enquiries: 17 DICK PERRY AVE, KENSINGTON, WESTERN AUSTRALIA
Telephone: 08 9334 0333
Facsimile: 08 9334 0242

Correspondence: **Locked Bag 30**
Bentley Delivery Centre WA 6983

PAGE NO. 1
SF009443
PERSON NO. 38246

RECEIPT NO. **AMOUNT** $0.00

WILDLIFE CONSERVATION ACT 1950
REGULATION 17

LICENCE TO TAKE FAUNA FOR SCIENTIFIC PURPOSES

THE UNDERMENTIONED PERSON MAY TAKE FAUNA FOR RESEARCH OR OTHER SCIENTIFIC PURPOSES AND WHERE AUTHORISED, KEEP IT IN CAPTIVITY, SUBJECT TO THE FOLLOWING AND ATTACHED CONDITIONS, WHICH MAY BE ADDED TO, SUSPENDED OR OTHERWISE VARIED AS CONSIDERED FIT.

DIRECTOR GENERAL

CONDITIONS

1 THE LICENSEE SHALL COMPLY WITH THE PROVISIONS OF THE WILDLIFE CONSERVATION ACT AND REGULATIONS AND ANY NOTICES IN FORCE UNDER THIS ACT AND REGULATIONS.

2 UNLESS SPECIFICALLY AUTHORISED IN THE CONDITIONS OF THIS LICENCE OR OTHERWISE IN WRITING BY THE DIRECTOR GENERAL, SPECIES OF FAUNA DECLARED AS LIKELY TO BECOME EXTINCT, RARE OR OTHERWISE IN NEED OF SPECIAL PROTECTION SHALL NOT BE CAPTURED OR OTHERWISE TAKEN.

3 NO FAUNA SHALL BE TAKEN FROM ANY NATURE RESERVE, WILDLIFE SANCTUARY, NATIONAL PARK, MARINE PARK, TIMBER RESERVE OR STATE FOREST WITHOUT PRIOR WRITTEN APPROVAL OF THE DIRECTOR GENERAL. NO FAUNA SHALL BE TAKEN FROM ANY OTHER PUBLIC LAND WITHOUT THE WRITTEN APPROVAL OF THE GOVERNMENT AUTHORITY MANAGING THAT LAND.

4 NO ENTRY OR COLLECTION OF FAUNA TO BE UNDERTAKEN ON ANY PRIVATE PROPERTY OR PASTORAL LEASE WITHOUT THE CONSENT IN WRITING OF THE OWNER OR OCCUPIER, OR FROM ANY ABORIGINAL RESERVE WITHOUT THE WRITTEN APPROVAL OF THE DEPARTMENT OF INDIGENOUS AFFAIRS.

5 NO FAUNA OR THEIR PROGENY SHALL BE RELEASED IN ANY AREA WHERE IT DOES NOT NATURALLY OCCUR, NOR BE HANDED OVER TO ANY OTHER PERSON OR AUTHORITY UNLESS APPROVED BY THE DIRECTOR GENERAL, NOR SHALL THE REMAINS OF SUCH FAUNA BE DISPOSED OF IN SUCH MANNER AS TO CONFUSE THE NATURAL OR PRESENT DAY DISTRIBUTION OF THE SPECIES.

6 THIS LICENCE AND THE WRITTEN PERMISSION REFERRED TO AT CONDITIONS 3 & 4 MUST BE CARRIED BY THE LICENSEE OR AUTHORISED AGENT AT ALL TIMES FOR THE PURPOSE OF PROVING THEIR AUTHORITY TO TAKE FAUNA WHEN QUESTIONED AS TO THEIR RIGHT TO DO SO BY A WILDLIFE OFFICER, ANY OTHER STATE OR LOCAL GOVERNMENT EMPLOYEE OR ANY MEMBER OF THE PUBLIC.

7 **********ANY INTERACTION INVOLVING GAZETTED THREATENED FAUNA THAT MAY BE HARMFUL AND/OR INVASIVE MAY REQUIRE APPROVAL FROM THE DEPT OF SUSTAINABILITY, ENVIRONMENT, WATER, POPULATION & COMMUNITIES PH 02 6274 1111. INTERACTION WITH SUCH SPECIES IS CONTROLLED BY THE COMMONWEALTH GOVERNMENT'S "ENVIRONMENT PROTECTION AND BIODIVERSITY CONSERVATION ACT 1999" & "ENVIRONMENT PROTECTION AND BIODIVERSITY CONSERVATION REGULATIONS 2000" AS WELL AS DPaW'S WILDLIFE CONSERVATION ACT & REGULATIONS.**********

8 NO BIOPROSPECTING INVOLVING THE REMOVAL OF SAMPLE AQUATIC AND TERRESTRIAL ORGANISMS (BOTH FLORA AND FAUNA) FOR CHEMICAL EXTRACTION AND BIOACTIVITY SCREENING IS PERMITTED TO BE CONDUCTED WITHOUT SPECIFIC WRITTEN APPROVAL BY THE DIRECTOR GENERAL OF DPaW.

9 FURTHER CONDITIONS (NUMBERED \ TO 9) ARE ATTACHED.

PURPOSE

FAUNA SURVEY TARGETING CONSERVATION SIGNIFICANT SPECIES USING ELLIOTT TRAPS, ECHOLOCATION CALL RECORDING, MOTION SENSITIVE CAMERAS, HAND FORAGING, AND OPPORTUNISTIC SAMPLING, AND TROGLOFAUNA SURVEY USING LITTER TRAPS IN EXISTING DRILLHOLES, AT THE HOPE DOWNS 1 PROJECT AREA, SURROUNDING THE EXISTING HOPE DOWNS MINE, 75KM NORTH OF NEWMAN, FOR RIO TINTO.

AUTHORISED PERSONS

ROY TEALE, DAVID KEIRLE, MICHAEL GREENHAM, DANIEL KAMIEN, JASON ALEXANDER, TIM SACHSE, JESSICA CAIRNES, PENNY BROOSHOOFT, VICKIE CARTLEDGE, CHRIS COLE, SYLVIE SCHMIDT, STEWART FORD, JACINTA KING, MICHAEL DELANEY, ANDREW SHEPPARD.

DEPARTMENT OF PARKS AND WILDLIFE

Department of
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PERSON NO. SF009443
38246

DATE OF ISSUE 18/09/2013
VALID FROM 18/09/2013
DATE OF EXPIRY 30/11/2013

LICENSING OFFICER

LICENSEE: DR G HUMPHREYS (GARTH)
ADDRESS BIOTA ENVIRONMENTAL SCIENCES
P.O. BOX 155
LEEDERVILLE
W.A. 6903

WILDLIFE CONSERVATION REGULATIONS 1970

Regulation 17:- Licence to Take Fauna for Scientific Purposes

FURTHER CONDITIONS (OF LICENCE NUMBER SF009443)

1. The licensee shall take fauna only in the manner stated on the endorsed Regulation 17 licence application form and endorsed related correspondence.

2. Except in the case of approved lethal traps, the licensee shall ensure that measures are taken in the capture and handling of fauna to prevent injury or mortality resulting from that capture or handling. Where traps or other mechanical means or devices are used to capture fauna these shall be deployed so as to prevent exposure of trapped animals to ants and debilitating weather conditions and inspected at regular intervals throughout each day of their use. At the conclusion of research all markers etc and signs erected by the licensee and all traps shall be removed, all pitfalls shall be refilled or capped and the study area returned to the condition it was in prior to the research/capture program. During any break in research, cage traps should be removed and pitfalls either removed, capped or filled with sand.

3. No collecting is to be undertaken in areas where it would impinge on pre-existing scientific research programs.

4. Any form of colour marking of birds or bats shall only be undertaken in accordance with the requirements of the Australian Bird and Bat Banding Scheme.

5. Any inadvertently captured specimen of fauna which is declared as likely to become extinct, rare or otherwise in need of special protection is to be released immediately at the point of capture. Where such a specimen is injured or deceased, the licensee shall contact Department of Parks and Wildlife licensing staff at Kensington (08 9219 9833) for advice on disposal. Records are to be kept of any fauna so captured and details included in the report required under further condition 6 below.

6. Within one (1) month of the expiration of this licence, the holder shall submit an electronic return detailing the locality, site, geocode, date and number of each species captured, sighted or vouchered during the currency of the licence, into the Department's Fauna Survey Return System. A copy of any paper, report or thesis resulting from the research shall on completion be lodged with the Director General. If a renewal of this licence is required, the licensee shall submit a written progress report for activities undertaken during this licence period prior to the expiry of this licence.

7. Not more than ten specimens of any one protected species shall be taken and removed from any location less than 20km apart. Where exceptional circumstances make it necessary to take large series in order to obtain adequate statistical data the collector will proceed with circumspection and justify their actions to the Director General in advance.

8. All holotypes and syntypes and a half share of paratypes of species or subspecies permitted to be permanently taken under this licence shall be donated to the Western Australian Museum. Duplicates (one pair in each case) of any species collected which represents a significant extension of geographic range shall be donated on request to the Western Australian Museum.

9. To prevent any unnecessary collecting in this State, all specimens and material collected under the authority of this license shall, on request, be loaned to the Western Australian Museum. Also, the unused portion or portions of any specimen collected under the authority of this license shall be offered for donation to the Western Australian Museum or made available to other scientific workers if so required.

Appendix 3

Helix Mygalomorph Spider Report

Helix
Molecular
Solutions

School of Animal Biology The University of Western Australia
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3 April, 2015

Dan Kamien
Biota Environmental Sciences Pty. Ltd.
Level 1, 228 Carr Place,
Leederville, WA 6007, AUSTRALIA

Via email

Re. Report on the molecular systematics of Mygalomorphae from Baby Hope Downs

Dear Dan,

Following is a summary of the results for the Baby Hope Downs collections. We detected three distinct genetic lineages in a single family of Mygalomorphae (Nemesiidae). The three Mygalomorphae lineages likely represent three putative species, all of which have been detected previously in the Pilbara.

Thank you once again for collaborating on this project with Helix. We hope we can continue to provide you with useful information, and feel free to contact us if you have any questions or would like to discuss the results in detail.

Sincerely,

Dr. Terrie Finston, Yvette Hitchen and Dr. Jason Kennington
Helix Molecular Solutions Pty Ltd

Background
Extensive molecular work has been conducted on the trap-door spider fauna of Western Australia (Helix 2012a). The resulting dataset provides a molecular framework that can be used to provide a regional context for localised sampling.

The present study involved the collection and sequencing of ten Mygalomorphae specimens from the Baby Hope Downs site in order to assess their relationships to the existing sequencing records for more than 2200 specimens from the Pilbara.

The new Baby Hope Downs Mygalomorphae sequences were added to the existing sequence dataset to assign specimens to existing lineages and species or to identify new lineages/species.

Executive Summary
- Ten specimens from Baby Hope Downs were sequenced for COXI.
- A DNA sequence was obtained from six of the ten specimens.
- Phylogenetic analysis of the six new specimens revealed the presence of three distinct genetic lineages.
- The three lineages likely represent three species of Nemesiidae, all of which have been detected previously in the Pilbara.

Methods
The specimens were sequenced and analysed as previously described (Helix 2012b), with the following changes:

In order to reduce analysis time and to simplify the presentation of results, a preliminary neighbour-joining (NJ) tree was constructed from the six new specimens for which sequences were obtained, in order to identify the number of unique lineages present. Representatives from each lineage were then used in a model-based phylogenetic analysis along with 41 reference specimens of Mygalomorphae as described below.

Model-based phylogenetic analysis was performed using the lineages of Mygalomorphae detected among the new specimens and a sub-set of reference lineages (N=41) that were selected based on the criteria that they showed ≤12% sequence divergence from at least one of the new lineages. The reference lineages represented a single family of Mygalomorphae detected in the Pilbara (Nemesiidae). Lineages detected in the present study were assumed to belong to a previously detected lineage when they shared a single common ancestor, were well-supported by posterior probabilities (≥0.95), and differed from one another by ≤3% sequence divergence.

Results
Six of the ten specimens yielded a 425 - 678 base-pair fragment of the COXI gene (Table 1).

Preliminary analysis
The NJ analyses placed the six new specimens into three distinct genetic lineages (haplotypes or clusters of highly similar haplotypes separated from other such clusters by long branch lengths; Figure 1). The number of individuals in each lineage ranged from 1 to 3 (Figure 1; Table 1).

Mean genetic distances between individuals within the three Baby Hope Downs lineages detected in the NJ analysis ranged from 0.5 to 1.3% sequence divergence (Table 2). The three lineages differed from one another by between 17.7 and 20.3% mean sequence divergence (Table 3).

Phylogenetic analyses
Model-based phylogenetic analysis was performed using representatives of the three lineages detected among the new Baby Hope Downs specimens and 41 reference lineages that were ≤ 12% divergent from at least one of the new lineages (Figure 2). The GTR+I+G model was used for the analysis, with the tree running for 1 $\times 10^6$ generations. Specimens were assumed to belong to the same lineage as a reference specimen when they shared a single common

ancestor, were well-supported by posterior probabilities (≥0.95), and differed from one another by ≤3% sequence divergence.

All three of the lineages detected in the present study (HM13, HM17, HM20) were placed in well-supported lineages that also contained reference specimens of Nemesiidae (Figure 2). HM13 was placed in a well-supported lineage containing reference lineage NH, which with eight other lineages, formed species N1 (Figure 2). HM17 was placed in a well-supported clade containing lineage NY, forming species N37 (Figure 2). HM20 was placed in a well-supported clade with reference lineage NG, which with 15 other lineages, formed species N16 (Figure 2).

Genetic differentiation between haplotypes and lineages

The three lineages of Nemesiidae differed from the reference specimens by between 1.3 and 22.1% sequence divergence (Table 4). All three lineages from Baby Hope Downs showed a high genetic similarity to reference lineages. Baby Hope Downs specimen HM13 differed from the reference lineage NH by 1.3% sequence divergence, and specimen HM17 differed from the reference lineage NY by 1.9% sequence divergence (Table 4). Specimen HM20 differed from reference lineage NG by 1.3% sequence divergence (Table 4).

Conclusions

Taxonomic implications

The number of lineages and putative species detected in the present study, as assessed using standard methods (Helix, 2012a), may be summarised as follows:

Nemesiidae (three lineages, three species)

One specimen was assigned to the existing lineage NH and two specimens were assigned to the existing lineage NG. These lineages were assigned to existing species N1 and N16 respectively. Three specimens were assigned to the existing lineage NY, which was assigned to the existing species N37.

Distributions of lineages and species

All three of the lineages of Nemesiidae collected at Baby Hope Downs (NG, NH and NY) have been detected previously. Lineage NG has been detected previously at six sites (Area C, Hamersley Range, Southern Flank to Jinidi Rail, Mudlark, Newman as well as Hope Downs). Lineage NG was assigned to species N16, which has been detected previously at ten additional sites for a total of 17 sites, including Baby Hope Downs (Table 5). Lineage NH has been detected at six sites (Area C, Newman, Mudlark, Juna Downs Station, Area C West, Koodaideri Southern Corridor). Lineage NH was assigned to species N1, which has been detected previously at eight additional sites for a total of 14 sites (Table 5). Finally, lineage NY was detected previously at Newman and Mudlark. Lineage NY is so far the only lineage assigned to species N37 (Table 5).

In summary, three lineages of Nemesiidae were detected at Baby Hope Downs. These lineages may be grouped into three species, all of which have been detected previously at reference sites.

References

Helix 2012a. Report on the Molecular systematics of Mygalomorphae from the Pilbara. Unpublished report, prepared for Biota Environmental Sciences, 31 January.

Helix Molecular Solutions (2012b). Molecular systematics of invertebrates from Koodaideri. Unpublished report, prepared for Biota Environmental Sciences, 25 April.

Table 1. Specimens used in this study, and the genetic lineage and putative species to which they were assigned based on variation at the COXI gene. ND= no data.

WAM ID	Field ID	Helix ID	Lineage/Species
132658	M20130912 HDTSRE02-01	HM12	ND
132659	M20130912 HDTSRE02-02	HM13	NH/N1
132660	M20130913.HDTSRE04-01	HM14	ND
132661	M20130913 HDTSRE04-02	HM15	NY/N37
132662	M20130914 HDTSRE06-01	HM16	NG/N16
132663	M20130914 HDTSRE06-02	HM17	NY/N37
132664	M20130914HDTSRE06-03	HM18	ND
132665	M20130914HDTSRE06-04	HM19	NY/N37
132666	M20130914 HDTSRE07-01	HM20	NG/N16
132667	M20130915.HDTSRE08-01	HM21	ND

Table 2. Mean distance (D) and standard error (s.e.) within lineages and the number (N) of individuals assigned to that lineage, detected in the Neighbour-Joining analysis. rep= haplotype chosen to represent the lineage in the model-based phylogenetic analysis. n/c= not calculated, where N=1.

Lineage	D	s.e.	N	rep
1	0.005	0.003	3	HM17
2	0.013	0.006	2	HM20
3	n/c	n/c	1	HM13

Table 3. Mean distance (below diagonal) and standard error (above diagonal, in blue) between lineages of Mygalomorphae detected at Baby Hope Downs in the Neighbour Joining analysis.

Lineage	1	2	3
1		0.018	0.017
2	0.177		0.015
3	0.190	0.203	

Table 4 (attached). Pairwise distance (below diagonal) and standard error (above diagonal, in blue) between lineages of Nemesiidae detected in the present study and selected reference lineages. Distances between the Baby Hope Downs lineages and the reference lineages are highlighted in yellow.

Table 5. Putative species (defined as groups of lineages that form well-supported clades and differ by <9.5% sequence divergence) detected in the present study and the distinct genetic lineages that compose them.

Species	Composite lineages	Distribution
Nemesiidae		
N1	NA, NH, NI, NAC, NBD, NEI, NFP, NFM, NFY	South Parmelia, Marillana, Koodaideri, Jimblebar, Davidson Creek, Koodaideri Southern Corridor, Newman, Area C, Area C West, Jinayri, Jinidi to Mainline, Mudlark, Juna Downs Station, Baby Hope Downs
N16	NB, NG, NEK, NEP, NEQ, NFE, NFR, NFS, NFT, NFU, NFV, NIB, NIC, NREF1	Jinayri, South Parmelia, Jinidi, Southern Flank to Jinidi Rail, Jinidi to Mainline, Newman, Koodaideri, Koodaideri Western Corridor, Koodaideri Southern Corridor, Area C, Area C West, Hope Downs, Hamersley Range, Mudlark, West Angelas, Juna Downs Station, Baby Hope Downs
N37	NY	Newman, Mudlark, Baby Hope Downs

Figure 1. Neighbour-joining analysis of the six specimens of Mygalomorphae from Baby Hope Downs. Numbers on nodes correspond to bootstrap support over 2000 iterations; values < 50% not shown. Scale bar= genetic distance. The specimens selected to represent each lineage (labelled 1 – 3) are highlighted in yellow.

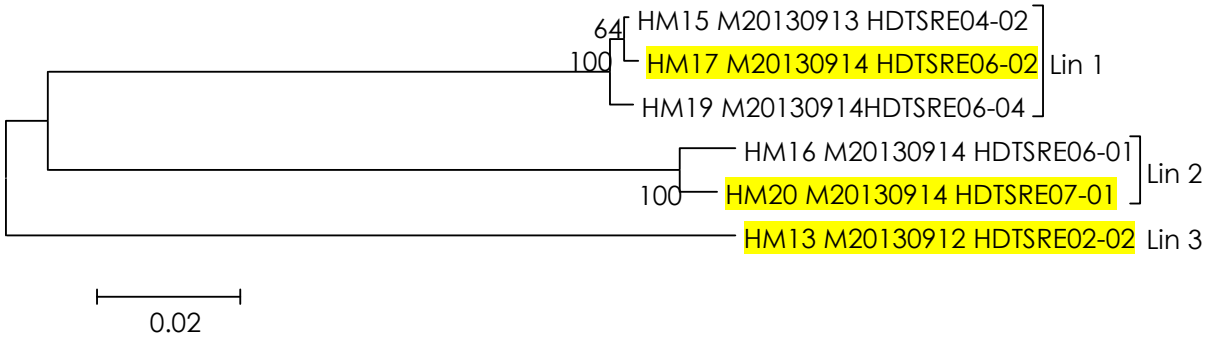
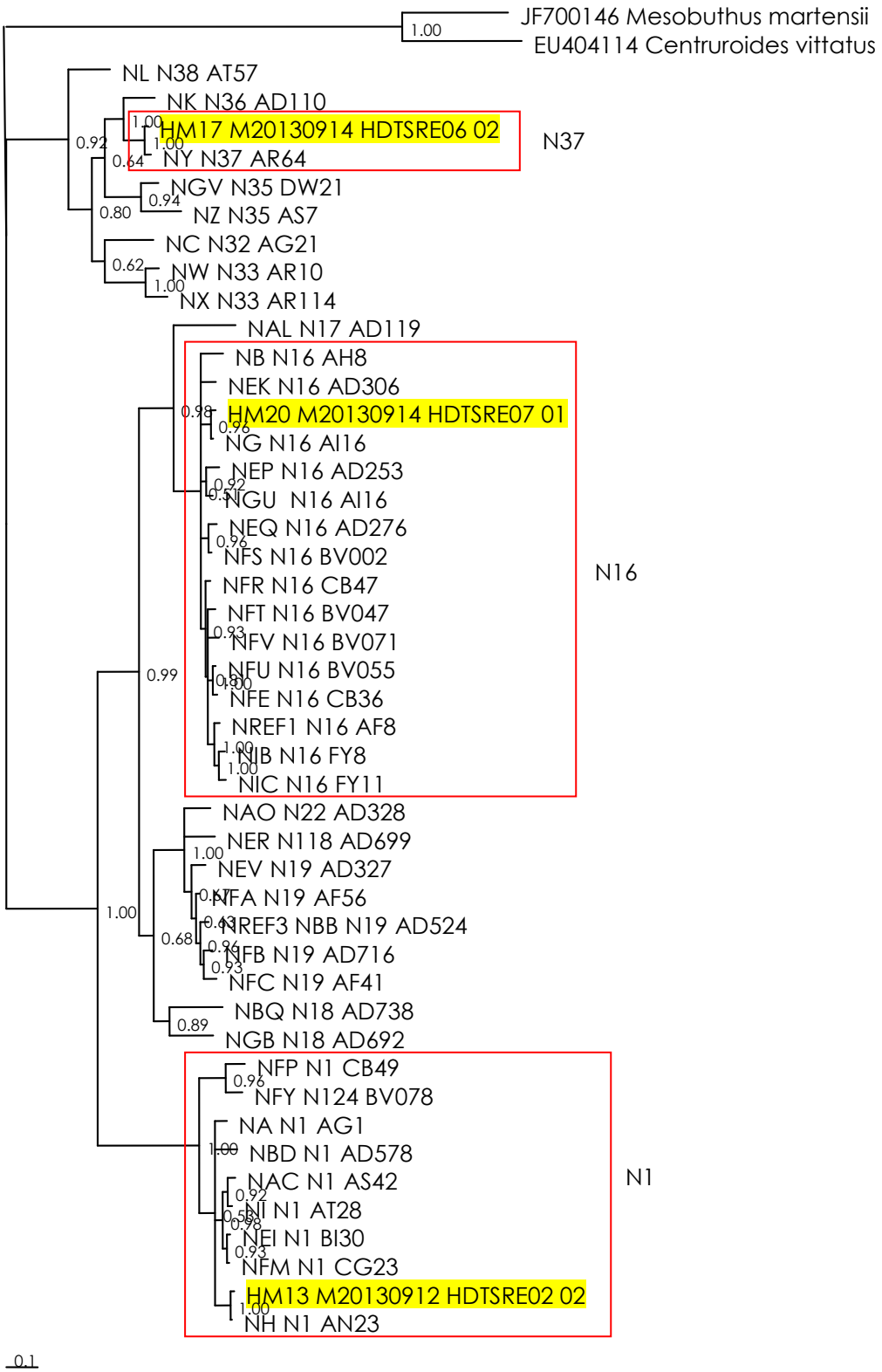


Figure 2. Bayesian analysis of COXI haplotypes of Nemesiidae from Baby Hope Downs. Numbers on major nodes correspond to posterior probabilities; values <50% are not shown. Lineages from the present study are highlighted in yellow. Scale bar= number of substitutions per site. Clades that are well supported and whose composite lineages differ by ≤ 9.5%, or which have met these criteria in previous studies, are enclosed by red boxes. *= new lineage or species this study.



Appendix 4

Helix Schizomid Report

Helix
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3 April 2015

Dan Kamien
Biota Environmental Sciences
Level 1, 228 Carr Place
Leederville, WA 6007

Via email

Re. Report on the molecular systematics of Schizomida from Baby Hope Downs

Dear Dan,

Following is a summary of the results of the schizomid study we have completed from Baby Hope Downs. The 11 specimens of schizomids likely belong to three species. One of the three species has been detected previously in the Pilbara, whereas the other two appear to be new, based on the material available for comparison.

Thanks once again for collaborating on this project with Helix. We hope we can continue to provide you with useful information, and feel free to contact us if you have any questions or would like to discuss the results in detail.

Sincerely,

Dr. Terrie Finston, Yvette Hitchen and Dr. Oliver Berry
Helix Molecular Solutions

Background and Objective

Extensive molecular work has been conducted on the schizomid fauna of Western Australia (Helix, unpublished). The resulting dataset provides a molecular framework that can be used to provide a regional context for localised sampling.

The present study involved the collection and sequencing of 11 schizomid specimens from the Baby Hope Downs site in order to assess their relationships to the existing sequencing records for more than 300 specimens from the Pilbara.

The new Baby Hope Downs schizomid sequences were added to the existing sequence dataset to assign specimens to existing lineages and species or to identify new lineages/species.

Executive summary

- Eleven schizomid specimens from Baby Hope Downs were sequenced for variation at the COXI gene.
- All 11 schizomid specimens yielded a 686 - 839 base-pair fragment of the COXI gene.
- Phylogenetic analysis and genetic distance measures were employed to estimate the number of species present.
- The 11 schizomid specimens were placed in three distinct genetic lineages, which likely correspond to three distinct species.
- One of the three species has been detected previously in the Hamersley Range area, whereas two appear to be new, based on the material available for comparison.

Methods

Eleven specimens of Schizomida collected from the Baby Hope Downs area (Table 1) were sequenced for variation at the mitochondrial cytochrome oxidase subunit I gene (COXI) using primers LCOI/CIN2341.

Sequences were edited using GENEIOUS software (Drummond *et al.* 2011). Alignment was performed with CLUSTAL W (Thompson *et al*. 1994) using default parameters. Genetic distances between unique genetic sequences (haplotypes) were measured using uncorrected p-distances (total percentage of nucleotide differences between sequences).

MODELTEST software (Posada and Crandall, 1998) was used to determine the model of sequence evolution that best fitted the data. Bayesian analysis was used to construct the phylogenetic tree, incorporating the model as identified in MODELTEST. The phylogeny, branch lengths and posterior probabilities were obtained by running two trees simultaneously, each running four simultaneous MCMC chains. The number of cycles needed was determined by the standard deviation of the split frequencies of the two trees. The analysis was paused after every 1 x 10^6 generations and when the standard deviation fell below 0.01, the analysis was stopped. A majority rule consensus tree was constructed after discarding the "burn-in" trees. The burn-in value was determined by plotting the posterior probabilities obtained after every generation and identifying the point at which the values reach stationarity (= the asymptote). Trees produced prior to stationarity were discarded.

Results

All 11 specimens yielded an 686 - 839 base-pair fragment of the COXI gene (Table 1).

Preliminary analysis

In order to reduce analysis time and to simplify the presentation of results, a preliminary neighbour-joining (NJ) tree was constructed from the 11 new sequences in order to identify the number of unique lineages present. Representatives from each lineage were then used in a model-based phylogenetic analysis along with a sub-set of reference specimens of schizomids that were selected based on the criteria that they showed ≤ 15% sequence divergence from at least one of the new lineages. Three hundred and ninety reference sequences were tested, and of those, 34 were detected that differed by ≤ 15% sequence divergence from the new Baby Hope Downs specimens. The 34 individuals represented 34 distinct lineages (haplotypes or

groups of closely related haplotypes that differ from other such groups by >3% sequence divergence). Representatives of the nine described species of *Draculoides* and *Paradraculoides* were also included in the preliminary analysis and those that fit the above criteria were included in the analysis as reference sequences.

The NJ tree revealed the presence of three distinct lineages of schizomids (Figure 1). The number of specimens in each lineage ranged from two to six (Table 2).

Individuals within each of the three lineages detected in the NJ analysis differed from one another by between 0 and 2.5% mean sequence divergence (Table 2). The three NJ lineages differed from one another by between 7.6 and 8.0% mean sequence divergence (Table 3).

Phylogenetic analysis
The phylogenetic analysis, which included the three Baby Hope Downs lineages detected in the NJ analysis, in addition to 34 reference specimens of schizomids, revealed the presence of 36 lineages (Figure 2). All of the Baby Hope Downs specimens (highlighted in yellow; Figure 2) formed a well-supported clade with reference specimens from a previous survey in the Hamersley Range area, and in particular, one of the Baby Hope Downs lineages (HM1) was placed in the same lineage as one of the reference specimens from the Hamersley Range (Figure 2).

Differentiation within and between lineages
The 39 specimens included in the phylogenetic analysis shown in Figure 2 differed from one another by between 2.3 and 18.8% sequence divergence (Table 4). The three lineages from the present study differed from the reference lineages by between 2.3 and 17.7% sequence divergence (Table 4). Specifically, HM1 differed from reference specimen CI1 by 2.3% sequence divergence, HM4 differed from CI2 by 6.9% and HM9 differed from CI4 by 7.7% (Table 4).

Conclusions
COXI is widely considered to show suitable variation to distinguish species (Hebert et al., 2003a). In a comparison of COXI sequences for over 13,000 pairs of taxa, Hebert et al (2003b) found a mean of 11.1% sequence divergence between distinct species. Nearly 80% of the comparisons showed that species pairs differed from one another by greater than 8% sequence divergence. More specifically, previous analyses of genetic variation between morphologically distinct species of Schizomida can be used as a genetic 'yardstick' to interpret the current data set. The five species of *Paradraculoides* differ from one another by between 8.4 to 12.1% sequence divergence (uncorrected p-distances; calculated from Harvey et al., 2008). Similarly, the four species of *Draculoides* differ from one another by between 4.5 to 13.7% sequence divergence (uncorrected p-distances from Harvey et al., 2008).

Three lineages of schizomids from Baby Hope Downs were detected in the present study, differing from one another by between 7.6 and 8.0% sequence divergence. Based on the observed distances between the three lineages, each likely represents a distinct species. Baby Hope Downs lineage HM1 was sufficiently similar (2.3% sequence divergence) to reference lineage CI1 to conclude that they belong to the same species. However, based on the observed distances between the remaining two lineages from Baby Hope Downs (HM4 and HM9) and the reference specimens (>7%), it is likely that these two lineages represent two new, distinct species. The Baby Hope Downs species share a recent common ancestor with the reference specimens from a previous survey at Hamersley Range.

In summary, based on phylogenetic and distance analyses, the three lineages detected at Baby Hope Downs are likely to represent three species, one of which has been detected previously in the Hamersley Range area and two of which appear to be new, based on the material available for comparison.

References

Drummond AJ, Ashton B, Buxton S, Cheung M, Cooper A, Duran C, Field M, Heled J, Kearse M, Markowitz S, Moir R, Stones-Havas S, Sturrock S, Thierer T, Wilson A (2011) Geneious v5.4, http://www.geneious.com/

Harvey, M. S., Berry, O. Edward, K. L., Humphreys, G. (2008) Molecular and morphological systematics of hypogean schizomids (Schizomida: Hubbardiidae) in semiarid Australia. Invertebrate Systematics 22: 167-194.

Hebert, P.D.N., Cywinska, A., Ball, S.L., deWaard J.R. (2003a). Biological identifications through DNA barcodes. Proceedings of the Royal Society of London B 270: 313-321.

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Simon, C., Fratl, F, Beckenbach, A., Crespi, B., Liu, H., Flook, P. (1996) Evolution, weighting, and phylogenetic utility of mitochondrial gene sequences and a compilation of conserved polymerase chain reaction primers. Annals of the Entomological Society 87: 651-701.

Thompson, J., Higgins, D., and Gibson, T. (1994). CLUSTAL W: improving the sensitivity of progressive multiple sequence alignment through sequence weighting, position-specific gap penalties and weight matrix choice. Nucleic Acids Research 22: 4673–4680. doi:10.1093/nar/ 22.22.4673

Table 1. Specimens of Schizomida from Baby Hope Downs used in the present study and the lineage and species to which they were assigned, based on variation at the COXI gene.

Helix ID	Source	Sample ID	Tube ID	Lineage/Species
HM1	Biota	RC12H1SW0026P1T1-1	15	Lineage 1/ species CI1
HM2	Biota	RC12H1SW0026P1T3-1	5	Lineage 1/ species CI1
HM3	Biota	RC12H1SW0051T3-2	48	Lineage 3/ new species BHD2
HM4	Biota	RC12H1SW0144T3-4	86	Lineage 3/ new species BHD2
HM5	Biota	RC12H1SW0144T3-4	86	Lineage 3/ new species BHD2
HM6	WAM	1218P1T1-4	221	Lineage 1/ species CI1
HM7	WAM	1218P1T1-4	221	Lineage 1/ species CI1
HM8	WAM	1218P1T3-3	129	Lineage 1/ species CI1
HM9	WAM	RC07HIS1048P1T1-3	136	Lineage 2/ new species BHD1
HM10	WAM	RC07HIS1048P1T1-3	136	Lineage 2/ new species BHD1
HM11	WAM	5515Pt1T1-2	138	Lineage 1/ species CI1

Table 2. Mean distance (D) and standard error (s.e.) within lineages of schizomids and the number (N) of individuals assigned to that lineage, detected in the preliminary NJ analysis as shown in Figure 2. rep= haplotype(s) chosen to represent the lineage in the model-based phylogenetic analysis. n/c = not calculated, for groups where n=1.

Lineage	D	s.e.	N	rep
1	0.025	0.004	6	HM1
2	0.000	0.000	2	HM9
3	0.016	0.004	3	HM4

Table 3. Mean distance (below diagonal) and standard error (above diagonal, in blue) between lineages of schizomids detected at Baby Hope Downs in the preliminary NJ analysis as shown in Figure 1.

Lineage	1	2	3
1		0.010	0.011
2	0.076		0.010
3	0.080	0.077	

Table 4 (attached). Pairwise COXI distances (below diagonal) between lineages of schizomids detected in the model-based phylogenetic analysis as shown in Figure 2. Above diagonal= standard error.

Figure 1. Neighbour-joining analysis of the 11 specimens of schizomids from Baby Hope Downs. Numbers on nodes correspond to bootstrap support over 2000 iterations; values < 50% not shown. Scale bar= genetic distance. The three specimens selected to represent the three genetic lineages are highlighted in yellow.

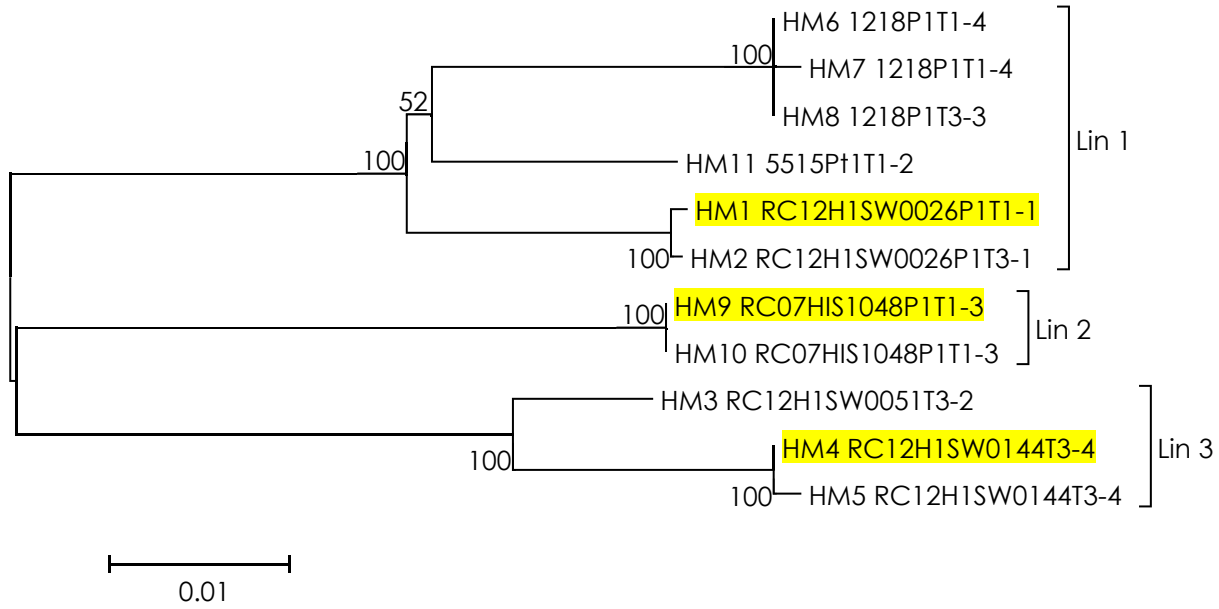
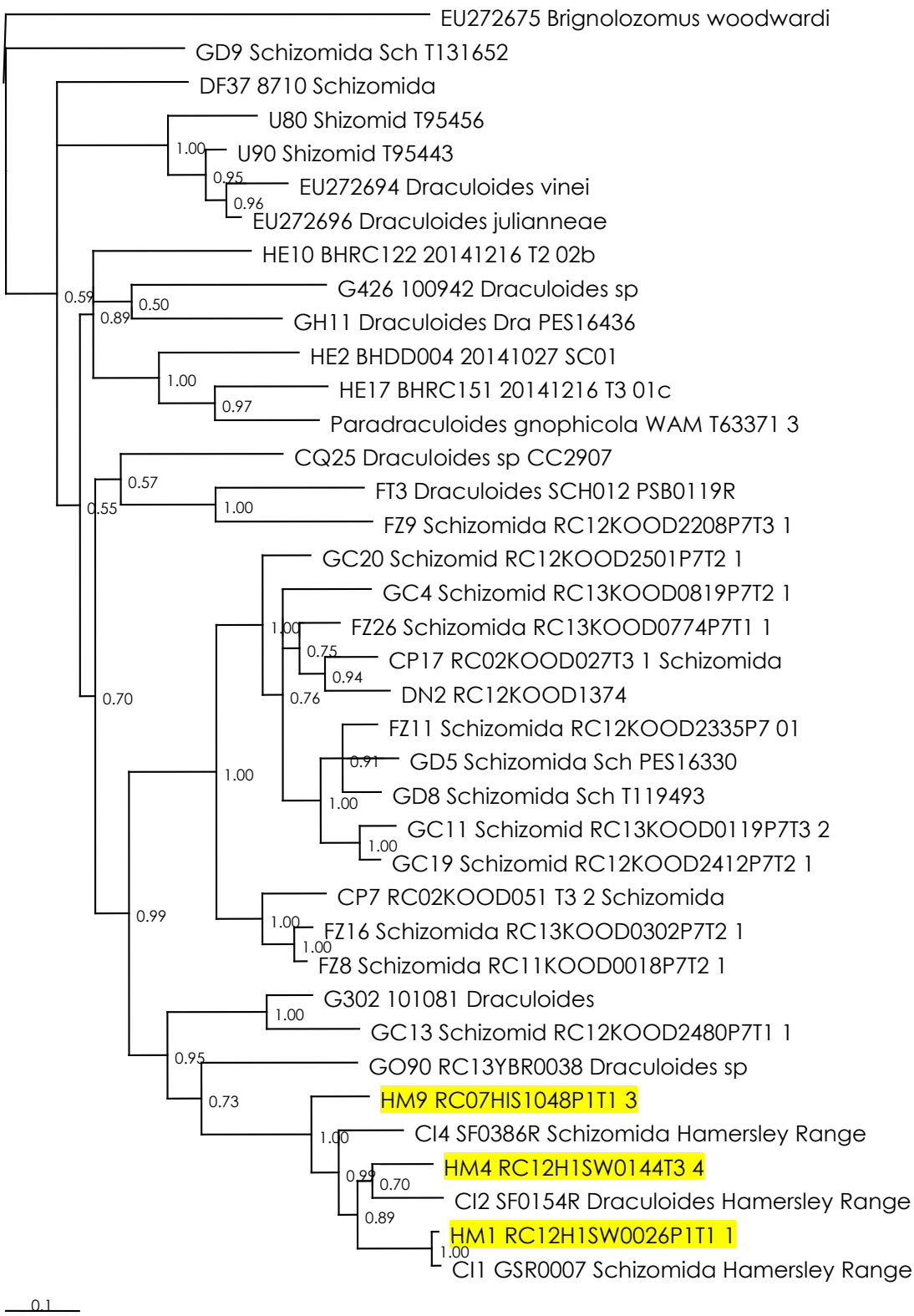


Figure 2. Bayesian analysis of COXI haplotypes of Schizomida from the present study. Numbers on major nodes correspond to posterior probabilities; values <50% are not shown. Specimens from the present study are highlighted in yellow. Scale bar= number of substitutions per site.



Appendix 5

WA Bat Call Report

Hope Downs 1 fauna survey, Pilbara WA, September 2013

Echolocation Survey of Bat Activity.

Prepared for Biota Environmental Sciences

Bat Call WA Pty Ltd
ABN 26 146 117 839
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Prepared by:
R. D. Bullen – Bat Call WA
Issue 1
4 October 2013

Document Revision History

Date	Issue	Revision History
4 Oct 2013	Issue 1	Initial issue prepared for Biota

Summary
Microbat species presence, with an estimate of activity level, is presented for four sites at the Hope Downs 1 mine in the Pilbara, WA. Biota Environmental Sciences carried out an echolocation based targeted survey during September of 2013. Bat Call WA has reviewed the recordings made and provided species lists for the bats present.

Six species of echolocating microbats were recorded. No Pilbara leaf-nosed (*Rhinonicteris aurantia*) or Ghost bat (*Macroderma gigas*) calls were detected.

Habitats
Sites for the survey were chosen by Biota. The sites were chosen to target the presence of Pilbara leaf-nosed bats and Ghost bats. Breakaways with caves and ephemeral watercourses were targeted. The survey was carried out over 6 recording nights in September 2013. Details of the sites are presented in Table 1. The general locations of the sites are shown in relation to the local features in Figure 1.

Characteristics of the calls recorded are presented in Table 2.

Bat Fauna
A microbat assemblage of six insectivorous species was confirmed as present at the study sites, Table 3. Each of the insectivorous species is common in the region. No Pilbara leaf-nosed or Ghost bat calls were detected.

Species activity levels was low to medium, which is expected for the study area habitats and the time of year, see criteria below.

Survey Timing, Moon Phase and Weather
The echolocation survey was conducted between 9th to 15th September 2013. Sampling evenings were warm and dry with minimum overnight temperatures around 15^{O}C. The moon in this period was first quarter. These conditions correspond to typical levels of bat echolocation detection for the season.

Survey Team
A team of Biota ecologists conducted the bat sampling work. Bob Bullen of Bat Call WA completed analysis of echolocation recordings.

Systematic Sampling
The survey consisted of completing six overnight bat sound recordings, beginning at twilight, at locations within the survey area. The recordings were “continuous” (Hyder *et al.* 2010) made using a SM2BAT SongMeter (Wildlife Acoustics Inc, USA). The jumper and audio settings used for the SM2BAT followed the manufacturers recommendations for bat detection contained in the user manual (Wildlife Acoustics 2010). Selectable filters and triggers were also set using the manufacturers recommendations, see also Table 4. Table 2 provides details of the methods used by date and site.

For the recordings, once reformatted as .wav files, COOL EDIT 2000 (Now available as AUDITION from Adobe Systems Inc.) was used to display each sequence for identification. Calls were identified manually. Only good quality call sequences were used. Details of calls analysed are provided in Table 2 as recommended by Australasian Bat Society (ABS 2006). Reference data for the species identified are available in Bullen and McKenzie 2002, McKenzie and Bullen 2003 and McKenzie and Bullen 2009.

Bat activity was then characterised as "Low", "Medium" or "High" based on the rate of call sequences recorded.

- Low species activity is referred when a species is recorded with call spacing less often than ten minutes,
- Medium species activity refers to call recordings more often than 10 minutes but less often than two minutes apart for a at least an hour followed by sporadic records for the remainder of the session.
- High species activity refers to call recording more often than two minutes apart for at least two hours followed by reasonably regular records for the remainder of the session.

Survey Limitations

The sites surveyed were accessible on foot and the SM2, using an omnidirectional microphone, was set on the ground with the microphone horizontal. Species are unlikely to be under-represented as a result.

Bat species density away from cave or adit entrances is impossible to estimate from echolocation records. Bat activity is therefore substituted as an approximate guide to the relative numbers of each species using the study area.

References

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McKenzie N.L. and Bullen R.D. (2003). Identifying Little Sandy Desert bat species from their echolocation calls. *Australian Mammalogy* 25: 73-80.

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Table 1 Site Specific details.

Site	Date	Recording Time	Habitat	Easting Note 1	Northing Note 1
HDTbat1E	15th Sept	One overnight recording using SM2	On rim of south facing gully	710795	7453757
HDTbat2E	13th Sept	One overnight recording using SM2	On rim of south facing gully	711528	7453502
HDTbat3E	11th to 12th Sept	Two overnight recordings using SM2	On rim of south facing gully	712660	7453622
HDTbat4E	9th to 10th Sept	Two overnight recordings using SM2	On rim of south facing gully	713865	7453741

Note 1: Coordinates are GDA94 Zone 50K

Table 2: Summary of Echolocation call characteristics for microbat species present.

Genus species Authority	Common name	Typical F_{peakC} kHz	Ave. Q	Typical Duration msec	Typical Call Shape
Chalinolobus gouldii (Gray 1841)	Gould's wattled bat	32	10	7 - 11	FM
Nyctophilus geoffroyi Leach 1821	Lesser long-eared bat	45	3	5	Steep FM
Saccolaimus flaviventris (Peters 1867)	Yellow-bellied sheath-tailed bat	17	9	12 - 21	CF - FM
Scotorepens greyii (Gray 1843)	Little broad-nosed bat	38	10	7 - 13	FM
Taphozous georgianus Thomas 1915	Common sheath-tailed bat	24.5	14	9 - 18	CF– shallow FM
Vespadelus finlaysoni (Kitchener, Jones and Caputi 1987)	Inland cave bat	55	14	4 - 8	FM

Note: FpeakC and Q are defined in McKenzie and Bullen 2003, 2009.

Table 3. Microbat lists obtained presented by site and night.

Site	Date	*Chalinolobus gouldii*	*Nyctophilus geoffroyi*	*Saccolaimus flaviventris*	*Scotorepens greyii*	*Taphozous georgianus* Note 1.	*Vespadelus finlaysoni*
HDTbat1E	15th Sept	Low					Med
HDTbat2E	13th Sept	Low			Low		Med
HDTbat3E	11th to 12th Sept			Low	Low	Low	Low
HDTbat4E	9th to 10th Sept	Low	Low	Low	Low	Low	Low

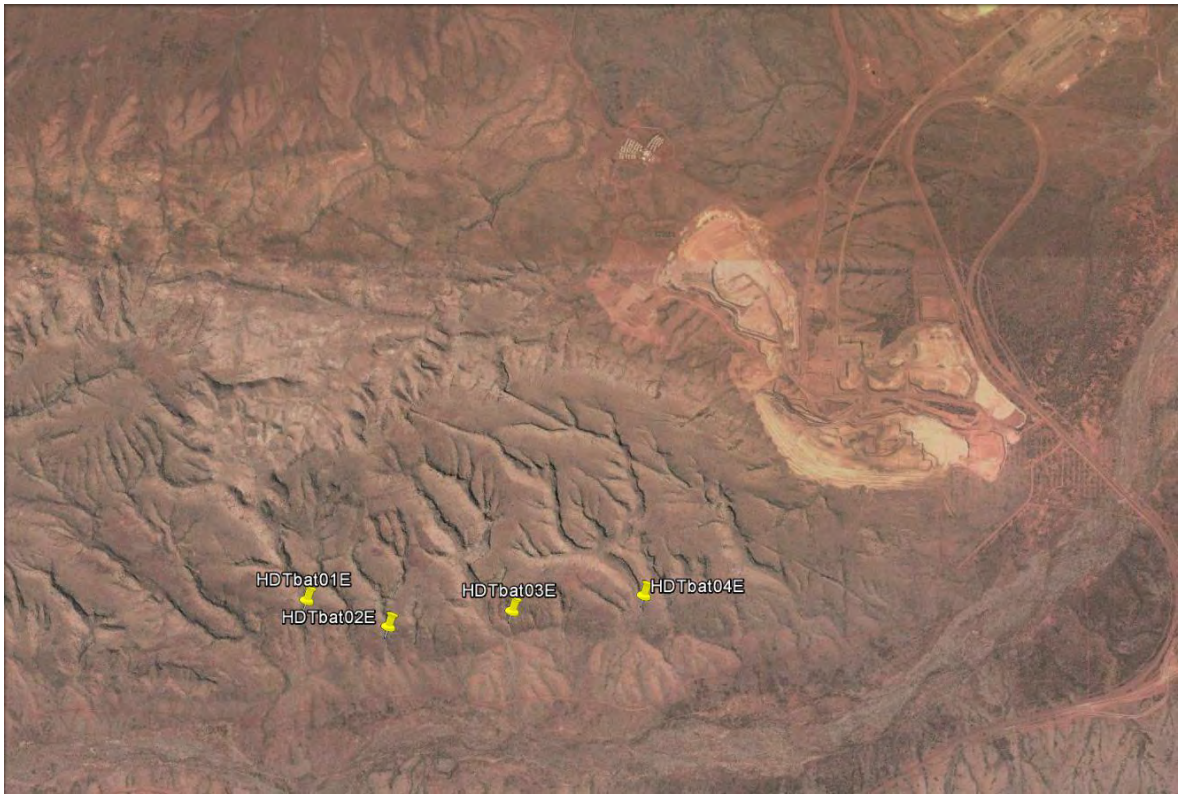
Note 1: *Taphozous* calls recorded had the characteristics of *T. georgianus*. There may be a similar species, *T. hilli*, with a like call interspersed

Table 4 SM2 Audio settings used during survey.

Parameter	Setting
Sample rate	384,000 kHz
Channel used	Left
Compression protocol	WAC4 (12 bit audio samples)
Gain - left channel	0.00
Digital high pass filter Left channel	fs/48 (giving 8 kHz minimum frequency)
Digital low pass filter Left channel	Off
Triggering level Left channel	6SNR (adaptive +6 dB triggering)
Triggering window Left channel	0.5 sec.

Note: These settings are as recommended in Wildlife Acoustics (2010) except the high pass filter. This is set lower to 8kHz to record any *Tadarida australis* that may be present

Figure 1. Detector Sites (HDT' sites) in relation to features in the study area.



Appendix 6

Previous Studies Conducted in the Locality of the Study Area

Table 8.1: Previous fauna studies conducted within 40 km of the study area.

Author (Year)	Title	Phase / Dates		Location	Focal Fauna
Terrestrial Vertebrate Surveys					
Ecologia (1997)	Hope Downs Biological Survey	i ii	18/08/1993 – 10/09/1993 19/04/1994 – 30/04/1994	Hope Downs 1: Adjacent to study area	Terrestrial vertebrates
Ecologia (1998)	Weeli Wolli Creek, Biological Assessment Survey	i ii	08/12/1994 – 15/12/1994 03/04/1995 – 13/04/1995	Weeli Wolli Creek: 15 km northeast of study area	Terrestrial vertebrates
Biota (2004)	Yandi Expansion Desktop Fauna Assessment and Targeted Invertebrate Survey	i	30/08/2004 – 03/09/2004	Yandi: 25 km northeast of study area	Terrestrial vertebrates SRE invertebrates
Ecologia (2005)	Mindy-Coondiner Exploration Project Biological Survey	i	07/11/2005 –11/11/2005	Mindy-Coondiner 30 km northeast of study area	Terrestrial vertebrates (level 1)
Biota (2006d)	Hope Downs Rail Corridor (Juna Downs Section) Fauna Survey	i	04/09/2005 – 14/09/2005	Hope Downs 1 rail option. West from Hope Downs mine	Terrestrial vertebrates SRE invertebrates
Ecologia (2006)	Marillana Terrestrial Vertebrate Fauna Survey	i ii	02/10/2005 – 09/10/2005 10/03/2006 – 17/03/2006	Marillana; 35 km northeast of study area	Terrestrial vertebrates
ENV (2007a)	Mindy North Exploration Lease Fauna Assessment	i ii	18/04/2007 – 24/04/2007 13/04/2007 – 20/04/2007	Mindy; 30 km northeast of study area	Terrestrial vertebrates
ENV (2007b)	Coondiner and Mindy East Exploration Leases Fauna Assessment	i	13/04/2007 – 20/04/2007	Coondiner and Mindy East: 30 km northeast of study area	Terrestrial vertebrates
ENV (2008a)	Area C West Fauna Assessment	i	15/08/2007 - 04/09/2007	Area C West: 25 km west of study area	Terrestrial vertebrates
ENV (2008b)	Area C South Flank Deposit Fauna Assessment	i	30/01/2008 – 06/02/2008	Area C South Flank: 10 km west of study area	Terrestrial vertebrates (level 1)
ENV (2009)	Jinayri Access Road Vertebrate Fauna Survey. Unpublished report for BHP Billiton Iron Ore	i ii	06/03/2008 – 18/03/2008 20/05/2009 – 30/05/2009	Adjacent to study area	Terrestrial vertebrates
ENV (2010a)	Area C West NVCP Flora, Vegetation and Fauna Assessment	i	22/03/2010 – 31/03/2011	Area C West: 25 km west of study area	Terrestrial vertebrates (level 1)
ENV (2010b)	South Flank NVCP Extension Flora, Vegetation and Fauna Assessment	i	16/11/2009 – 20/11/2009	Intersecting study area	Terrestrial vertebrates (level 1)
ENV (2010c)	Jinayri Mining Lease Vertebrate Fauna Survey. Unpublished report for BHP Billiton Iron Ore	i	05/03/2008 – 18/03/2008	Adjacent to study area	Terrestrial vertebrates
Outback Ecology (2010)	Area C to Jinayri to Mount Newman Railway, Terrestrial Vertebrate Fauna Survey	i ii iii	20/10/2008 – 01/11/2008 29/03/2009 – 05/03/2009 08/10/2008 – 12/10/2008	Adjacent to study area	Terrestrial vertebrates
Biota (2010b)	Yandicoogina Junction South-west, Billiards & Oxbow Single Phase Fauna Survey	i	05/07/2008 – 12/07/2008	20 km north of study area	Terrestrial vertebrates SRE invertebrates
Biota (2010c)	West Angelas Gas Pipeline Targeted Fauna Survey	i	21/06/201 – 28/06/2010	34 km southwest of study area	Targeted vertebrates SRE invertebrates

Author (Year)	Title	Phase / Dates		Location	Focal Fauna
Astron (2011)	Packsaddle West Vegetation and Flora Survey and Fauna Assessment	i	10/04/2010 – 19/04/2011	Packsaddle: 12 km northwest of study area	Terrestrial vertebrates (level 1)
Biologic (2011b)	Jinidi Vertebrate Fauna Survey	i ii	14/03/2011 – 20/03/2011 06/04/2011 – 10/04/2011	Jinidi: 10 km east of study area	Terrestrial vertebrates (level 1)
Biota (2012d)	Jinidi to Mindy Level 1 Fauna Survey	i	11/03/2011 – 13/03/2011	Jinidi: 10 km east of study area	Terrestrial vertebrates (level 1)
(Biota 2012e)	South Flank to Jinidi Level 2 Vertebrate Fauna Survey	i ii iii	11/04/2011 – 20/04/2011 02/11/2011 – 11/11/2011 31/01/2012 – 04/02/2012	Intersecting study area	Terrestrial vertebrates
Targeted Terrestrial Vertebrate Surveys					
Biota (2009d)	Yandicoogina Targeted Northern Quoll Survey	i	05/10/2009 – 13/10/2009	Yandi: 25 km northeast of study area	Targeted Northern Quoll
Biota (2011a)	Hope Downs Project Life of Mine Targeted Fauna Survey	i i	terrestrial 21/06/2010 – 27/06/2010 troglofauna 24/06/2010 – 17/08/2010	Hope Downs 1 mine	Targeted terrestrial vertebrates SRE invertebrates and Troglofauna
Biologic (2011a)	Jinidi Targeted Northern Quoll Survey	i ii	20/06/2011 – 01/07/2011 08/07/2011 – 19/07/2011	Jinidi: 10 km east of study area	Targeted Northern Quoll
Biota (2012f)	Koodaideri Southern Corridor Seasonal Fauna Survey	i ii	03/05/2011 – 13/05/2011 15/11/2011 – 24/11/2011	Koodaideri: 32 km northwest of study area	Terrestrial vertebrates SRE invertebrates
Biota (2013f)	South Parmelia Level 2 Vertebrate Fauna Survey	i ii	11/04/2011 – 20/04/2011 02/11/2011 – 11/11/2011	South Parmelia: 5 km east of study area	Terrestrial vertebrates
Biota (2013g)	Area C West to Yandi Level 2 Vertebrate Fauna Survey	i ii iii	25/05/2011 – 02/06/2011 07/09/2011 – 15/09/2011 05/02/2012 – 08/02/2012	Area C West to Yandi: 30 km northwest of study area	Terrestrial vertebrates (level 2)
Short-Range-Endemic Invertebrate and Troglofauna Surveys					
Biota (2004)	Yandi Expansion Desktop Fauna Assessment and Targeted Invertebrate Survey	i	30/08/2004 – 03/09/2004	Yandi: 25 km northeast of study area	Terrestrial vertebrates SRE invertebrates
Biota (2006d)	Hope Downs Rail Corridor (Juna Downs Section) Fauna Survey	i	04/09/2005 – 14/09/2005	Hope Downs 1 rail option. West from Hope Downs mine	Terrestrial vertebrates SRE invertebrates
Outback Ecology (2008)	Area C Mining Operation Environmental Management Plan (Revision 4) A, D, P1 and P3 Deposits: Terrestrial Invertebrate SRE Assessment	i ii	10/04/2008 – 18/04/2008 09/06/2008 – 18/06/2008	Area C: 20 km west of study area	SRE invertebrates
Biota (2010b)	Yandicoogina Junction South-west, Billiards & Oxbow Single Phase Fauna Survey	i	05/07/2008 – 12/07/2008	20 km north of study area	Terrestrial vertebrates SRE invertebrates
Biota (2010c)	West Angelas Gas Pipeline Targeted Fauna	i	21/06/201 – 28/06/2010	34 km southwest of study area	Targeted NES vertebrates

Author (Year)	Title	Phase / Dates		Location	Focal Fauna
	Survey				SRE invertebrates
Biota (2011a)	Hope Downs Project Life of Mine Targeted Fauna Survey	i i	terrestrial 21/06/2010 – 27/06/2010 troglofauna 24/06/2010 – 17/08/2010	Hope Downs 1 mine	Targeted terrestrial vertebrates SRE invertebrates and Troglofauna
Biota (2011c)	Area C and Surrounds SRE Invertebrate Fauna Survey	i-iii	3 phases: July – October 2008	Area C: 20 km west of study area	SRE invertebrates
Biota (2011d)	Area C Southern Flank SRE Survey	i ii iii iv	22/08/2008 – 02/09/2008 12/01/2009 – 12/02/2009 25/03/2009 – 02/04/2009 17/06/2009 – 23/06/2009	Intersecting study area	SRE invertebrates
Biota (2011e)	Jinidi Lease and Jinidi to Mainline Rail SRE Review	i ii	15/02/2010 – 26/02/2010 23/06/2010 – 30/06/2010	Jinidi: 10 km east of study area	SRE invertebrates
Biota (2012g)	Jinidi Iron Ore Mine – Terrestrial Invertebrate SRE Impact Assessment	i ii	15/02/2010 – 26/02/2010 14/08/2010 – 17/08/2010	Jinidi: 10 km east of study area	SRE invertebrates
Biota (2012f)	Koodaideri Southern Corridor Seasonal Fauna Survey	i ii	03/05/2011 – 13/05/2011 15/11/2011 – 24/11/2011	Koodaideri: 32 km northwest of study area	Terrestrial vertebrates and SRE invertebrates
Biota (2013h)	A Survey of the SRE Invertebrate Fauna of Mudlark	i ii iii	30/03/2011 – 01/04/ 2011 29/06/2011 – 07 /07/2011 06/02/2012 – 15/06/2012	Adjacent to study area	SRE invertebrates
Biota (2013i)	A Survey of the SRE Invertebrate Fauna of South Parmelia	i	11/04/2011 – 18/04/2011	South Parmelia: 5 km east of study area	SRE invertebrates
Biota (2013j)	A Survey of the SRE Invertebrate Fauna of Area C West	i	11/04/2011 – 18/04/2011	Area C West: 25 km west of study area	SRE invertebrates
Biota (2013k)	A Survey of the SRE Invertebrate Fauna of Area C West to Yandi	i ii	13/06/2011 – 22/06/2011 07/02/2012 – 08/02/2012	Area C West to Yandi: 30 km northwest of study area	SRE invertebrates
Biota (2013l)	A Survey of the SRE Invertebrate Fauna in the Jinidi to Mainline Corridor	i ii	11/02/2012 – 12/02/2012 27/03/2012 – 02/04/2012	Jinidi to Mainline: 15 km northeast of study area	SRE invertebrates
Biota (2013m)	A Survey of the SRE Invertebrate Fauna of South Flank to Jinidi	i ii iii	25/05/2011 – 02/06/2011 07/08/2011 – 15/08/2011 05/02/2012 – 08/02/2012	Intersecting study area	SRE invertebrates

Appendix 7

NatureMap Search Results

NatureMap
Mapping Western Australia's biodiversity

NatureMap Species Report

Created By Guest user on 01/12/2014

Current Names Only Yes
Core Datasets Only Yes
Method 'By Circle'
Centre 119°04' 10" E,23°01' 04" S
Buffer 40km
Group By Family

Family	Species	Records
Acanthaceae	4	21
Acanthizidae	12	874
Accipitridae	12	100
Actinopodidae	2	9
Aegothelidae	1	18
Agamidae	14	705
Aizoaceae	1	2
Alaudidae	1	1
Amaranthaceae	32	136
Anatidae	2	6
Anhingidae	2	5
Apiaceae	1	1
Apocynaceae	4	9
Apodidae	1	6
Araliaceae	4	11
Araneidae	5	10
Ardeidae	3	6
Artamidae	4	153
Asparagaceae	1	1
Asphodelaceae	1	3
Asteraceae	70	266
Bignoniaceae	1	1
Boidae	6	45
Boraginaceae	14	36
Bovidae	1	25
Brassicaceae	13	94
Burhinidae	1	4
Camelidae	1	14
Campanulaceae	7	27
Campephagidae	4	232
Canidae	3	20
Capparaceae	3	7
Caprimulgidae	1	23
Carphodactylidae	2	31
Caryophyllaceae	3	8
Casuariidae	1	10
Celastraceae	3	12
Centropodidae	1	1
Charadriidae	1	10
Cheluidae	1	1
Chenopodiaceae	26	148
Chthoniidae	1	19
Cinclosomatidae	2	3
Cleomaceae	2	7
Columbidae	6	479
Commelinaceae	1	1
Convolvulaceae	15	37
Corinnidae	1	2
Corvidae	4	121
Cracticidae	5	237
Crassulaceae	1	1
Cuculidae	2	49
Cucurbitaceae	5	18
Cupressaceae	1	1
Cyperaceae	19	37
Dasyuridae	11	409
Dicaeidae	1	26
Dicruridae	7	302
Dilleniaceae	1	12
Diplodactylidae	15	724
Ditrichaceae	1	1
Elapidae	15	187
Emballonuridae	3	110
Equidae	2	3
Estrilidae	4	1032
Euphorbiaceae	15	64
Fabaceae	122	747
Falconidae	7	88
Felidae	1	3
Funariaceae	1	1
Garypidae	2	10
Gekkonidae	9	383
Gentianaceae	1	1
Geraniaceae	1	1
Gnaphosidae	1	1
Goodeniaceae	27	143
Gyrostemonaceae	1	2

Halcyonidae	4	67
Haloragaceae	5	11
Hemerocallidaceae	1	4
Hersiliidae	1	1
Hipposideridae	1	2
Hirundinidae	4	6
Hylidae	3	393
Idiopidae	1	1
Lamiaceae	9	27
Lamponidae	1	4
Lauraceae	1	1
Leporidae	1	9
Limnodynastidae	2	7
Loranthaceae	9	16
Lycosidae	1	3
Lythraceae	1	1
Macropodidae	4	65
Maluridae	8	257
Malvaceae	66	392
Marsileaceae	3	10
Megadermatidae	1	52
Meliphagidae	12	559
Meropidae	1	72
Molluginaceae	1	2
Molossidae	3	126
Momoniidae	1	2
Moraceae	2	3
Motacillidae	2	5
Muridae	10	624
Myobatrachidae	3	140
Myrtaceae	26	110
Nemesiidae	1	105
Neosittidae	1	2
Nyctaginaceae	3	12
Oleaceae	2	3
Oonopidae	4	10
Ophioglossaceae	1	3
Orobanchaceae	1	1
Oryidae	1	2
Otididae	1	53
Oxalidaceae	1	4
Pachycephalidae	5	553
Papaveraceae	1	2
Pardalotidae	5	142
Pedaliaceae	2	3
Pelecanidae	1	1
Petroicidae	2	79
Phalacrocoracidae	2	5
Phasianidae	1	5
Phrymaceae	5	8
Phyllanthaceae	4	8
Plantaginaceae	3	4
Plotosidae	1	14
Plumbaginaceae	1	1
Poaceae	108	627
Podargidae	1	6
Polygalaceae	1	4
Polygonaceae	2	4
Polyxenidae	1	1
Pomatostomidae	3	149
Portulacaceae	8	21
Procellariidae	1	3
Prodidomidae	1	2
Proteaceae	9	23
Psittacidae	11	1778
Pteridaceae	6	33
Ptilonorhynchidae	1	10
Pygopodidae	7	170
Recurvirostridae	1	1
Rhamnaceae	2	14
Rubiaceae	8	22
Santalaceae	3	9
Sapindaceae	10	15
Scincidae	48	2184
Scolopacidae	1	2
Scolopendridae	6	78
Scrophulariaceae	27	133
Scutigeridae	1	10
Solanaceae	24	94
Sparassidae	1	1
Strigidae	4	32
Stylidiaceae	1	6
Surianaceae	1	2
Sylviidae	4	150
Synxenidae	1	3
Terapontidae	1	5
Threskiornithidae	1	3
Thymelaeaceae	3	6
Trigoniulidae	1	56
Trochanteriidae	2	4
Turnicidae	1	108
Typhlopidae	6	82
Tytonidae	1	3
Urodacidae	1	1
Urticaceae	1	1
Varanidae	14	292
Vespertilionidae	7	298
Violaceae	1	5
Zodariidae	2	4
Zygophyllaceae	7	19
TOTAL	**1172**	**18820**

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
Acanthaceae					
1.	7164	*Dicladanthera forrestii*			
2.	11320	*Dipteracanthus australasicus subsp. australasicus*			
3.	17325	*Harnieria kempeana subsp. muelleri*			
4.	11556	*Rostellularia adscendens var. latifolia*		P3	
Acanthizidae					
5.	24260	*Acanthiza apicalis (Broad-tailed Thornbill, Inland Thornbill)*			
6.	24261	*Acanthiza chrysorrhoa (Yellow-rumped Thornbill)*			
7.	24264	*Acanthiza robustirostris (Slaty-backed Thornbill)*			
8.	-13889	*Acanthiza sp.*			
9.	24265	*Acanthiza uropygialis (Chestnut-rumped Thornbill)*			
10.	25528	*Aphelocephala leucopsis (Southern Whiteface)*			
11.	24272	*Gerygone (fusca) mungi (Desert Gerygone)*			
12.	25530	*Gerygone fusca (Western Gerygone)*			
13.	24271	*Gerygone fusca subsp. fusca (Western Gerygone)*			
14.	-14017	*Gerygone fusca subsp. mungi*			
15.	24278	*Pyrrholaemus brunneus (Redthroat)*			
16.	30948	*Smicrornis brevirostris (Weebill)*			
Accipitridae					
17.	25535	*Accipiter cirrocephalus (Collared Sparrowhawk)*			
18.	24281	*Accipiter cirrocephalus subsp. cirrocephalus (Collared Sparrowhawk)*			
19.	25536	*Accipiter fasciatus (Brown Goshawk)*			
20.	24285	*Aquila audax (Wedge-tailed Eagle)*			
21.	25538	*Aquila morphnoides (Little Eagle)*			
22.	24289	*Circus assimilis (Spotted Harrier)*			
23.	25540	*Elanus caeruleus (Black-shouldered Kite)*			
24.	24295	*Haliastur sphenurus (Whistling Kite)*			
25.	24296	*Hamirostra isura (Square-tailed Kite)*			
26.	24297	*Hamirostra melanosternon (Black-breasted Buzzard)*			
27.	25542	*Milvus migrans (Black Kite)*			
28.	24298	*Milvus migrans subsp. affinis (Black Kite)*			
Actinopodidae					
29.	-13156	*Missulena faulderi*			Y
30.	-13506	*Missulena langlandsi*			Y
Aegothelidae					
31.	25544	*Aegotheles cristatus (Australian Owlet-nightjar)*			
Agamidae					
32.	30833	*Amphibolurus longirostris (Long-nosed Dragon)*			
33.	25458	*Ctenophorus caudicinctus (Ring-tailed Dragon)*			
34.	24865	*Ctenophorus caudicinctus subsp. caudicinctus (Ring-tailed Dragon)*			
35.	25459	*Ctenophorus isolepis (Crested Dragon, Military Dragon)*			
36.	24874	*Ctenophorus isolepis subsp. citrinus (Crested Dragon, Military Dragon)*			
37.	24875	*Ctenophorus isolepis subsp. gularis (Central Military Dragon)*			
38.	24876	*Ctenophorus isolepis subsp. isolepis (Crested Dragon, Military Dragon)*			
39.	24882	*Ctenophorus nuchalis (Central Netted Dragon)*			
40.	24886	*Ctenophorus reticulatus (Western Netted Dragon)*			
41.	24899	*Diporiphora valens (Southern Pilbara Tree Dragon)*			
42.	25510	*Pogona minor (Dwarf Bearded Dragon)*			
43.	24907	*Pogona minor subsp. minor (Dwarf Bearded Dragon)*			
44.	24908	*Pogona minor subsp. mitchelli (Dwarf Bearded Dragon)*			
45.	30814	*Tympanocryptis cephalus (Pebble Dragon)*			
Aizoaceae					
46.	44241	*Trianthema glossostigmum*			
Alaudidae					
47.	25545	*Mirafra javanica (Horsfield's Bushlark, Singing Bushlark)*			
Amaranthaceae					
48.	2646	*Aerva javanica (Kapok Bush)*	Y		
49.	2648	*Alternanthera denticulata (Lesser Joyweed)*			
50.	2651	*Alternanthera nana (Hairy Joyweed)*			
51.	2660	*Amaranthus cuspidifolius*			
52.	2663	*Amaranthus interruptus (Native Amaranth)*			
53.	20018	*Amaranthus undulatus*			
54.	2676	*Gomphrena canescens (Batchelors Buttons)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
55.	18363	*Gomphrena canescens subsp. canescens*			
56.	2680	*Gomphrena cunninghamii*			
57.	18367	*Gomphrena kanisii*			
58.	2690	*Ptilotus aervoides*			
59.	2696	*Ptilotus astrolasius*			
60.	2698	*Ptilotus auriculifolius*			
61.	2704	*Ptilotus calostachyus (Weeping Mulla Mulla)*			
62.	2706	*Ptilotus carinatus*			
63.	2711	*Ptilotus clementii (Tassel Top)*			
64.	2718	*Ptilotus drummondii (Narrowleaf Mulla Mulla)*			
65.	2725	*Ptilotus fusiformis*			
66.	2727	*Ptilotus gaudichaudii*			
67.	41506	*Ptilotus gaudichaudii subsp. gaudichaudii*			
68.	2728	*Ptilotus gomphrenoides*			
69.	2731	*Ptilotus helipteroides (Hairy Mulla Mulla)*			
70.	2734	*Ptilotus incanus*			
71.	2741	*Ptilotus macrocephalus (Featherheads)*			
72.	2744	*Ptilotus mollis*		P4	
73.	2746	*Ptilotus nobilis (Tall Mulla Mulla)*			
74.	41001	*Ptilotus nobilis subsp. nobilis (Yellow Tails)*			
75.	2747	*Ptilotus obovatus (Cotton Bush)*			
76.	2751	*Ptilotus polystachyus (Prince of Wales Feather)*			
77.	2754	*Ptilotus roei*			
78.	2755	*Ptilotus rotundifolius (Royal Mulla Mulla)*			
79.	15855	*Ptilotus schwartzii var. schwartzii*			
Anatidae					
80.	24316	*Anas superciliosa (Pacific Black Duck)*			
81.	24325	*Dendrocygna eytoni (Plumed Whistling Duck)*			
Anhingidae					
82.	25553	*Anhinga melanogaster (Darter)*			
83.	24332	*Anhinga melanogaster subsp. novaehollandiae (Darter)*			
Apiaceae					
84.	6218	*Daucus glochidiatus (Australian Carrot)*			
Apocynaceae					
85.	6584	*Cynanchum floribundum (Dumara Bush, Tjipa)*			
86.	12832	*Gymnanthera cunninghamii*		P3	
87.	12949	*Marsdenia australis*			
88.	6599	*Rhyncharrhena linearis (Bush Bean, Wintjulanypa)*			
Apodidae					
89.	25554	*Apus pacificus (Fork-tailed Swift)*		IA	
Araliaceae					
90.	6202	*Astrotricha hamptonii (Ironplant)*			
91.	6278	*Trachymene oleracea*			
92.	19043	*Trachymene oleracea subsp. oleracea*			
93.	19053	*Trachymene pilbarensis*			
Araneidae					
94.	-1925	*Argiope protensa*			
95.	-12920	*Austracantha minax*			
96.	-13852	*Backobourkia collina*			
97.	-13573	*Cyrtobill darwini*			
98.	-12919	*Cyrtophora parnasia*			
Ardeidae					
99.	24340	*Ardea novaehollandiae (White-faced Heron)*			
100.	24341	*Ardea pacifica (White-necked Heron)*			
101.	24350	*Nycticorax caledonicus subsp. hilli (Rufous Night Heron)*			
Artamidae					
102.	25566	*Artamus cinereus (Black-faced Woodswallow)*			
103.	24352	*Artamus cinereus subsp. melanops (Black-faced Woodswallow)*			
104.	24355	*Artamus minor (Little Woodswallow)*			
105.	24356	*Artamus personatus (Masked Woodswallow)*			
Asparagaceae					
106.	1329	*Thysanotus exiliflorus*			
Asphodelaceae					
107.	14312	*Bulbine pendula*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
Asteraceae					
108.	7854	*Bidens bipinnata (Bipinnate Beggartick)*	Y		
109.	7866	*Blumea tenella*			
110.	7872	*Brachyscome ciliocarpa*			
111.	7878	*Brachyscome iberidifolia*			
112.	20427	*Brachyscome sp. Wanna Munna Flats (S. van Leeuwen 4662)*		P1	
113.	14090	*Calocephalus beardii*			
114.	7891	*Calocephalus francisii (Fine-leaf Beauty-heads)*			
115.	7893	*Calocephalus knappii*			
116.	7895	*Calocephalus multiflorus (Yellow-top)*			
117.	16525	*Calocephalus sp. Wittenoom (A.S. George 1082)*			
118.	7903	*Calotis hispidula (Bindy Eye)*			
119.	7905	*Calotis multicaulis (Many-stemmed Burr-daisy)*			
120.	7906	*Calotis plumulifera*			
121.	19762	*Centipeda minima subsp. macrocephala*			
122.	19757	*Centipeda minima subsp. minima*			
123.	7921	*Centipeda thespidioides (Desert Sneezewood)*			
124.	12612	*Chrysocephalum apiculatum*			
125.	33516	*Chrysocephalum gilesii*			
126.	12614	*Chrysocephalum pterochaetum*			
127.	35017	*Chrysocephalum sp. Pilbara (H. Demarz 2852)*			
128.	7939	*Conyza bonariensis (Flaxleaf Fleabane)*	Y		
129.	35558	*Flaveria trinervia (Speedy Weed)*	Y		
130.	7988	*Gnephosis arachnoidea (Cobwebby-headed Gnephosis)*			
131.	29594	*Helichrysum luteoalbum (Jersey Cudweed)*			
132.	8088	*Ixiochlamys cuneifolia*			
133.	8096	*Lactuca serriola (Prickly Lettuce)*	Y		
134.	29046	*Lactuca serriola forma serriola*	Y		
135.	19726	*Leiocarpa semicalva*			
136.	19236	*Leiocarpa tomentosa*			
137.	8110	*Minuria leptophylla (Minnie Daisy)*			
138.	17925	*Myriocephalus oldfieldii*			
139.	12635	*Olearia fluvialis*			
140.	12638	*Olearia mucronata*		P3	
141.	8151	*Olearia stuartii*			
142.	8153	*Olearia xerophila*			
143.	42160	*Pentalepis trichodesmoides subsp. trichodesmoides*			
144.	34997	*Peripleura arida*			
145.	35003	*Peripleura hispidula var. setosa*			
146.	34998	*Peripleura obovata*			
147.	35001	*Peripleura virgata*			
148.	20311	*Pilbara trudgenii*		P2	
149.	8167	*Pluchea dentex*			
150.	17816	*Pluchea ferdinandi-muelleri*			
151.	8172	*Podolepis canescens (Bright Podolepis, Grey Podolepis)*			
152.	18642	*Podolepis sp. Great Victoria Desert (A.S. George 8219)*			
153.	41221	*Pterocaulon serrulatum var. velutinum*			
154.	8192	*Pterocaulon sphacelatum (Apple Bush)*			
155.	8193	*Pterocaulon sphaeranthoides*			
156.	13308	*Rhodanthe charsleyae*			
157.	13301	*Rhodanthe floribunda*			
158.	13246	*Rhodanthe humboldtiana*			
159.	13310	*Rhodanthe margarethae*			
160.	42011	*Rhodanthe polakii*			
161.	13251	*Rhodanthe propinqua*			
162.	8198	*Rutidosis helichrysoides (Grey Wrinklewort)*			
163.	13285	*Schoenia ayersii*			
164.	8213	*Senecio magnificus (Showy Groundsel)*			
165.	8223	*Sigesbeckia orientalis (Indian Weed)*	Y		
166.	8231	*Sonchus oleraceus (Common Sowthistle)*	Y		
167.	8234	*Streptoglossa adscendens*			
168.	8235	*Streptoglossa bubakii*			
169.	8237	*Streptoglossa decurrens*			
170.	8238	*Streptoglossa liatroides*			
171.	8241	*Streptoglossa tenuiflora*			
172.	25902	*Symphyotrichum squamatum (Bushy Starwort)*	Y		
173.	8245	*Taraxacum officinale (Dandelion)*	Y		
174.	11788	*Vittadinia dissecta var. hirta*			
175.	8265	*Vittadinia eremaea*			
176.	33026	*Vittadinia sp. Coondewanna Flats (S. van Leeuwen 4684)*		P1	

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177.	19938	*Xerochrysum bracteatum*			
Bignoniaceae					
178.	7117	*Pandorea pandorana*			
Boidae					
179.	25318	*Antaresia perthensis (Pygmy Python)*			
180.	25448	*Antaresia stimsoni (Stimson's Python)*			
181.	25319	*Antaresia stimsoni subsp. orientalis (Stimson's Python)*			
182.	25241	*Antaresia stimsoni subsp. stimsoni (Stimson's Python)*			
183.	25320	*Aspidites melanocephalus (Black-headed Python)*			
184.	25238	*Liasis olivaceus subsp. barroni (Pilbara Olive Python)*		T	
Boraginaceae					
185.	6687	*Halgania cyanea (Rough Halgania)*			
186.	29840	*Halgania cyanea var. Allambi Stn (B.W. Strong 676)*			
187.	6690	*Halgania gustafsenii*			
188.	30294	*Halgania gustafsenii var. Mid West (G. Perry 370)*			
189.	17493	*Halgania gustafsenii var. gustafsenii*			
190.	30258	*Halgania solanacea var. Mt Doreen (G.M. Chippendale 4206)*			
191.	17301	*Heliotropium chrysocarpum*			
192.	6706	*Heliotropium cunninghamii*			
193.	6712	*Heliotropium heteranthum*			
194.	17307	*Heliotropium inexplicitum*			
195.	17309	*Heliotropium pachyphyllum*			
196.	17313	*Heliotropium skeleton*			
197.	6720	*Heliotropium ventricosum*			
198.	6727	*Trichodesma zeylanicum (Camel Bush, Kumbalin)*			
Bovidae					
199.	24251	*Bos taurus (European Cattle)*	Y		
Brassicaceae					
200.	3010	*Cuphonotus andraeanus*			
201.	3022	*Lepidium catapycnon (Hamersley Lepidium)*		T	
202.	3025	*Lepidium echinatum*			
203.	3032	*Lepidium muelleri-ferdinandii*			
204.	3033	*Lepidium oxytrichum*			
205.	3035	*Lepidium pedicellosum*			
206.	3037	*Lepidium phlebopetalum (Veined Peppercress)*			
207.	3038	*Lepidium pholidogynum*			
208.	3054	*Menkea villosula*			
209.	3074	*Stenopetalum anfractum*			
210.	3075	*Stenopetalum decipiens*			
211.	3078	*Stenopetalum nutans*			
212.	3082	*Stenopetalum velutinum (Velvet Thread Petal)*			
Burhinidae					
213.	24359	*Burhinus grallarius (Bush Stone-curlew)*		P4	
Camelidae					
214.	24254	*Camelus dromedarius (Dromedary, Camel)*	Y		
Campanulaceae					
215.	7397	*Isotoma petraea (Rock Isotome, Tundiwari)*			
216.	37480	*Lobelia arnhemiaca*			
217.	7403	*Lobelia heterophylla (Wing-seeded Lobelia)*			
218.	36863	*Lobelia heterophylla subsp. heterophylla*			
219.	36880	*Lobelia heterophylla subsp. pilbarensis*			
220.	7386	*Wahlenbergia gracilenta (Annual Bluebell)*			
221.	7393	*Wahlenbergia tumidifructa*			
Campephagidae					
222.	24361	*Coracina maxima (Ground Cuckoo-shrike)*			
223.	25568	*Coracina novaehollandiae (Black-faced Cuckoo-shrike)*			
224.	24363	*Coracina novaehollandiae subsp. subpallida (Black-faced Cuckoo-shrike)*			
225.	24367	*Lalage tricolor (White-winged Triller)*			
Canidae					
226.	25454	*Canis lupus (Dog, Dingo)*	Y		
227.	24039	*Canis lupus subsp. dingo (Dingo)*	Y		
228.	30883	*Canis lupus subsp. familiaris (Dog)*	Y		
Capparaceae					
229.	2976	*Capparis lasiantha (Split Jack, Balqarda)*			
230.	2978	*Capparis mitchellii (Wild Orange)*			

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231.	2981	*Capparis spinosa*			
Caprimulgidae					
232.	24368	*Eurostopodus argus (Spotted Nightjar)*			
Carphodactylidae					
233.	25498	*Nephrurus wheeleri*			
234.	24972	*Nephrurus wheeleri subsp. cinctus*			
Caryophyllaceae					
235.	12075	*Polycarpaea corymbosa var. corymbosa*			
236.	2901	*Polycarpaea holtzei*			
237.	2903	*Polycarpaea longiflora*			
Casuariidae					
238.	24470	*Dromaius novaehollandiae (Emu)*			
Celastraceae					
239.	19500	*Maytenus sp. Mt Windell (S. van Leeuwen 846)*			
240.	19555	*Stackhousia muricata subsp. annual (W.R. Barker 2172)*			
241.	18405	*Stackhousia sp. swollen gynophore (W.R. Barker 2041)*			
Centropodidae					
242.	25600	*Centropus phasianinus (Pheasant Coucal)*			
Charadriidae					
243.	24373	*Charadrius melanops (Black-fronted Dotterel)*			
Cheluidae					
244.	25339	*Chelodina steindachneri (Flat-shelled Turtle)*			
Chenopodiaceae					
245.	2485	*Chenopodium auricomum (Queensland Bluebush)*			
246.	11632	*Dysphania glomulifera subsp. eremaea*			
247.	2502	*Dysphania kalpari (Rat's Tail, Kalpari)*			
248.	33479	*Dysphania melanocarpa (Black Crumbweed)*			
249.	33596	*Dysphania melanocarpa forma leucocarpa*			
250.	33597	*Dysphania melanocarpa forma melanocarpa (Black Goosefoot)*			
251.	2506	*Dysphania rhadinostachya*			
252.	11653	*Dysphania rhadinostachya subsp. inflata*			
253.	11890	*Dysphania rhadinostachya subsp. rhadinostachya*			
254.	2511	*Enchylaena tomentosa (Barrier Saltbush)*			
255.	12064	*Enchylaena tomentosa var. tomentosa (Barrier Saltbush)*			
256.	2538	*Maireana carnosa (Cottony Bluebush)*			
257.	2544	*Maireana georgei (Satiny Bluebush)*			
258.	2551	*Maireana melanocoma (Pussy Bluebush)*			
259.	2556	*Maireana planifolia (Low Bluebush)*			
260.	2566	*Maireana thesioides (Lax Bluebush)*			
261.	2571	*Maireana villosa*			
262.	2582	*Rhagodia eremaea (Thorny Saltbush)*			
263.	20168	*Rhagodia sp. Hamersley (M. Trudgen 17794)*		P3	
264.	30434	*Salsola australis*			
265.	2602	*Sclerolaena convexula*			
266.	2603	*Sclerolaena cornishiana (Cartwheel Burr)*			
267.	2604	*Sclerolaena costata*			
268.	2607	*Sclerolaena densiflora*			
269.	2611	*Sclerolaena eriacantha (Tall Bindii)*			
270.	2631	*Sclerolaena tetragona*			
Chthoniidae					
271.	-13814	*Tyrannochthonius aridus*			
Cinclosomatidae					
272.	25580	*Cinclosoma castaneothorax (Chestnut-breasted Quail-thrush)*			
273.	24390	*Psophodes occidentalis (Western Wedgebill, Chiming Wedgebill)*			
Cleomaceae					
274.	2985	*Cleome oxalidea*			
275.	2988	*Cleome viscosa (Tickweed, Tjinduwadhu)*			
Columbidae					
276.	24401	*Geopelia cuneata (Diamond Dove)*			
277.	25585	*Geopelia striata (Zebra Dove)*			
278.	24403	*Geopelia striata subsp. placida (Peaceful Dove)*			
279.	24404	*Geophaps plumifera (Spinifex Pigeon)*			
280.	24407	*Ocyphaps lophotes (Crested Pigeon)*			
281.	24409	*Phaps chalcoptera (Common Bronzewing)*			

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Commelinaceae					
282.	1165	*Commelina ensifolia (Wandering Jew, Buargu)*			
Convolvulaceae					
283.	11167	*Bonamia erecta*			
284.	37721	*Bonamia sp. Dampier (A.A. Mitchell PRP 217)*			
285.	19880	*Convolvulus angustissimus*			
286.	19881	*Convolvulus angustissimus subsp. angustissimus*			
287.	6612	*Convolvulus clementii*			
288.	13733	*Cuscuta victoriana*			
289.	31274	*Duperreya commixta*			
290.	6617	*Evolvulus alsinoides (Tropical Speedwell)*			
291.	11200	*Evolvulus alsinoides var. villosicalyx*			
292.	6631	*Ipomoea lonchophylla (Cowvine)*			
293.	6633	*Ipomoea muelleri (Poison Morning Glory, Yumbu)*			
294.	6636	*Ipomoea plebeia (Bellvine)*			
295.	6637	*Ipomoea polymorpha*			
296.	6653	*Polymeria ambigua (Morning Glory)*			
297.	17513	*Polymeria lanata*			
Corinnidae					
298.	-13478	*Supunna funerea*			
Corvidae					
299.	24416	*Corvus bennetti (Little Crow)*			
300.	25593	*Corvus orru (Torresian Crow)*			
301.	24418	*Corvus orru subsp. cecilae (Western Crow)*			
Cracticidae					
302.	24420	*Cracticus nigrogularis (Pied Butcherbird)*			
303.	25595	*Cracticus tibicen (Australian Magpie)*			
304.	24422	*Cracticus tibicen subsp. dorsalis (White-backed Magpie)*			
305.	24423	*Cracticus tibicen subsp. tibicen (Black-backed Magpie)*			
306.	25596	*Cracticus torquatus (Grey Butcherbird)*			
Crassulaceae					
307.	3144	*Crassula peduncularis (Purple Stonecrop)*			
Cuculidae					
308.	42307	*Cacomantis pallidus (Pallid Cuckoo)*			
309.	24431	*Chrysococcyx basalis (Horsfield's Bronze Cuckoo)*			
Cucurbitaceae					
310.	33030	*Austrobryonia pilbarensis*			
311.	33031	*Cucumis maderaspatanus*			
312.	12039	*Cucumis melo subsp. agrestis (Ulcardo Melon, Gagalum)*	Y		
313.	41722	*Cucumis picrocarpus*			
314.	41721	*Cucumis variabilis*			
Cupressaceae					
315.	8466	*Callitris columellaris (White Cypress Pine)*			
Cyperaceae					
316.	750	*Bulbostylis barbata*			
317.	752	*Bulbostylis turbinata*			
318.	777	*Cyperus bulbosus (Bush Onion, Tjanmata)*			
319.	12811	*Cyperus cunninghamii subsp. cunninghamii*			
320.	789	*Cyperus difformis (Rice Sedge)*			
321.	12808	*Cyperus hesperius*			
322.	798	*Cyperus iria*			
323.	799	*Cyperus ixiocarpus*			
324.	814	*Cyperus squarrosus*			
325.	818	*Cyperus vaginatus (Stiffleaf Sedge)*			
326.	827	*Eleocharis geniculata*			
327.	842	*Fimbristylis cardiocarpa*			
328.	851	*Fimbristylis dichotoma (Eight Day Grass)*			
329.	862	*Fimbristylis microcarya*			
330.	882	*Fimbristylis sieberiana*		P3	
331.	12159	*Fimbristylis simulans*			
332.	962	*Schoenoplectus dissachanthus*			
333.	963	*Schoenoplectus laevis*			
334.	16257	*Schoenoplectus subulatus*			
Dasyuridae					
335.	30903	*Dasycercus blythi (Brush-tailed Mulgara, Ampurta)*			

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				P4	
336.	24091	*Dasykaluta rosamondae (Little Red Kaluta)*			
337.	24093	*Dasyurus hallucatus (Northern Quoll)*		T	
338.	24095	*Ningaui timealeyi (Pilbara Ningaui)*			
339.	24101	*Planigale ingrami (Long-tailed Planigale)*			
340.	24105	*Pseudantechinus roryi (Rory's Pseudantechinus)*			
341.	24106	*Pseudantechinus woolleyae (Woolley's Pseudantechinus)*			
342.	24109	*Sminthopsis dolichura (Little long-tailed Dunnart)*			
343.	24116	*Sminthopsis macroura (Stripe-faced Dunnart)*			
344.	24117	*Sminthopsis ooldea (Ooldea Dunnart)*			
345.	24120	*Sminthopsis youngsoni (Lesser Hairy-footed Dunnart)*			
Dicaeidae					
346.	25607	*Dicaeum hirundinaceum (Mistletoebird)*			
Dicruridae					
347.	24443	*Grallina cyanoleuca (Magpie-lark)*			
348.	24453	*Rhipidura (fuliginosa) albicauda (White-tailed Fantail)*			
349.	-14092	*Rhipidura albicauda*			
350.	25613	*Rhipidura fuliginosa (Grey Fantail)*			
351.	24451	*Rhipidura fuliginosa subsp. alisteri (Grey Fantail)*			
352.	25614	*Rhipidura leucophrys (Willie Wagtail)*			
353.	24454	*Rhipidura leucophrys subsp. leucophrys (Willie Wagtail)*			
Dilleniaceae					
354.	5128	*Hibbertia glaberrima*			
Diplodactylidae					
355.	25456	*Crenadactylus ocellatus (Clawless Gecko)*			
356.	24919	*Crenadactylus ocellatus subsp. horni (Clawless Gecko)*			
357.	24921	*Crenadactylus ocellatus subsp. rostralis (Clawless Gecko)*			
358.	24926	*Diplodactylus conspicillatus (Fat-tailed Gecko)*			
359.	24930	*Diplodactylus granariensis subsp. rex*			
360.	24940	*Diplodactylus pulcher*			
361.	24944	*Diplodactylus savagei (Southern Pilbara Beak-faced Gecko)*			
362.	-18598	*Lucasium sp.*			
363.	30933	*Lucasium stenodactylum*			
364.	30934	*Lucasium wombeyi*			
365.	24976	*Oedura marmorata (Marbled Velvet Gecko)*			
366.	24982	*Rhynchoedura ornata (Western Beaked Gecko)*			
367.	24927	*Strophurus elderi*			
368.	24932	*Strophurus jeanae*			
369.	24949	*Strophurus wellingtonae*			
Ditrichaceae					
370.	32348	*Eccremidium arcuatum*			
Elapidae					
371.	25332	*Acanthophis wellsi (Pilbara Death Adder)*			
372.	25331	*Brachyurophis approximans (North-western Shovel-nosed Snake)*			
373.	25468	*Demansia psammophis (Yellow-faced Whipsnake)*			
374.	25295	*Demansia psammophis subsp. cupreiceps (Yellow-faced Whipsnake)*			
375.	25296	*Demansia psammophis subsp. reticulata (Yellow-faced Whipsnake)*			
376.	25297	*Demansia rufescens (Rufous Whipsnake)*			
377.	25301	*Furina ornata (Moon Snake)*			
378.	25254	*Parasuta monachus*			
379.	25261	*Pseudechis australis (Mulga Snake)*			
380.	42416	*Pseudonaja mengdeni (Western Brown Snake)*			
381.	25263	*Pseudonaja modesta (Ringed Brown Snake)*			
382.	25264	*Pseudonaja nuchalis (Gwardar, Northern Brown Snake)*			
383.	25269	*Suta fasciata (Rosen's Snake)*			
384.	25307	*Suta punctata (Spotted Snake)*			
385.	25311	*Vermicella snelli*			
Emballonuridae					
386.	24174	*Saccolaimus flaviventris (Yellow-bellied Sheathtail-bat)*			
387.	24175	*Taphozous georgianus (Common Sheathtail-bat)*			
388.	24176	*Taphozous hilli (Hill's Sheathtail-bat)*			
Equidae					
389.	24257	*Equus asinus (Donkey)*	Y		
390.	24258	*Equus caballus (Horse)*	Y		
Estrilidae					
391.	24631	*Emblema pictum (Painted Finch)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
392.	25685	*Neochmia ruficauda (Star Finch)*			
393.	30870	*Taeniopygia guttata (Zebra Finch)*			
394.	30871	*Taeniopygia guttata subsp. castanotis (Zebra Finch)*			
Euphorbiaceae					
395.	17454	*Adriana tomentosa var. hookeri*			
396.	17422	*Adriana tomentosa var. tomentosa*			
397.	4617	*Euphorbia australis (Namana)*			
398.	42844	*Euphorbia australis var. hispidula*			
399.	35303	*Euphorbia australis var. subtomentosa*			
400.	4619	*Euphorbia biconvexa*			
401.	4620	*Euphorbia boophthona (Gascoyne Spurge)*			
402.	4622	*Euphorbia clementii*		P2	
403.	4623	*Euphorbia coghlanii (Namana)*			
404.	4626	*Euphorbia drummondii (Caustic Weed, Piwi)*			
405.	4630	*Euphorbia inappendiculata*			
406.	12097	*Euphorbia tannensis subsp. eremophila (Desert Spurge)*			
407.	42879	*Euphorbia trigonosperma*			
408.	42877	*Euphorbia vaccaria var. erucoides*			
409.	42876	*Euphorbia vaccaria var. vaccaria*			
Fabaceae					
410.	11215	*Acacia adoxa var. adoxa*			
411.	3205	*Acacia adsurgens*			
412.	3214	*Acacia ancistrocarpa (Fitzroy Wattle)*			
413.	3217	*Acacia aneura (Mulga, Wanari)*			
414.	37260	*Acacia aptaneura*			
415.	3228	*Acacia atkinsiana*			
416.	3232	*Acacia ayersiana*			
417.	3241	*Acacia bivenosa*			
418.	29571	*Acacia bromilowiana*		P4	
419.	19571	*Acacia catenulata*			Y
420.	23524	*Acacia catenulata subsp. occidentalis*			
421.	3260	*Acacia citrinoviridis*			
422.	17013	*Acacia colei var. colei*			
423.	13502	*Acacia coriacea subsp. pendens*			
424.	3272	*Acacia cowleana (Halls Creek Wattle)*			
425.	3300	*Acacia dictyophleba (Sandhill Wattle, Ngarkalya)*			
426.	3316	*Acacia effusa*		P3	
427.	16174	*Acacia elachantha*			
428.	3360	*Acacia hamersleyensis*			
429.	3370	*Acacia hilliana*			
430.	3377	*Acacia inaequilatera (Baderi)*			
431.	36418	*Acacia incurvaneura*			
432.	3399	*Acacia kempeana (Witchetty Bush, Ilykuwara)*			
433.	37240	*Acacia macraneura*			
434.	3434	*Acacia maitlandii (Maitland's Wattle)*			
435.	3435	*Acacia marramamba*			
436.	12952	*Acacia minyura*			
437.	3447	*Acacia monticola (Gawar, Lilwardi)*			
438.	36416	*Acacia mulganeura*			
439.	3475	*Acacia pachyacra*			
440.	15724	*Acacia paraneura*			
441.	3500	*Acacia pruinocarpa (Gidgee)*			
442.	36800	*Acacia pteraneura*			
443.	29016	*Acacia pyrifolia var. morrisonii*			
444.	29015	*Acacia pyrifolia var. pyrifolia*			
445.	3519	*Acacia rhodophloia*			
446.	13078	*Acacia sclerosperma subsp. sclerosperma*			
447.	3544	*Acacia sibilans*			
448.	8949	*Acacia sibirica (Bastard Mulga)*			
449.	3553	*Acacia spondylophylla*			
450.	23526	*Acacia steedmanii subsp. borealis*			
451.	23529	*Acacia subcontorta*			
452.	23528	*Acacia subtiliformis*		P3	
453.	13070	*Acacia synchronicia*			
454.	3573	*Acacia tenuissima*			
455.	3577	*Acacia tetragonophylla (Kurara, Wakalpuka)*			
456.	23521	*Acacia trudgeniana*			
457.	20319	*Acacia tumida var. pilbarensis*			
458.	3598	*Acacia wanyu*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
459.	3783	*Crotalaria medicaginea*			
460.	20179	*Crotalaria medicaginea var. neglecta*			
461.	3785	*Crotalaria novae-hollandiae (New Holland Rattlepod)*			
462.	11231	*Crotalaria novae-hollandiae subsp. novae-hollandiae*			
463.	17117	*Cullen cinereum*			
464.	17436	*Cullen graveolens*			
465.	17119	*Cullen leucochaites*			
466.	17116	*Cullen martinii*			
467.	17120	*Cullen pogonocarpum*			
468.	17140	*Daviesia eremaea*			
469.	3856	*Desmodium muelleri*			
470.	3903	*Gastrolobium grandiflorum (Wallflower Poison)*			
471.	3938	*Glycine canescens (Silky Glycine)*			
472.	3941	*Glycine tabacina (Glycine Pea)*			
473.	41245	*Gompholobium oreophilum*			
474.	3972	*Indigofera brevidens (Widji)*			
475.	3974	*Indigofera georgei (Bovine Indigo)*			
476.	3978	*Indigofera hirsuta (Hairy Indigo)*			
477.	3980	*Indigofera linifolia*			
478.	3982	*Indigofera monophylla*			
479.	3985	*Indigofera rugosa*			
480.	41782	*Indigofera sp. Fractiflexa (S. van Leeuwen 3773)*			
481.	41781	*Indigofera sp. Gilesii (M.E. Trudgen 15869)*		P3	
482.	3987	*Indigofera trita*			
483.	3989	*Isotropis atropurpurea (Poison Sage)*			
484.	3994	*Isotropis forrestii*			
485.	4061	*Lotus cruentus (Redflower Lotus)*			
486.	4105	*Mirbelia viminalis*			
487.	3614	*Neptunia dimorphantha (Sensitive Plant)*			
488.	3615	*Neptunia gracilis (Native Sensitive Plant)*			
489.	3675	*Petalostylis labicheoides (Slender Petalostylis)*			
490.	4190	*Rhynchosia australis (Rhynchosia)*			
491.	4191	*Rhynchosia minima (Rhynchosia)*			
492.	17645	*Senna artemisioides*			
493.	12279	*Senna artemisioides subsp. helmsii*			
494.	12280	*Senna artemisioides subsp. oligophylla*			
495.	17558	*Senna artemisioides subsp. x artemisioides*			
496.	12283	*Senna artemisioides subsp. x sturtii*			
497.	18443	*Senna ferraria*			
498.	18449	*Senna glaucifolia*			
499.	18346	*Senna glutinosa*			
500.	12305	*Senna glutinosa subsp. chatelainiana*			
501.	12307	*Senna glutinosa subsp. glutinosa*			
502.	12309	*Senna glutinosa subsp. pruinosa*			
503.	12308	*Senna glutinosa subsp. x luerssenii*			
504.	12312	*Senna notabilis*			
505.	12315	*Senna pleurocarpa var. angustifolia*			
506.	19347	*Senna sericea*			
507.	18595	*Senna sp. Karijini (M.E. Trudgen 10392)*			
508.	14577	*Senna sp. Meekatharra (E. Bailey 1-26)*			
509.	18445	*Senna stricta*			
510.	12319	*Senna venusta*			
511.	4196	*Sesbania cannabina (Sesbania Pea)*			
512.	12353	*Stylosanthes hamata (Verano Stylo)*	Y		
513.	4220	*Swainsona canescens (Grey Swainsona)*			
514.	13596	*Swainsona complanata*			
515.	4223	*Swainsona decurrens*			
516.	12356	*Swainsona formosa*			
517.	4231	*Swainsona kingii*			
518.	4233	*Swainsona leeana*			
519.	4234	*Swainsona maccullochiana (Ashburton Pea)*			
520.	4238	*Swainsona oroboides (Variable Swainsona)*			
521.	4252	*Templetonia egena (Round Templetonia)*			
522.	4263	*Tephrosia clementii*			
523.	41986	*Tephrosia oxalidea*			
524.	41825	*Tephrosia rosea var. Fortescue creeks (M.I.H. Brooker 2186)*			
525.	17768	*Tephrosia sp. Bungaroo Creek (M.E. Trudgen 11601)*			
526.	41811	*Tephrosia sp. Fortescue (A.A. Mitchell 606)*			
527.	42442	*Tephrosia sp. NW Eremaean (S. van Leeuwen et al. PBS 0356)*			
528.	42225	*Tephrosia sp. Newman (A.A. Mitchell PRP 29)*			

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529.	4316	*Trigonella suavissima (Sweet Fenugreek)*			
530.	30716	*Vachellia farnesiana (Mimosa Bush)*	Y		
531.	4323	*Vigna lanceolata (Maloga Vigna, Wega)*			
Falconidae					
532.	25621	*Falco berigora (Brown Falcon)*			
533.	24471	*Falco berigora subsp. berigora (Brown Falcon)*			
534.	25622	*Falco cenchroides (Australian Kestrel)*			
535.	24473	*Falco hypoleucos (Grey Falcon)*		T	
536.	25623	*Falco longipennis (Australian Hobby)*			
537.	24474	*Falco longipennis subsp. longipennis (Australian Hobby)*			
538.	25624	*Falco peregrinus (Peregrine Falcon)*		S	
Felidae					
539.	24041	*Felis catus (Cat)*	Y		
Funariaceae					
540.	32356	*Entosthodon subnudus*			
Garypidae					
541.	-12938	*Synsphyronus gracilis*			
542.	-12002	*Synsphyronus heptatrichus*			
Gekkonidae					
543.	24956	*Gehyra pilbara*			
544.	24958	*Gehyra punctata*			
545.	24957	*Gehyra purpurascens*			
546.	24959	*Gehyra variegata*			
547.	24961	*Heteronotia binoei (Bynoe's Gecko)*			
548.	-18628	*Heteronotia sp.*			
549.	24962	*Heteronotia spelea (Desert Cave Gecko)*			
550.	24983	*Underwoodisaurus milii (Barking Gecko)*			
551.	41426	*Underwoodisaurus seorsus (Pilbara Barking Gecko)*		P1	
Gentianaceae					
552.	41660	*Schenkia australis*			
Geraniaceae					
553.	4335	*Erodium cygnorum (Blue Heronsbill)*			
Gnaphosidae					
554.	-13270	*nr Encoptarthria sp. B01*			Y
Goodeniaceae					
555.	7413	*Brunonia australis (Native Cornflower)*			
556.	19070	*Brunonia sp. Long hairs (D.E. Symon 2440)*		P1	
557.	7424	*Dampiera candicans*			
558.	20378	*Dampiera metallorum*		P3	
559.	12517	*Goodenia cusackiana*			
560.	12529	*Goodenia lyrata*		P3	
561.	7526	*Goodenia microptera*			
562.	12552	*Goodenia muelleriana*			
563.	7530	*Goodenia nuda*		P4	
564.	12571	*Goodenia pascua*			
565.	12574	*Goodenia prostrata*			
566.	7545	*Goodenia scaevolina (Ngurubi)*			
567.	29381	*Goodenia sp. East Pilbara (A.A. Mitchell PRP 727) (O'Meara's Goodenia)*		P3	
568.	7550	*Goodenia stellata*			
569.	10982	*Goodenia stobbsiana*			
570.	7556	*Goodenia tenuiloba*			
571.	7558	*Goodenia triodiophila*			
572.	12578	*Scaevola acacioides*			
573.	12723	*Scaevola amblyanthera*			
574.	13179	*Scaevola amblyanthera var. amblyanthera*			
575.	13178	*Scaevola amblyanthera var. centralis*			
576.	12579	*Scaevola browniana*			
577.	13150	*Scaevola browniana subsp. browniana*			
578.	7633	*Scaevola parvifolia (Camel Weed)*			
579.	13172	*Scaevola parvifolia subsp. pilbarae*			
580.	7644	*Scaevola spinescens (Currant Bush, Maroon)*			
581.	7654	*Velleia connata (Cup Velleia)*			
Gyrostemonaceae					
582.	2778	*Codonocarpus cotinifolius (Native Poplar, Kundurangu)*			

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Halcyonidae					
583.	25547	*Dacelo leachii (Blue-winged Kookaburra)*			
584.	24304	*Dacelo leachii subsp. leachii (Blue-winged Kookaburra)*			
585.	42351	*Todiramphus pyrrhopygius (Red-backed Kingfisher)*			
586.	25549	*Todiramphus sanctus (Sacred Kingfisher)*			
Haloragaceae					
587.	6174	*Haloragis gossei*			
588.	23465	*Haloragis gossei var. gossei*			
589.	23464	*Haloragis gossei var. inflata*			
590.	20669	*Haloragis maierae*			
591.	6180	*Haloragis trigonocarpa*			
Hemerocallidaceae					
592.	29483	*Tricoryne sp. Hamersley Range (S. van Leeuwen 915)*			
Hersiliidae					
593.	-13792	*Tamopsis gracilis*			
Hipposideridae					
594.	43368	*Rhinonicteris aurantia (Orange Leafnosed-bat)*		T	
Hirundinidae					
595.	24489	*Hirundo ariel (Fairy Martin)*			
596.	24491	*Hirundo neoxena (Welcome Swallow)*			
597.	25629	*Hirundo nigricans (Tree Martin)*			
598.	24492	*Hirundo nigricans subsp. nigricans (Tree Martin)*			
Hylidae					
599.	25375	*Cyclorana maini (Sheep Frog)*			
600.	25376	*Cyclorana platycephala (Water-holding Frog)*			
601.	25392	*Litoria rubella (Little Red Tree Frog)*			
Idiopidae					
602.	-13193	*Anidiops villosus*			
Lamiaceae					
603.	13692	*Clerodendrum floribundum var. angustifolium*			
604.	13689	*Clerodendrum tomentosum var. lanceolatum*			
605.	6754	*Dicrastylis cordifolia*			
606.	20252	*Newcastelia sp. Hamersley Range (S. van Leeuwen 4264)*			
607.	12707	*Prostanthera albiflora*			
608.	6912	*Prostanthera campbellii*			
609.	6826	*Spartothamnella puberula*		P2	
610.	6827	*Spartothamnella teucriiflora*			
611.	19366	*Teucrium pilbaranum*		P1	
Lamponidae					
612.	-12220	*Asadipus yundamindra*			
Lauraceae					
613.	2949	*Cassytha capillaris*			
Leporidae					
614.	24085	*Oryctolagus cuniculus (Rabbit)*	Y		
Limnodynastidae					
615.	25422	*Neobatrachus aquilonius (Northern Burrowing Frog)*			
616.	25427	*Neobatrachus sutor (Shoemaker Frog)*			
Loranthaceae					
617.	2372	*Amyema fitzgeraldii (Pincushion Mistletoe)*			
618.	11614	*Amyema gibberula var. gibberula*			
619.	2374	*Amyema hilliana*			
620.	2383	*Amyema preissii (Wireleaf Mistletoe)*			
621.	29080	*Amyema sanguinea var. pulchra*			
622.	11874	*Amyema sanguinea var. sanguinea*			
623.	2395	*Diplatia grandibractea*			
624.	2396	*Lysiana casuarinae*			
625.	2398	*Lysiana murrayi (Mistletoe, Parka-Parka)*			
Lycosidae					
626.	-12781	*Hoggicosa bicolor*			
Lythraceae					
627.	5277	*Ammannia baccifera*			
Macropodidae					

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628.	25489	*Macropus robustus (Euro)*			
629.	24135	*Macropus robustus subsp. erubescens (Euro, Biggada)*			
630.	24136	*Macropus rufus (Red Kangaroo, Marlu)*			
631.	24144	*Petrogale rothschildi (Rothschild's Rock-wallaby)*			
Maluridae					
632.	25647	*Amytornis striatus (Striated Grasswren)*			
633.	24540	*Amytornis striatus subsp. whitei (Striated Grasswren)*			
634.	25651	*Malurus lamberti (Variegated Fairy-wren)*			
635.	24544	*Malurus lamberti subsp. assimilis (Variegated Fairy-wren)*			
636.	25652	*Malurus leucopterus (White-winged Fairy-wren)*			
637.	24549	*Malurus leucopterus subsp. leuconotus (White-winged Fairy-wren)*			
638.	25654	*Malurus splendens (Splendid Fairy-wren)*			
639.	25656	*Stipiturus ruficeps (Rufous-crowned Emu-wren)*			
Malvaceae					
640.	4886	*Abutilon amplum*			
641.	4889	*Abutilon cryptopetalum*			
642.	9080	*Abutilon cunninghamii*			
643.	4891	*Abutilon fraseri (Lantern Bush)*			
644.	4895	*Abutilon lepidum*			
645.	4896	*Abutilon leucopetalum (Desert Chinese Lantern)*			
646.	4898	*Abutilon macrum*			
647.	4899	*Abutilon malvifolium (Bastard Marshmallow)*			
648.	4901	*Abutilon otocarpum (Desert Chinese Lantern)*			
649.	42920	*Abutilon sp. Dioicum (A.A. Mitchell PRP 1618)*			
650.	14113	*Abutilon sp. Pilbara (W.R. Barker 2025)*			
651.	40910	*Androcalva luteiflora (Yellow-flowered Rulingia)*			
652.	12716	*Brachychiton acuminatus*			
653.	13560	*Corchorus crozophorifolius*			
654.	17405	*Corchorus lasiocarpus*			
655.	18409	*Corchorus lasiocarpus subsp. lasiocarpus*			
656.	18408	*Corchorus lasiocarpus subsp. parvus*			
657.	4865	*Corchorus tridens*			
658.	4910	*Gossypium australe (Native Cotton)*			
659.	4918	*Gossypium robinsonii (Wild Cotton)*			
660.	4919	*Gossypium sturtianum (Sturt's Desert Rose)*			
661.	17722	*Hannafordia bissillii subsp. bissillii*			
662.	4922	*Hibiscus brachychlaenus*			
663.	4923	*Hibiscus brachysiphonius*			
664.	4924	*Hibiscus burtonii*			
665.	4925	*Hibiscus coatesii*			
666.	4931	*Hibiscus haynaldii*			
667.	4933	*Hibiscus leptocladus*			
668.	43022	*Hibiscus sp. Gardneri (A.L. Payne PRP 1435)*			
669.	40560	*Hibiscus sp. Gurinbiddy Range (M.E. Trudgen MET 15708)*		P2	
670.	40640	*Hibiscus sp. Mt Robinson (G. Byrne 3537)*			
671.	4942	*Hibiscus sturtii (Sturt's Hibiscus)*			
672.	11651	*Hibiscus sturtii var. campylochlamys*			
673.	11385	*Hibiscus sturtii var. grandiflorus*			
674.	11477	*Hibiscus sturtii var. platychlamys*			
675.	11893	*Hibiscus sturtii var. truncatus*			
676.	43081	*Hibiscus verdcourtii*			
677.	5024	*Keraudrenia nephrosperma*			
678.	13729	*Keraudrenia velutina*			
679.	19636	*Keraudrenia velutina subsp. elliptica*			
680.	4962	*Malvastrum americanum (Spiked Malvastrum)*	Y		
681.	5051	*Melhania oblongifolia*			
682.	4966	*Sida arenicola*			
683.	4970	*Sida calyxhymenia (Tall Sida)*			
684.	4971	*Sida cardiophylla*			
685.	4972	*Sida clementii*			
686.	4976	*Sida echinocarpa*			
687.	31759	*Sida ectogama*			
688.	4977	*Sida fibulifera (Silver Sida)*			
689.	4986	*Sida platycalyx (Lifesaver Burr)*			
690.	4988	*Sida rohlenae*			
691.	18149	*Sida rohlenae subsp. rohlenae*			
692.	31859	*Sida sp. Articulation below (A.A. Mitchell PRP 1605)*			
693.	16616	*Sida sp. Barlee Range (S. van Leeuwen 1642)*		P3	
694.	31854	*Sida sp. Excedentifolia (J.L. Egan 1925)*			

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695.	31857	*Sida sp. Golden calyces glabrous (H.N. Foote 32)*			
696.	33698	*Sida sp. Pilbara (A.A. Mitchell PRP 1543)*			
697.	20253	*Sida sp. Shovelanna Hill (S. van Leeuwen 3842)*			
698.	19712	*Sida sp. dark green fruits (S. van Leeuwen 2260)*			
699.	16617	*Sida sp. spiciform panicles (E. Leyland s.n. 14/8/90)*			
700.	18144	*Sida sp. tiny glabrous fruit (A.A. Mitchell PRP1152)*			
701.	16948	*Sida sp. verrucose glands (F.H. Mollemans 2423)*			
702.	4989	*Sida spinosa (Spiny Sida)*			
703.	4879	*Triumfetta leptacantha*			
704.	14942	*Triumfetta maconochieana*			
705.	5106	*Waltheria indica*			
Marsileaceae					
706.	74	*Marsilea drummondii (Common Nardoo)*			
707.	75	*Marsilea exarata*			
708.	76	*Marsilea hirsuta (Nardoo)*			
Megadermatidae					
709.	24180	*Macroderma gigas (Ghost Bat)*		P4	
Meliphagidae					
710.	24559	*Acanthagenys rufogularis (Spiny-cheeked Honeyeater)*			
711.	24564	*Certhionyx variegatus (Pied Honeyeater)*			
712.	24570	*Epthianura tricolor (Crimson Chat)*			
713.	42314	*Gavicalis virescens (Singing Honeyeater)*			
714.	24572	*Lacustroica whitei (Grey Honeyeater)*			
715.	25661	*Lichmera indistincta (Brown Honeyeater)*			
716.	24582	*Lichmera indistincta subsp. indistincta (Brown Honeyeater)*			
717.	24583	*Manorina flavigula (Yellow-throated Miner)*			
718.	25665	*Melithreptus gularis (Black-chinned Honeyeater)*			
719.	42323	*Ptilotula keartlandi (Grey-headed Honeyeater)*			
720.	42341	*Ptilotula penicillatus (White-plumed Honeyeater)*			
721.	42344	*Purnella albifrons (White-fronted Honeyeater)*			
Meropidae					
722.	24598	*Merops ornatus (Rainbow Bee-eater)*		IA	
Molluginaceae					
723.	29851	*Mollugo molluginea*			
Molossidae					
724.	24181	*Chaerephon jobensis (Northern Freetail-bat)*			
725.	24182	*Mormopterus beccarii (Beccari's Freetail-bat)*			
726.	24185	*Tadarida australis (White-striped Freetail-bat)*			
Momoniidae					
727.	-13553	*Hesperomomonia humphreysi*			
Moraceae					
728.	19648	*Ficus brachypoda*			
729.	1753	*Ficus platypoda (Native Fig, Makartu)*			
Motacillidae					
730.	25670	*Anthus australis (Australian Pipit)*			
731.	24599	*Anthus australis subsp. australis (Australian Pipit)*			
Muridae					
732.	24217	*Leggadina lakedownensis (Short-tailed Mouse, Karekanga)*		P4	
733.	24223	*Mus musculus (House Mouse)*	Y		
734.	24224	*Notomys alexis (Spinifex Hopping-mouse)*			
735.	24233	*Pseudomys chapmani (Western Pebble-mound Mouse, Ngadji)*		P4	
736.	24234	*Pseudomys delicatulus (Delicate Mouse)*			
737.	24235	*Pseudomys desertor (Desert Mouse)*			
738.	24237	*Pseudomys hermannsburgensis (Sandy Inland Mouse)*			
739.	24239	*Pseudomys nanus (Western Chestnut Mouse)*			
740.	24248	*Zyzomys argurus (Common Rock-rat)*			
741.	-18370	*Zyzomys sp.*			Y
Myobatrachidae					
742.	25432	*Pseudophryne douglasi (Gorge Toadlet)*			
743.	25445	*Uperoleia russelli (Northwest Toadlet)*			
744.	41428	*Uperoleia saxatilis (Pilbara Toadlet)*			
Myrtaceae					
745.	5446	*Calytrix carinata*			
746.	16783	*Corymbia candida*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
747.	17082	*Corymbia deserticola*			
748.	17083	*Corymbia deserticola subsp. deserticola*			
749.	17077	*Corymbia ferriticola*			
750.	17093	*Corymbia hamersleyana*			
751.	17092	*Corymbia opaca*			
752.	35345	*Eucalyptus camaldulensis subsp. obtusa (Blunt-budded River Red Gum)*			
753.	5641	*Eucalyptus ewartiana (Ewart's Mallee)*			
754.	5655	*Eucalyptus gamophylla (Twin-leaf Mallee, Warilu)*			
755.	5684	*Eucalyptus kingsmillii (Kingsmill's Mallee)*			
756.	13528	*Eucalyptus kingsmillii subsp. kingsmillii*			
757.	5698	*Eucalyptus leucophloia (Snappy Gum, Migum)*			
758.	18088	*Eucalyptus leucophloia subsp. leucophloia*			
759.	5744	*Eucalyptus pilbarensis*			
760.	18058	*Eucalyptus repullulans*			
761.	5773	*Eucalyptus socialis (Red Mallee, Altarpa)*			
762.	19576	*Eucalyptus socialis subsp. eucentrica*			
763.	18219	*Eucalyptus tephrodes*			
764.	29733	*Eucalyptus trivalva (Victoria Spring Mallee)*			
765.	14548	*Eucalyptus victrix*			
766.	15592	*Eucalyptus xerothermica*			
767.	5846	*Lamarchea sulcata*			
768.	5875	*Melaleuca argentea (Silver Cadjeput, Bandaran)*			
769.	5908	*Melaleuca eleuterostachya*			
770.	5915	*Melaleuca glomerata*			
Nemesiidae					
771.	-12359	*Aname mellosa*			
Neosittidae					
772.	25673	*Daphoenositta chrysoptera (Varied Sittella)*			
Nyctaginaceae					
773.	2770	*Boerhavia coccinea (Tar Vine, Wituka)*			
774.	2773	*Boerhavia paludosa*			
775.	2774	*Boerhavia repleta*			
Oleaceae					
776.	6501	*Jasminum didymum*			
777.	12059	*Jasminum didymum subsp. lineare (Desert Jasmine)*			
Oonopidae					
778.	-12261	*Cavisternum clavatum*			
779.	-12057	*Prethopalpus julianneae*			Y
780.	-12316	*Prethopalpus maini*			Y
781.	-13140	*Prethopalpus pearsoni*			Y
Ophioglossaceae					
782.	17	*Ophioglossum lusitanicum (Adders Tongue)*			
Orobanchaceae					
783.	12492	*Striga squamigera*			
Oryidae					
784.	-13190	*Orphnaeus brevilabiatus*			
Otididae					
785.	24610	*Ardeotis australis (Australian Bustard)*		P4	
Oxalidaceae					
786.	30374	*Oxalis sp. Pilbara (M.E. Trudgen 12725)*		P2	
Pachycephalidae					
787.	25675	*Colluricincla harmonica (Grey Shrike-thrush)*			
788.	24613	*Colluricincla harmonica subsp. rufiventris (Grey Shrike-thrush)*			
789.	24618	*Oreoica gutturalis (Crested Bellbird)*			
790.	25680	*Pachycephala rufiventris (Rufous Whistler)*			
791.	24624	*Pachycephala rufiventris subsp. rufiventris (Rufous Whistler)*			
Papaveraceae					
792.	2961	*Argemone ochroleuca (Mexican Poppy)*	Y		
Pardalotidae					
793.	24627	*Pardalotus rubricatus (Red-browed Pardalote)*			
794.	25682	*Pardalotus striatus (Striated Pardalote)*			
795.	24628	*Pardalotus striatus subsp. murchisoni (Striated Pardalote)*			
796.	24629	*Pardalotus striatus subsp. uropygialis (Striated Pardalote)*			
797.	24630	*Pardalotus striatus subsp. westraliensis (Striated Pardalote)*			

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Pedaliaceae					
798.	7118	*Josephinia eugeniae (Josephinia Burr)*			
799.	14322	*Josephinia sp. Marandoo (M.E. Trudgen 1554)*		P1	
Pelecanidae					
800.	24648	*Pelecanus conspicillatus (Australian Pelican)*			
Petroicidae					
801.	24658	*Petroica cucullata (Hooded Robin)*			
802.	24659	*Petroica goodenovii (Red-capped Robin)*			
Phalacrocoracidae					
803.	24667	*Phalacrocorax sulcirostris (Little Black Cormorant)*			
804.	25699	*Phalacrocorax varius (Pied Cormorant)*			
Phasianidae					
805.	25701	*Coturnix ypsilophora (Brown Quail)*			
Phrymaceae					
806.	7057	*Elacholoma hornii*			
807.	7060	*Glossostigma diandrum*			
808.	7082	*Mimulus gracilis*			
809.	7092	*Peplidium muelleri*			
810.	18462	*Peplidium sp. E Evol. Fl. Fauna Arid Aust. (A.S. Weston 12768)*			
Phyllanthaceae					
811.	38423	*Notoleptopus decaisnei var. Orbicularis (A.B. Craig 428)*			
812.	17626	*Phyllanthus erwinii*			
813.	4680	*Phyllanthus maderaspatensis*			
814.	4711	*Sauropus trachyspermus*			
Plantaginaceae					
815.	12488	*Stemodia glabella*			
816.	7098	*Stemodia grossa (Marsh Stemodia, Mindjaara)*			
817.	7102	*Stemodia viscosa (Pagurda)*			
Plotosidae					
818.	-14444	*Neosilurus hyrtlii*			
Plumbaginaceae					
819.	6491	*Plumbago zeylanica (Native Plumbago)*			
Poaceae					
820.	172	*Acrachne racemosa*			
821.	19835	*Amphipogon sericeus*			
822.	204	*Aristida burbidgeae*			
823.	207	*Aristida contorta (Bunched Kerosene Grass)*			
824.	12063	*Aristida holathera var. holathera*			
825.	11193	*Aristida holathera var. latifolia*			
826.	17918	*Aristida jerichoensis var. subspinulifera*		P1	
827.	215	*Aristida latifolia (Feathertop Wiregrass)*			
828.	216	*Aristida lazaridis*		P2	
829.	217	*Aristida nitidula (Flat-awned Threeawn)*			
830.	218	*Aristida obscura (Brush Threeawn)*			
831.	227	*Astrebla elymoides (Weeping Mitchell Grass)*			
832.	229	*Astrebla pectinata (Barley Mitchell Grass)*			
833.	239	*Bothriochloa bladhii (Forest Bluegrass)*			
834.	240	*Bothriochloa ewartiana (Desert Bluegrass)*			
835.	241	*Brachyachne convergens (Spider Grass)*			
836.	258	*Cenchrus ciliaris (Buffel Grass)*	Y		
837.	259	*Cenchrus echinatus (Burrgrass)*	Y		
838.	266	*Chloris barbata (Purpletop Chloris)*	Y		
839.	269	*Chloris pectinata (Comb Chloris)*			
840.	272	*Chloris virgata (Feathertop Rhodes Grass)*	Y		
841.	273	*Chrysopogon fallax (Golden Beard Grass)*			
842.	279	*Cymbopogon ambiguus (Scentgrass)*			
843.	281	*Cymbopogon obtectus (Silkyheads)*			
844.	282	*Cymbopogon procerus (Lemon Grass)*			
845.	290	*Dactyloctenium radulans (Button Grass)*			
846.	13741	*Dichanthium sericeum subsp. humilius*			
847.	13740	*Dichanthium sericeum subsp. polystachyum*			
848.	11964	*Dichanthium sericeum subsp. sericeum*			
849.	308	*Digitaria ammophila (Silky Umbrella Grass)*			
850.	310	*Digitaria brownii (Cotton Panic Grass)*			
851.	311	*Digitaria ciliaris (Summer Grass)*			

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			Y		
852.	312	*Digitaria coenicola*			
853.	313	*Digitaria ctenantha (Comb Finger Grass)*			
854.	355	*Elytrophorus spicatus (Spikegrass)*			
855.	357	*Enneapogon caerulescens (Limestone Grass)*			
856.	12746	*Enneapogon intermedius*			
857.	360	*Enneapogon lindleyanus (Wiry Nineawn, Purple-head Nineawn)*			
858.	365	*Enneapogon polyphyllus (Leafy Nineawn)*			
859.	20377	*Enneapogon robustissimus*			
860.	368	*Enteropogon ramosus (Windmill Grass, Curly Windmill Grass)*			
861.	375	*Eragrostis cumingii (Cuming's Love Grass)*			
862.	378	*Eragrostis dielsii (Mallee Lovegrass)*			
863.	380	*Eragrostis eriopoda (Woollybutt Grass, Wangurnu)*			
864.	381	*Eragrostis falcata (Sickle Lovegrass)*			
865.	388	*Eragrostis leptocarpa (Drooping Lovegrass)*			
866.	392	*Eragrostis pergracilis*			
867.	393	*Eragrostis setifolia (Neverfail Grass)*			
868.	20243	*Eragrostis sp. Mt Robinson (S. van Leeuwen 4109)*		P1	Y
869.	398	*Eragrostis tenellula (Delicate Lovegrass)*			
870.	399	*Eragrostis xerophila (Knotty-butt Neverfail)*			
871.	400	*Eriachne aristidea*			
872.	403	*Eriachne benthamii (Swamp Wanderrie)*			
873.	408	*Eriachne flaccida (Claypan Grass)*			
874.	411	*Eriachne helmsii (Buck Wanderrie Grass)*			
875.	13660	*Eriachne lanata*			
876.	413	*Eriachne mucronata (Mountain Wanderrie Grass)*			
877.	415	*Eriachne ovata*			
878.	16485	*Eriachne pulchella subsp. dominii*			
879.	16486	*Eriachne pulchella subsp. pulchella*			
880.	421	*Eriachne tenuiculmis*			
881.	11011	*Eulalia aurea*			
882.	12663	*Ischaemum albovillosum*			
883.	458	*Iseilema dolichotrichum*			
884.	461	*Iseilema fragile*			
885.	464	*Iseilema membranaceum (Small Flinders Grass)*			
886.	465	*Iseilema vaginiflorum (Red Flinders Grass)*			
887.	490	*Monachather paradoxus*			
888.	503	*Panicum decompositum (Native Millet, Kaltu-kaltu)*			
889.	504	*Panicum effusum (Hairy Panic Grass)*			
890.	505	*Panicum laevinode*			
891.	515	*Paraneurachne muelleri (Northern Mulga Grass)*			
892.	10975	*Paspalidium basicladum*			
893.	518	*Paspalidium clementii (Clements Paspalidium)*			
894.	519	*Paspalidium constrictum (Knottybutt Grass)*			
895.	521	*Paspalidium gracile (Slender Panic)*			
896.	522	*Paspalidium jubiflorum (Warrego Grass)*			
897.	523	*Paspalidium rarum (Rare Paspalidium)*			
898.	527	*Paspalum dilatatum*	Y		
899.	546	*Perotis rara (Comet Grass)*			
900.	599	*Schizachyrium fragile (Senale Redgrass)*			
901.	606	*Setaria dielsii (Diels' Pigeon Grass)*			
902.	612	*Setaria surgens (Pigeon Grass)*			
903.	613	*Setaria verticillata (Whorled Pigeon Grass)*	Y		
904.	12919	*Sorghum plumosum var. plumosum*			
905.	629	*Sporobolus australasicus (Fairy Grass)*			
906.	17820	*Themeda sp. Hamersley Station (M.E. Trudgen 11431)*		P3	
907.	17819	*Themeda sp. Mt Barricade (M.E. Trudgen 2471)*			
908.	673	*Themeda triandra*			
909.	674	*Thyridolepis mitchelliana (Mulga Grass)*			
910.	678	*Tragus australianus (Small Burrgrass)*			
911.	680	*Triodia basedowii (Lobed Spinifex)*			
912.	17886	*Triodia biflora*			
913.	681	*Triodia brizoides*			
914.	690	*Triodia longiceps (Giant Grey Spinifex)*			
915.	17877	*Triodia melvillei*			
916.	696	*Triodia pungens (Soft Spinifex)*			
917.	17873	*Triodia schinzii*			
918.	41101	*Triodia sp. Karijini (S. van Leeuwen 4111)*		P1	
919.	19534	*Triodia sp. Mt Ella (M.E. Trudgen 12739)*		P3	
920.	20241	*Triodia sp. Shovelanna Hill (S. van Leeuwen 3835)*			

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921.	704	*Triodia wiseana (Limestone Spinifex)*			
922.	705	*Tripogon loliiformis (Five Minute Grass)*			
923.	706	*Triraphis mollis (Needle Grass)*			
924.	29268	*Urochloa occidentalis*			
925.	717	*Urochloa piligera*			
926.	718	*Urochloa pubigera*			
927.	732	*Yakirra australiensis*			
Podargidae					
928.	25703	*Podargus strigoides (Tawny Frogmouth)*			
Polygalaceae					
929.	41365	*Polygala glaucifolia*			
Polygonaceae					
930.	17739	*Acetosa vesicaria*	Y		
931.	16982	*Muehlenbeckia florulenta*			
Polyxenidae					
932.	-13128	*Unixenus attemsi*			
Pomatostomidae					
933.	24683	*Pomatostomus superciliosus (White-browed Babbler)*			
934.	25706	*Pomatostomus temporalis (Grey-crowned Babbler)*			
935.	24684	*Pomatostomus temporalis subsp. rubeculus (Grey-crowned Babbler)*			
Portulacaceae					
936.	2860	*Calandrinia polyandra (Parakeelya)*			
937.	2864	*Calandrinia ptychosperma*			
938.	2865	*Calandrinia pumila*			
939.	2868	*Calandrinia reticulata*			
940.	31073	*Calandrinia sp. The Pink Hills (F. Obbens FO 19/06)*			
941.	43981	*Portulaca decipiens*			
942.	2884	*Portulaca oleracea (Purslane, Wakati)*			
943.	2886	*Portulaca pilosa (Djanggara)*			
Procellariidae					
944.	24690	*Macronectes giganteus (Southern Giant Petrel)*		P4	
Prodidomidae					
945.	-12093	*Molycria vokes*			
Proteaceae					
946.	1963	*Grevillea berryana*			
947.	2079	*Grevillea pyramidalis (Caustic Bush, Tjungu)*			
948.	19570	*Grevillea pyramidalis subsp. leucadendron*			
949.	40220	*Grevillea sp. Turee (J. Bull & G. Hopkinson ONS JJ 01.01)*		P1	
950.	2096	*Grevillea stenobotrya*			
951.	2121	*Grevillea wickhamii (Wickham's Grevillea)*			
952.	19478	*Grevillea wickhamii subsp. hispidula*			
953.	2138	*Hakea chordophylla*			
954.	2177	*Hakea lorea (Witinti)*			
Psittacidae					
955.	25715	*Cacatua roseicapilla (Galah)*			
956.	24725	*Cacatua roseicapilla subsp. assimilis (Galah)*			
957.	24726	*Cacatua roseicapilla subsp. roseicapilla (Galah)*			
958.	25716	*Cacatua sanguinea (Little Corella)*			
959.	24728	*Cacatua sanguinea subsp. sanguinea (Little Corella)*			
960.	24727	*Cacatua sanguinea subsp. westralensis (Little Corella)*			
961.	24736	*Melopsittacus undulatus (Budgerigar)*			
962.	24742	*Nymphicus hollandicus (Cockatiel)*			
963.	24748	*Platycercus varius (Mulga Parrot)*			
964.	25721	*Platycercus zonarius (Australian Ringneck, Ring-necked Parrot)*			
965.	24751	*Platycercus zonarius subsp. zonarius (Port Lincoln Parrot)*			
Pteridaceae					
966.	31	*Cheilanthes austrotenuifolia*			
967.	37	*Cheilanthes lasiophylla (Woolly Cloak Fern)*			
968.	12815	*Cheilanthes sieberi subsp. pseudovellea*			
969.	12818	*Cheilanthes sieberi subsp. sieberi*			
970.	8462	*Cheilanthes tenuifolia (Rock Fern)*			
971.	43	*Paraceterach reynoldsii*			
Ptilonorhynchidae					
972.	24757	*Ptilonorhynchus maculatus subsp. guttatus (Western Bowerbird)*			

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Pygopodidae					
973.	24998	*Delma elegans*			
974.	25000	*Delma haroldi*			
975.	25001	*Delma nasuta*			
976.	25002	*Delma pax*			
977.	25004	*Delma tincta*			
978.	25005	*Lialis burtonis*			
979.	25009	*Pygopus nigriceps*			
Recurvirostridae					
980.	25734	*Himantopus himantopus (Black-winged Stilt)*			
Rhamnaceae					
981.	16189	*Cryptandra monticola*			
982.	16199	*Stenanthemum petraeum*			
Rubiaceae					
983.	7338	*Oldenlandia crouchiana*			
984.	19640	*Oldenlandia sp. Hamersley Station (A.A. Mitchell PRP 1479)*		P3	
985.	12964	*Pomax rupestris*			
986.	18154	*Psydrax latifolia*			
987.	18210	*Psydrax rigidula*			
988.	18155	*Psydrax suaveolens*			
989.	13575	*Spermacoce brachystema*			
990.	7363	*Synaptantha tillaeacea*			
Santalaceae					
991.	2333	*Anthobolus leptomerioides*			
992.	2356	*Santalum acuminatum (Quandong, Warnga)*			
993.	2357	*Santalum lanceolatum (Northern Sandalwood, Yarnguli)*			
Sapindaceae					
994.	4739	*Alectryon oleifolius*			
995.	4740	*Atalaya hemiglauca (Whitewood)*			
996.	4759	*Dodonaea coriacea*			
997.	4767	*Dodonaea lanceolata (Pirrungu)*			
998.	11406	*Dodonaea lanceolata var. lanceolata*			
999.	4772	*Dodonaea pachyneura*			
1000.	4773	*Dodonaea petiolaris*			
1001.	4782	*Dodonaea viscosa (Sticky Hopbush)*			
1002.	11674	*Dodonaea viscosa subsp. mucronata*			
1003.	11202	*Dodonaea viscosa subsp. spatulata (Sticky Hop-bush)*			
Scincidae					
1004.	25015	*Carlia munda (Shaded-litter Rainbow Skink)*			
1005.	25017	*Carlia triacantha (Desert Rainbow Skink)*			
1006.	30893	*Cryptoblepharus buchananii*			
1007.	25020	*Cryptoblepharus plagiocephalus*			
1008.	30892	*Cryptoblepharus ustulatus*			
1009.	25025	*Ctenotus ariadnae*			
1010.	25036	*Ctenotus duricola*			
1011.	25462	*Ctenotus grandis*			
1012.	25041	*Ctenotus grandis subsp. grandis*			
1013.	25044	*Ctenotus hanloni*			
1014.	25045	*Ctenotus helenae*			
1015.	25052	*Ctenotus leonhardii*			
1016.	25463	*Ctenotus pantherinus (Leopard Ctenotus)*			
1017.	25060	*Ctenotus pantherinus subsp. acripes (Leopard Ctenotus)*			
1018.	25064	*Ctenotus pantherinus subsp. ocellifer (Leopard Ctenotus)*			
1019.	25072	*Ctenotus rubicundus*			
1020.	25071	*Ctenotus rutilans*			
1021.	25073	*Ctenotus saxatilis (Rock Ctenotus)*			
1022.	25074	*Ctenotus schomburgkii*			
1023.	25077	*Ctenotus serventyi*			
1024.	25465	*Ctenotus uber (Spotted Ctenotus)*			
1025.	25080	*Ctenotus uber subsp. uber (Spotted Ctenotus)*			
1026.	25086	*Cyclodomorphus branchialis (Gilled Slender Blue-tongue Skink)*		T	
1027.	25466	*Cyclodomorphus melanops (Slender Blue-tongue)*			
1028.	25089	*Cyclodomorphus melanops subsp. elongatus (Slender Blue-tongue)*			
1029.	25090	*Cyclodomorphus melanops subsp. melanops (Slender Blue-tongue)*			
1030.	41406	*Egernia cygnitos (Western Pilbara Spiny-tailed Skink)*			
1031.	25092	*Egernia depressa (Southern Pygmy Spiny-tailed Skink)*			
1032.	25094	*Egernia formosa*			

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1033.	43381	*Eremiascincus pallidus (Western Narrow-banded Skink, Narrow-banded Sand Swimmer)*			
1034.	25109	*Eremiascincus richardsonii (Broad-banded Sand Swimmer)*			
1035.	30926	*Lerista amicorum*			
1036.	25125	*Lerista bipes*			
1037.	25146	*Lerista labialis*			
1038.	25482	*Lerista macropisthopus*			
1039.	25151	*Lerista macropisthopus subsp. fusciceps*			
1040.	25155	*Lerista muelleri*			
1041.	25156	*Lerista neander*			
1042.	42411	*Lerista timida*			
1043.	30925	*Lerista verhmens*			
1044.	25183	*Lerista zietzi*			
1045.	25184	*Menetia greyii*			
1046.	25491	*Menetia surda*			
1047.	25187	*Menetia surda subsp. surda*			
1048.	25495	*Morethia ruficauda*			
1049.	25193	*Morethia ruficauda subsp. exquisita*			
1050.	25199	*Proablepharus reginae*			
1051.	25202	*Tiliqua multifasciata (Central Blue-tongue)*			
Scolopacidae					
1052.	24808	*Tringa nebularia (Common Greenshank)*		IA	
Scolopendridae					
1053.	-1933	*Arthrorhabdus paucispinus*			
1054.	-1846	*Cormocephalus strigosus*			
1055.	-1868	*Cormocephalus turneri*			
1056.	-1918	*Ethmostigmus curtipes*			
1057.	-1822	*Scolopendra laeta*			
1058.	-1978	*Scolopendra morsitans*			
Scrophulariaceae					
1059.	14509	*Eremophila caespitosa*			
1060.	15167	*Eremophila canaliculata*			
1061.	7189	*Eremophila clarkei (Turpentine Bush)*			
1062.	7190	*Eremophila compacta*			
1063.	7192	*Eremophila cuneifolia (Pinyuru, T'iranju)*			
1064.	7205	*Eremophila exilifolia*			
1065.	7208	*Eremophila forrestii (Wilcox Bush)*			
1066.	15052	*Eremophila forrestii subsp. forrestii*			
1067.	7209	*Eremophila fraseri (Burra)*			
1068.	16696	*Eremophila fraseri subsp. fraseri*			
1069.	29532	*Eremophila galeata*			
1070.	17519	*Eremophila jucunda subsp. pulcherrima*			
1071.	7228	*Eremophila lachnocalyx (Woolly-calyxed Eremophila)*			
1072.	16940	*Eremophila lanceolata*			
1073.	7230	*Eremophila latrobei (Warty Fuchsia Bush, Mintjingka)*			
1074.	17597	*Eremophila latrobei subsp. filiformis*			
1075.	17576	*Eremophila latrobei subsp. latrobei*			
1076.	7234	*Eremophila longifolia (Berrigan, Tulypurpa)*			
1077.	14893	*Eremophila magnifica subsp. magnifica*		P4	
1078.	18570	*Eremophila oppositifolia subsp. angustifolia*			
1079.	15164	*Eremophila petrophila subsp. petrophila*			
1080.	17283	*Eremophila phyllopoda subsp. obliqua*			
1081.	15160	*Eremophila platycalyx subsp. pardalota*			
1082.	15058	*Eremophila platycalyx subsp. platycalyx*			
1083.	40643	*Eremophila sp. Hamersley Range (K. Walker KW 136)*		P1	
1084.	20256	*Eremophila sp. West Angelas (S. van Leeuwen 4068)*		P1	
1085.	23997	*Eremophila tietkensii*			
Scutigeridae					
1086.	-13276	*Pilbarascutigera incola*			
Solanaceae					
1087.	6962	*Datura leichhardtii (Native Thornapple)*	Y		
1088.	6971	*Nicotiana benthamiana (Tjuntiwari)*			
1089.	11331	*Nicotiana occidentalis subsp. obliqua*			
1090.	11856	*Nicotiana occidentalis subsp. occidentalis*			
1091.	6977	*Nicotiana rosulata (Rosetted Tobacco)*			
1092.	11410	*Nicotiana rosulata subsp. ingulba*			
1093.	11734	*Nicotiana rosulata subsp. rosulata*			
1094.	6979	*Nicotiana simulans*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
1095.	6995	*Solanum centrale (Desert Raisin, Kampurarpa)*			
1096.	6997	*Solanum chippendalei*			
1097.	6998	*Solanum cleistogamum*			
1098.	42544	*Solanum elatius*			
1099.	7008	*Solanum ferocissimum*			
1100.	7009	*Solanum gabrielae*			
1101.	7014	*Solanum horridum*			
1102.	42542	*Solanum kentrocaule*		P3	
1103.	7018	*Solanum lasiophyllum (Flannel Bush, Mindjulu)*			
1104.	9258	*Solanum morrisonii*			
1105.	7022	*Solanum nigrum (Black Berry Nightshade)*	Y		
1106.	7026	*Solanum orbiculatum (Wild Tomato)*			
1107.	11241	*Solanum orbiculatum subsp. orbiculatum (Round-leaved Solanum)*			
1108.	7029	*Solanum phlomoides*			
1109.	42546	*Solanum piceum*			
1110.	7036	*Solanum sturtianum (Thargomindah Nightshade)*			
Sparassidae					
1111.	-13284	*Pediana horni*			
Strigidae					
1112.	25747	*Ninox connivens (Barking Owl)*			
1113.	24819	*Ninox connivens subsp. connivens (Barking Owl (southwest pop P2), Barking Owl)*		P2	
1114.	25748	*Ninox novaeseelandiae (Boobook Owl)*			
1115.	24820	*Ninox novaeseelandiae subsp. boobook (Boobook Owl)*			
Stylidiaceae					
1116.	18123	*Stylidium weeliwolli*		P2	
Surianaceae					
1117.	3182	*Stylobasium spathulatum (Pebble Bush)*			
Sylviidae					
1118.	25755	*Acrocephalus australis (Australian Reed Warbler)*			
1119.	24833	*Cincloramphus cruralis (Brown Songlark)*			
1120.	24834	*Cincloramphus mathewsi (Rufous Songlark)*			
1121.	24837	*Eremiornis carteri (Spinifex-bird)*			
Synxenidae					
1122.	-13811	*Phryssonotus novaehollandiae*			
Terapontidae					
1123.	-14440	*Amniataba percoides*			
Threskiornithidae					
1124.	24845	*Threskiornis spinicollis (Straw-necked Ibis)*			
Thymelaeaceae					
1125.	5245	*Pimelea forrestiana*			
1126.	5250	*Pimelea holroydii*			
1127.	11185	*Pimelea microcephala subsp. microcephala*			
Trigoniulidae					
1128.	-13071	*Austrostrophus stictopygus*			
Trochanteriidae					
1129.	-12115	*Fissarena castanea*			
1130.	-13724	*Trachyspina mundaring*			
Turnicidae					
1131.	24851	*Turnix velox (Little Button-quail)*			
Typhlopidae					
1132.	25270	*Ramphotyphlops ammodytes*			
1133.	25276	*Ramphotyphlops ganei (blind snake)*		P1	
1134.	25277	*Ramphotyphlops grypus*			
1135.	25279	*Ramphotyphlops hamatus*			
1136.	25315	*Ramphotyphlops pilbarensis*			
1137.	25288	*Ramphotyphlops waitii*			
Tytonidae					
1138.	25762	*Tyto alba (Barn Owl)*			
Urodacidae					
1139.	-12091	*Urodacus butleri*			
Urticaceae					
1140.	12670	*Parietaria cardiostegia*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
Varanidae					
1141.	25209	*Varanus acanthurus (Spiny-tailed Monitor)*			
1142.	25210	*Varanus brevicauda (Short-tailed Pygmy Monitor)*			
1143.	30825	*Varanus bushi (Pilbara Mulga Monitor)*			
1144.	25211	*Varanus caudolineatus*			
1145.	25212	*Varanus eremius (Pygmy Desert Monitor)*			
1146.	25216	*Varanus giganteus (Perentie)*			
1147.	25218	*Varanus gouldii (Bungarra or Sand Monitor)*			
1148.	25524	*Varanus panoptes (Yellow-spotted Monitor)*			
1149.	25222	*Varanus panoptes subsp. panoptes*			
1150.	25223	*Varanus panoptes subsp. rubidus*			
1151.	25224	*Varanus pilbarensis (Pilbara Rock Monitor)*			
1152.	25526	*Varanus tristis (Racehorse Monitor)*			
1153.	25227	*Varanus tristis subsp. tristis (Racehorse Monitor)*			
Vespertilionidae					
1154.	24186	*Chalinolobus gouldii (Gould's Wattled Bat)*			
1155.	24187	*Chalinolobus morio (Chocolate Wattled Bat)*			
1156.	25500	*Nyctophilus bifax (Eastern Long-eared Bat)*			Y
1157.	42365	*Nyctophilus daedalus (Northwestern Long-eared Bat)*			
1158.	24194	*Nyctophilus geoffroyi (Lesser Long-eared Bat)*			
1159.	24200	*Scotorepens greyii (Little Broad-nosed Bat)*			
1160.	24205	*Vespadelus finlaysoni (Finlayson's Cave Bat)*			
Violaceae					
1161.	5215	*Hybanthus aurantiacus*			
Zodariidae					
1162.	-13504	*Leptasteron platyconductor*			
1163.	-13827	*Spinasteron waldockae*			
Zygophyllaceae					
1164.	4374	*Tribulus astrocarpus*			
1165.	4376	*Tribulus forrestii*			
1166.	4377	*Tribulus hirsutus*			
1167.	4379	*Tribulus macrocarpus*			
1168.	18072	*Tribulus suberosus*			
1169.	18140	*Zygophyllum eichleri*			
1170.	4392	*Zygophyllum iodocarpum*			

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

[1] For NatureMap's purposes, species flagged as endemic are those whose records are wholely contained within the search area. Note that only those records complying with the search criterion are included in the calculation. For example, if you limit records to those from a specific datasource, only records from that datasource are used to determine if a species is restricted to the query area.

Appendix 8

EPBC Act 1999 Protected Matters Search

Australian Government

Department of the Environment

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

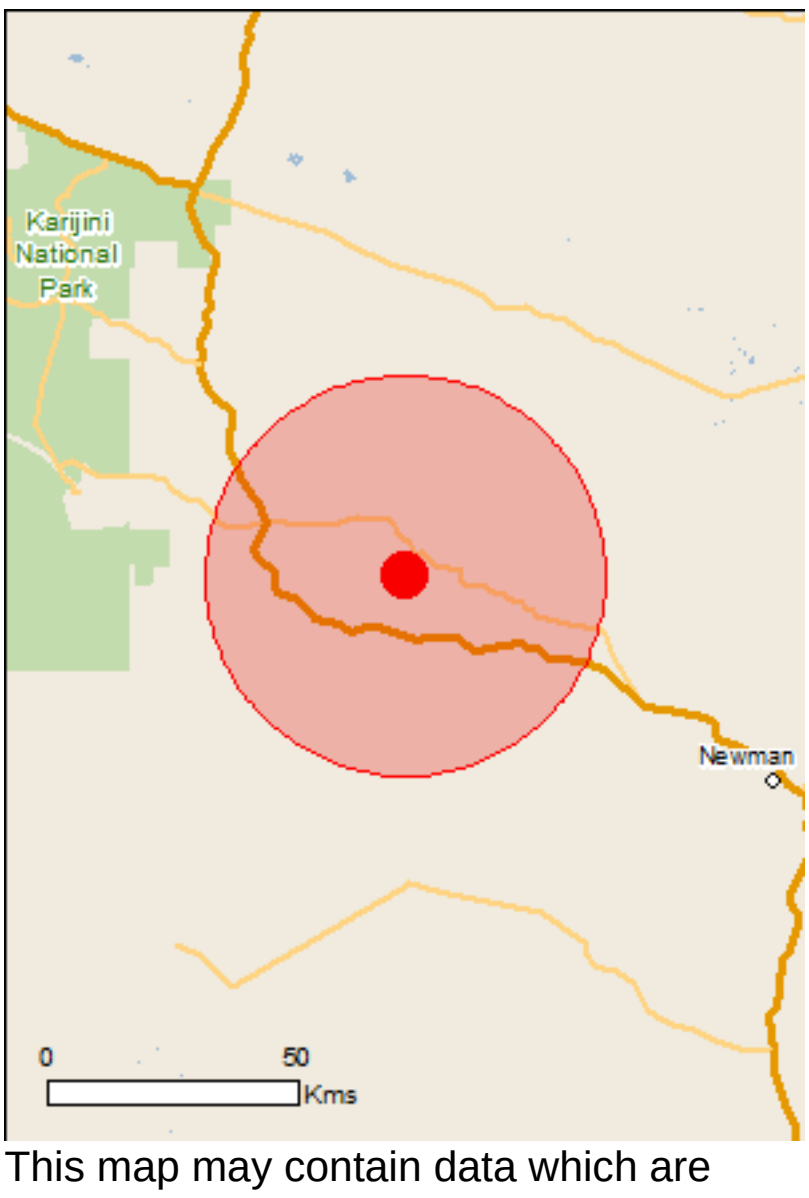
Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 01/12/14 14:13:45

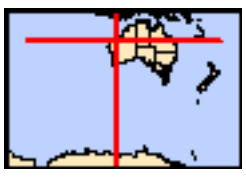
Summary
Details
- Matters of NES
- Other Matters Protected by the EPBC Act
- Extra Information

Caveat
Acknowledgements



Coordinates

Buffer: 40.0Km



Summary

Matters of National Environmental Significance

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

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Areas:	None
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	8
Listed Migratory Species:	6

Other Matters Protected by the EPBC Act

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

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place and the heritage values of a place on the Register of the National Estate.

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

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	6
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Commonwealth Reserves Marine	None

Extra Information

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

Place on the RNE:	1
State and Territory Reserves:	None
Regional Forest Agreements:	None
Invasive Species:	9
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Listed Threatened Species		[Resource Information]
Name	Status	Type of Presence
Birds		
Pezoporus occidentalis Night Parrot [59350]	Endangered	Species or species habitat likely to occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area
Mammals		
Dasyurus hallucatus Northern Quoll [331]	Endangered	Species or species habitat likely to occur within area
Macrotis lagotis Greater Bilby [282]	Vulnerable	Species or species habitat may occur within area
Notoryctes caurinus Kakarratul, Northern Marsupial Mole [295]	Endangered	Species or species habitat likely to occur within area
Rhinonicteris aurantia (Pilbara form) Pilbara Leaf-nosed Bat [82790]	Vulnerable	Species or species habitat known to occur within area
Plants		
Lepidium catapycnon Hamersley Lepidium, Hamersley Catapycnon [9397]	Vulnerable	Species or species habitat likely to occur within area
Reptiles		
Liasis olivaceus barroni Olive Python (Pilbara subspecies) [66699]	Vulnerable	Species or species habitat known to occur within area

Listed Migratory Species		[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Migratory Wetlands Species		
Ardea alba Great Egret, White Egret [59541]		Species or species habitat likely to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat likely to occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species		[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat likely to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat likely to occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat may occur within area

Extra Information

Places on the RNE [Resource Information]

Note that not all Indigenous sites may be listed.

Name	State	Status
Indigenous		
Wanmanna Art Site	WA	Registered

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Mammals		
Camelus dromedarius Dromedary, Camel [7]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Equus asinus Donkey, Ass [4]		Species or species habitat likely to occur within area
Equus caballus Horse [5]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		

Name	Status	Type of Presence
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species habitat likely to occur within area

Coordinates

-23.01777 119.06989

Caveat

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

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

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

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

For species where the distributions are well known, maps are digitised from sources such as recovery plans and detailed habitat studies. Where appropriate, core breeding, foraging and roosting areas are indicated under 'type of presence'. For species whose distributions are less well known, point locations are collated from government wildlife authorities, museums, and non-government organisations; bioclimatic distribution models are generated and these validated by experts. In some cases, the distribution maps are based solely on expert knowledge.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

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

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

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

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

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

Acknowledgements

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

-Department of Environment, Climate Change and Water, New South Wales
-Department of Sustainability and Environment, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment and Natural Resources, South Australia
-Parks and Wildlife Service NT, NT Dept of Natural Resources, Environment and the Arts
-Environmental and Resource Management, Queensland
-Department of Environment and Conservation, Western Australia
-Department of the Environment, Climate Change, Energy and Water
-Birds Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-SA Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Atherton and Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
-State Forests of NSW
-Geoscience Australia
-CSIRO
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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Appendix 9

Troglobitic Fauna Raw Data

Date	Drillhole	Biota ID Number	Taxon	#	Identifier	Notes
28/10/13	RC12H1SW0008	RC12H1SW0008T1-2	Acarina	1	Andrew Sheppard	
28/10/13	RC12H1SW0042	RC12H1SW0042T2-6	Acarina	1	Jacinta King	
28/10/13	RC12H1SW0064	RC12H1SW0064T1-1	Acarina	1	Chris Cole	
28/10/13	RC12H1SW0128	RC12H1SW0128T2-2	Acarina	1	Jess Cairnes	
28/10/13	RC13HD10106	RC13HD10106T3-2	Acarina	1	Jess Cairnes	
28/10/13	RC12H1SW0082	RC12H1SW0082T1-2	Acarina	2	Jess Cairnes	
28/10/13	RC12H1SW0132	RC12H1SW0132T1-1	Acarina	2	Penny Brooshooft	
28/10/13	RC12H1SW0082	RC12H1SW0082T3-1	Acarina	3	Jess Cairnes	
28/10/13	RC12H1SW0085	RC12H1SW0085T3-1	Acarina	4	Jess Cairnes	
28/10/13	RC12H1SW0128	RC12H1SW0128T1-1	Acarina	4	Jess Cairnes	
28/10/13	RC10H1SW043	RC10H1SW043T2-1	Acarina	5	Jess Cairnes	
28/10/13	RC12H1SW0014	RC12H1SW0014T2-4	Acarina	5	Jess Cairnes	
28/10/13	RC12H1SW0085	RC12H1SW0085T2-3	Acarina	5	Jess Cairnes	
28/10/13	RC12H1SW0132	RC12H1SW0132T2-1	Acarina	5	Penny Brooshooft	
28/10/13	RC12H1SW0102	RC12H1SW0102T3-3	Acarina	8	Jess Cairnes	
28/10/13	RC12H1SW0102	RC12H1SW0102T1-2	Acarina	10	Jess Cairnes	
28/10/13	RC12H1SW0144	RC12H1SW0144T1-1	Acarina	10	Penny Brooshooft	
28/10/13	RC13HD10124	RC13HD10124T2-1	Acarina	10	Penny Brooshooft	
28/10/13	RC12H1SW0102	RC12H1SW0102T2-4	Acarina	13	Jess Cairnes	
28/10/13	RC12H1SW0085	RC12H1SW0085T1-1	Acarina	18	Jess Cairnes	
28/10/13	RC12H1SW0064	RC12H1SW0064T2-1	Acarina	19	Chris Cole	
28/10/13	RC12H1SW0144	RC12H1SW0144T2-1	Acarina	20	Penny Brooshooft	
28/10/13	RC10H1SW043	RC10H1SW043T1-1	Acarina	10	Jess Cairnes	
28/10/13	RC10H1SW013	RC10H1SW013T3-1	Acarina	20	Jess Cairnes	
28/10/13	RC12H1SW0008	RC12H1SW0008T3-2	Acarina	20	Jess Cairnes	
28/10/13	RC12H1SW0051	RC12H1SW0051T3-1	Acarina	20	Jess Cairnes	
28/10/13	RC12H1SW0076	RC12H1SW0076T1-1	Acarina	20	Jess Cairnes	
28/10/13	RC12H1SW0178	RC12H1SW0178T3-1	Acarina	20	Chris Cole	
28/10/13	RC11H1SW0022	RC11H1SW0022T2-1	Acarina	31	Jacinta King	
28/10/13	RC12H1SW0074	RC12H1SW0074T3-1	Acarina	20	Chris Cole	
28/10/13	RC10H1SW043	RC10H1SW043T3-1	Acarina	15	Jess Cairnes	
28/10/13	RC12H1SW0009	RC12H1SW0009T2-1	Acarina	20	Penny Brooshooft	
28/10/13	RC12H1SW0074	RC12H1SW0074T2-1	Acarina	20	Chris Cole	
28/10/13	RC12H1SW0076	RC12H1SW0076T2-1	Acarina	20	Jess Cairnes	
28/10/13	RC12H1SW0076	RC12H1SW0076T3-2	Acarina	20	Jess Cairnes	
28/10/13	RC12H1SW0042	RC12H1SW0042T1-3	Acarina	10	Jacinta King	
28/10/13	RC11H1SW0022	RC11H1SW0022T3-1	Acarina	20	Jacinta King	
28/10/13	RC12H1SW0008	RC12H1SW0008T2-2	Acarina	20	Jess Cairnes	
28/10/13	RC12H1SW0014	RC12H1SW0014T3-4	Acarina	20	Jess Cairnes	
28/10/13	RC12H1SW0124	RC12H1SW0124T3-1	Acarina	20	Penny Brooshooft	
28/10/13	RC12H1SW0137	RC12H1SW0137T2-1	Acarina	20	Jess Cairnes	
28/10/13	RC12H1SW0144	RC12H1SW0144T3-1	Acarina	20	Penny Brooshooft	
28/10/13	RC11H1SW0022	RC11H1SW0022T1-1	Acarina	16	Jacinta King	
28/10/13	RC12H1SW0051	RC12H1SW0051T1-1	Acarina	15	Jacinta King	
28/10/13	RC12H1SW0051	RC12H1SW0051T2-1	Acarina	21	Jacinta King	
28/10/13	RC12H1SW0082	RC12H1SW0082T2-3	Acarina	20	Jess Cairnes	
28/10/13	RC12H1SW0178	RC12H1SW0178T2-1	Acarina	20	Chris Cole	
28/10/13	RC13HD10124	RC13HD10124T1-1	Acarina	20	Penny Brooshooft	
28/10/13	RC12H1SW0009	RC12H1SW0009T1-1	Acarina	20	Penny Brooshooft	
28/10/13	RC12H1SW0014	RC12H1SW0014T1-2	Acarina	20	Jess Cairnes	
28/10/13	RC12H1SW0064	RC12H1SW0064T3-2	Acarina	20	Jess Cairnes	
28/10/13	RC12H1SW0124	RC12H1SW0124T1-1	Acarina	20	Penny Brooshooft	
28/10/13	RC12H1SW0124	RC12H1SW0124T2-1	Acarina	20	Penny Brooshooft	
28/10/13	RC12H1SW0009	RC12H1SW0009T3-1	Acarina	20	Penny Brooshooft	
28/10/13	RC12H1SW0074	RC12H1SW0074T1-1	Acarina	20	Chris Cole	
28/10/13	RC12H1SW0178	RC12H1SW0178T1-1	Acarina	20	Chris Cole	
28/10/13	RC12H1SW0026	RC12H1SW0026P1T3-4	Acarina	10	Andrew Sheppard	
28/10/13	RC12H1SW0019	RC12H1SW0019P1T2-1	Acarina	10	Andrew Sheppard	

Date	Drillhole	Biota ID Number	Taxon	#	Identifier	Notes
28/10/13	RC12H1SW0026	RC12H1SW0026P1T2-1	Acarina	20	Andrew Sheppard	
28/10/13	RC12H1SW0026	RC12H1SW0026P1T1-3	Acarina	3	Andrew Sheppard	
28/10/13	RC12H1SW0019	RC12H1SW0019P1T1-4	Acarina	2	Andrew Sheppard	
28/10/13	RC10H1SW043	RC10H1SW043T3-2	Araneae	1	Jess Cairnes	
28/10/13	RC12H1SW0019	RC12H1SW0019P1T1-2	Araneae	1	Andrew Sheppard	
28/10/13	RC12H1SW0042	RC12H1SW0042T2-3	Araneae	1	Jacinta King	
28/10/13	RC12H1SW0074	RC12H1SW0074T1-2	Araneae	1	Chris Cole	
28/10/13	RC12H1SW0178	RC12H1SW0178T1-4	Araneae	5	Chris Cole	
28/10/13	RC12H1SW0026	RC12H1SW0026P1T3-3	Blattodea	1	Andrew Sheppard	Troglobitic
28/10/13	RC12H1SW0082	RC12H1SW0082T2-1	Blattodea	1	Jess Cairnes	Troglobitic
28/10/13	RC12H1SW0026	RC12H1SW0026P1T3-2	Blattodea	2	Andrew Sheppard	Troglobitic
28/10/13	RC10H1SW013	RC10H1SW013T3-3	Coleoptera	1	Jess Cairnes	
28/10/13	RC12H1SW0026	RC12H1SW0026P1T1-2	Coleoptera	1	Andrew Sheppard	Larvae
28/10/13	RC12H1SW0042	RC12H1SW0042T1-5	Coleoptera	1	Jacinta King	Larvae
28/10/13	RC12H1SW0102	RC12H1SW0102T2-2	Coleoptera	1	Jess Cairnes	
28/10/13	RC12H1SW0124	RC12H1SW0124T2-3	Coleoptera	1	Penny Brooshooft	
28/10/13	RC12H1SW0144	RC12H1SW0144T2-3	Coleoptera	1	Penny Brooshooft	
28/10/13	RC12H1SW0051	RC12H1SW0051T1-3	Coleoptera	4	Jacinta King	Larvae
28/10/13	RC12H1SW0082	RC12H1SW0082T2-4	Coleoptera	9	Jess Cairnes	
28/10/13	RC12H1SW0008	RC12H1SW0008T3-3	Collembola	1	Jess Cairnes	
28/10/13	RC12H1SW0019	RC12H1SW0019P1T3-2	Collembola	1	Andrew Sheppard	
28/10/13	RC12H1SW0026	RC12H1SW0026P1T2-4	Collembola	1	Andrew Sheppard	
28/10/13	RC12H1SW0128	RC12H1SW0128T2-1	Collembola	1	Jess Cairnes	
28/10/13	RC12H1SW0178	RC12H1SW0178T1-2	Collembola	1	Chris Cole	
28/10/13	RC13HD10124	RC13HD10124T2-2	Collembola	1	Penny Brooshooft	
28/10/13	RC12H1SW0082	RC12H1SW0082T2-2	Collembola	2	Jess Cairnes	
28/10/13	RC10H1SW013	RC10H1SW013T3-2	Collembola	3	Jess Cairnes	
28/10/13	RC10H1SW017	RC10H1SW017T2-3	Collembola	3	Jess Cairnes	
28/10/13	RC12H1SW0008	RC12H1SW0008T1-1	Collembola	3	Andrew Sheppard	
28/10/13	RC12H1SW0026	RC12H1SW0026P1T1-5	Collembola	3	Andrew Sheppard	
28/10/13	RC12H1SW0051	RC12H1SW0051T2-2	Collembola	3	Jacinta King	
28/10/13	RC12H1SW0144	RC12H1SW0144T2-2	Collembola	3	Penny Brooshooft	
28/10/13	RC12H1SW0178	RC12H1SW0178T3-2	Collembola	3	Chris Cole	
28/10/13	RC13HD10124	RC13HD10124T1-2	Collembola	3	Penny Brooshooft	
28/10/13	RC13HD10124	RC13HD10124T3-1	Collembola	4	Penny Brooshooft	
28/10/13	RC12H1SW0076	RC12H1SW0076T1-2	Collembola	6	Jess Cairnes	
28/10/13	RC12H1SW0076	RC12H1SW0076T2-2	Collembola	6	Jess Cairnes	
28/10/13	RC12H1SW0085	RC12H1SW0085T3-2	Collembola	6	Jess Cairnes	
28/10/13	RC12H1SW0076	RC12H1SW0076T3-3	Collembola	13	Jess Cairnes	
28/10/13	RC12H1SW0085	RC12H1SW0085T2-2	Collembola	20	Jess Cairnes	
28/10/13	RC12H1SW0124	RC12H1SW0124T3-2	Collembola	20	Penny Brooshooft	
28/10/13	RC13HD10124	RC13HD10124T4-1	Collembola	20	Penny Brooshooft	
28/10/13	RC12H1SW0124	RC12H1SW0124T2-2	Collembola	20	Penny Brooshooft	
28/10/13	RC12H1SW0144	RC12H1SW0144T3-2	Collembola	20	Penny Brooshooft	
28/10/13	RC12H1SW0042	RC12H1SW0042T1-4	Collembola	24	Jacinta King	
28/10/13	RC12H1SW0042	RC12H1SW0042T2-4	Collembola	31	Jacinta King	
28/10/13	RC12H1SW0019	RC12H1SW0019P1T1-3	Collembola	5	Andrew Sheppard	
28/10/13	RC12H1SW0019	RC12H1SW0019P1T2-2	Collembola	5	Andrew Sheppard	
28/10/13	RC12H1SW0026	RC12H1SW0026P1T3-5	Collembola	3	Andrew Sheppard	
28/10/13	RC10H1SW017	RC10H1SW017T1-1	Diptera	1	Jess Cairnes	
28/10/13	RC10H1SW017	RC10H1SW017T2-4	Diptera	1	Jess Cairnes	
28/10/13	RC12H1SW0008	RC12H1SW0008T2-1	Diptera	1	Jess Cairnes	
28/10/13	RC12H1SW0014	RC12H1SW0014T2-1	Diptera	1	Jess Cairnes	
28/10/13	RC12H1SW0014	RC12H1SW0014T3-2	Diptera	1	Jess Cairnes	
28/10/13	RC12H1SW0019	RC12H1SW0019P1T3-1	Diptera	1	Andrew Sheppard	
28/10/13	RC12H1SW0026	RC12H1SW0026P1T1-4	Diptera	1	Andrew Sheppard	Larvae
28/10/13	RC12H1SW0026	RC12H1SW0026P1T2-3	Diptera	1	Andrew Sheppard	Larvae
28/10/13	RC12H1SW0051	RC12H1SW0051T1-4	Diptera	1	Jacinta King	

Date	Drillhole	Biota ID Number	Taxon	#	Identifier	Notes
28/10/13	RC12H1SW0076	RC12H1SW0076T3-1	Diptera	1	Jess Cairnes	
28/10/13	RC12H1SW0085	RC12H1SW0085T1-2	Diptera	1	Jess Cairnes	
28/10/13	RC12H1SW0102	RC12H1SW0102T2-3	Diptera	1	Jess Cairnes	
28/10/13	RC12H1SW0128	RC12H1SW0128T2-3	Diptera	1	Jess Cairnes	
28/10/13	RC12H1SW0102	RC12H1SW0102T3-2	Diptera	2	Jess Cairnes	
28/10/13	RC11H1SW0022	RC11H1SW0022T2-2	Diptera	3	Jacinta King	Larvae
28/10/13	RC12H1SW0042	RC12H1SW0042T2-1	Diptera	3	Jacinta King	
28/10/13	RC12H1SW0051	RC12H1SW0051T3-3	Diptera	3	Jess Cairnes	
28/10/13	RC12H1SW0102	RC12H1SW0102T1-3	Diptera	3	Jess Cairnes	
28/10/13	RC11H1SW0022	RC11H1SW0022T3-2	Diptera	4	Jacinta King	Larvae
28/10/13	RC12H1SW0042	RC12H1SW0042T2-2	Diptera	16	Jacinta King	Larvae
28/10/13	RC12H1SW0042	RC12H1SW0042T1-1	Diptera	20	Jacinta King	Larvae
28/10/13	RC12H1SW0019	RC12H1SW0019P1T1-1	Diptera	3	Andrew Sheppard	
28/10/13	RC10H1SW017	RC10H1SW017T1-2	Hemiptera	1	Jess Cairnes	
28/10/13	RC10H1SW017	RC10H1SW017T2-2	Hemiptera	1	Jess Cairnes	
28/10/13	RC12H1SW0014	RC12H1SW0014T2-2	Hemiptera	1	Jess Cairnes	
28/10/13	RC12H1SW0014	RC12H1SW0014T3-1	Hemiptera	1	Jess Cairnes	
28/10/13	RC12H1SW0082	RC12H1SW0082T1-1	Hemiptera	1	Jess Cairnes	
28/10/13	RC12H1SW0124	RC12H1SW0124T2-4	Hemiptera	1	Penny Brooshooft	
28/10/13	RC13HD10106	RC13HD10106T2-1	Hemiptera	1	Jess Cairnes	
28/10/13	RC13HD10106	RC13HD10106T3-1	Hemiptera	1	Jess Cairnes	
28/10/13	RC10H1SW017	RC10H1SW017T3-1	Hemiptera	2	Jess Cairnes	
28/10/13	RC12H1SW0102	RC12H1SW0102T3-1	Hemiptera	10	Jess Cairnes	
28/10/13	RC12H1SW0102	RC12H1SW0102T1-1	Hemiptera	20	Jess Cairnes	
28/10/13	RC12H1SW0102	RC12H1SW0102T2-1	Hemiptera	20	Jess Cairnes	
28/10/13	RC12H1SW0014	RC12H1SW0014T1-1	Hymenoptera	1	Jess Cairnes	
28/10/13	RC12H1SW0026	RC12H1SW0026P1T2-2	Hymenoptera	1	Andrew Sheppard	
28/10/13	RC12H1SW0051	RC12H1SW0051T1-2	Hymenoptera	1	Jacinta King	
28/10/13	RC12H1SW0074	RC12H1SW0074T1-3	Hymenoptera	1	Chris Cole	
28/10/13	RC12H1SW0144	RC12H1SW0144T3-3	Hymenoptera	1	Penny Brooshooft	
28/10/13	RC12H1SW0178	RC12H1SW0178T3-3	Hymenoptera	1	Chris Cole	
28/10/13	RC12H1SW0014	RC12H1SW0014T3-3	Hymenoptera	2	Jess Cairnes	
28/10/13	RC12H1SW0014	RC12H1SW0014T2-3	Hymenoptera	3	Jess Cairnes	
28/10/13	RC12H1SW0085	RC12H1SW0085T3-3	Isopoda	1	Jess Cairnes	
28/10/13	RC10H1SW013	RC10H1SW013T3-5	Polyxenida	1	Jess Cairnes	Troglobitic
28/10/13	RC12H1SW0008	RC12H1SW0008T3-1	Polyxenida	1	Jess Cairnes	Troglobitic
28/10/13	RC12H1SW0042	RC12H1SW0042T2-5	Polyxenida	1	Jacinta King	Troglobitic
28/10/13	RC12H1SW0064	RC12H1SW0064T2-2	Polyxenida	1	Chris Cole	Troglobitic
28/10/13	RC12H1SW0064	RC12H1SW0064T3-1	Polyxenida	1	Jess Cairnes	Troglobitic
28/10/13	RC12H1SW0042	RC12H1SW0042T1-2	Polyxenida	3	Jacinta King	Troglobitic
28/10/13	RC10H1SW013	RC10H1SW013T3-4	Psocoptera	1	Jess Cairnes	
28/10/13	RC12H1SW0085	RC12H1SW0085T2-1	Psocoptera	1	Jess Cairnes	
28/10/13	RC12H1SW0085	RC12H1SW0085T3-4	Psocoptera	1	Jess Cairnes	
28/10/13	RC12H1SW0178	RC12H1SW0178T1-3	Psocoptera	1	Chris Cole	
28/10/13	RC10H1SW043	RC10H1SW043T2-2	Psocoptera	2	Jess Cairnes	
28/10/13	RC13HD10106	RC13HD10106T1-1	Psocoptera	7	Jess Cairnes	
28/10/13	RC10H1SW043	RC10H1SW043T1-2	Psocoptera	10	Jess Cairnes	
28/10/13	RC13HD10106	RC13HD10106T2-2	Psocoptera	20	Jess Cairnes	
28/10/13	RC12H1SW0026	RC12H1SW0026P1T1-1	Schizomida	1	Andrew Sheppard	Troglobitic
28/10/13	RC12H1SW0026	RC12H1SW0026P1T3-1	Schizomida	1	Andrew Sheppard	Troglobitic
28/10/13	RC12H1SW0051	RC12H1SW0051T3-2	Schizomida	1	Jess Cairnes	Troglobitic
28/10/13	RC12H1SW0144	RC12H1SW0144T3-4	Schizomida	2	Penny Brooshooft	Troglobitic
28/10/13	RC10H1SW017	RC10H1SW017T2-1	Thysanura	1	Jess Cairnes	