Bennelongia Environmental Consultants

Ministers North Short-Range Endemic (SRE) Desktop and Field Survey

Prepared for:

BHP Western Australian Iron Ore

September 2024

Final Report

Short-Range Endemics I Subterranean Fauna

Waterbirds I Wetlands

Ministers North Short-Range Endemic (SRE) Desktop and Survey

Bennelongia Pty Ltd
5 Bishop Street
Jolimont WA 6014

P: (08) 9285 8722
F: (08) 9285 8811
E: info@bennelongia.com.au

ABN: 55 124 110 167

Report Number: 721

Report Version	Prepared by	Reviewed by	Submitted to Client	
			Method	Date
Draft	Huon Clark	Stuart Halse	email	08 February 2024
Draft	Huon Clark	Kevin Espinoza	email	28 June 2024
Final	Huon Clark	Stuart Halse	email	20 September 2024

K:\Projects\B_BHPBIO_125 - Ministers Nth SRE\final16ix24

EXECUTIVE SUMMARY

BHP Western Australian Iron Ore (WAIO) have been conducting environmental investigations, including studies of Short-Range Endemic (SRE) terrestrial invertebrates, at BHP's Minister's North approximately 90 km north-west of Newman in the Pilbara. BHP WAIO commissioned Bennelongia Environmental Consultants to conduct a desktop and baseline survey of SRE terrestrial invertebrates in a Study Area including the Minister's North iron ore deposit and infrastructure corridor, with three main objectives:

1. Determine, based on existing data, what confirmed or potential SRE species are known, or are likely, to occur in the Study Area through a desktop database and literature review;
2. Undertake a single season detailed field survey to provide further information about the occurrence of SRE species at the Study Area; and
3. Provide a comprehensive survey report detailing the results of the desktop assessment and field survey

A database and literature review was undertaken using publicly and privately held SRE records as well as habitat data such as vegetation and geology to identify SRE species that are known, or have the potential, to occur in the Study Area. Subsequently, a single season field survey targeting invertebrates belonging to SRE Groups was carried out from 13-21 April 2023. SRE Groups comprise several ground-dwelling taxa recognised by the Environment Protection Authority as containing high proportions of SRE species. The aim of the field survey was to collect the species belonging to SRE Groups in representative habitat types at Ministers North.

The desktop review identified 7523 records of species belonging to SRE Groups that had been previously collected within 30 km of the Study Area. This includes nine Confirmed SRE species and 50 Potential SRE species.

The field survey resulted in the collection of 182 specimens (including higher order identifications) belonging to 39 species from SRE groups. This includes 12 centipedes, nine pseudoscorpions, five spiders (four mygalomorph spiders and one selenopid spider), five isopods, four scorpions, three millipedes, and one snail. The survey collected one Confirmed SRE species, and seven Potential SREs at Ministers North. The single Confirmed SRE species is the Mouse Spider *Missulena faulderi*. This species has also been collected outside the Study Area, most recently during surveys at Yandi operations, and it is not considered to be of conservation concern.

The Potential SRE species collected in the survey include:

- Scorpion
  - *Lychas* \`BSCO088\` \`pilbara1 group\`,
- Pseudoscorpions
  - *Austrohorus* \`BPS524\`,
  - *Afrosternophorus* \`BPS529\`,
- Mygalomorph spider
  - *Synothele* \`BMYG199\`,
- Isopods
  - *Buddelundia* \`BIS536\`,
  - *Buddelundia* \`BIS539\`, and
  - *Laevophiloscia* \`BIS522\`

The vast majority of species regarded as either Confirmed, Potential or Uncertain SREs were collected from the Undulating Low Hills habitat, which is made up of Sandy/Stony Plains. Minor Drainage Lines and Gullies yielded some Potential and Uncertain SRE species. All the habitats recognized in the Study area are deemed to extend outside it as well.

CONTENTS

LIST OF FIGURES

LIST OF TABLES

1. INTRODUCTION

BHP Western Australia Iron Ore (WAIO) are conducting environmental surveys at the Ministers North Mining Tenement (M266SA), hereafter referred to as the Study Area. The Study Area is situated within the Pilbara region of Western Australia, approximately 90 km north-west of Newman, and on the southern border of the existing Yandi Operations (Figure 1).

Bennelongia Environmental Consultants (BEC) were commissioned by BHP WAIO to conduct a desktop and baseline survey of SRE terrestrial invertebrates at the Study Area, with three main objectives:

1. Determine, based on existing data, what confirmed or potential SRE species are known, or are likely, to occur in the Study Area through a desktop database and literature review;
2. Undertake a single season detailed field survey to provide further information about the occurrence of SRE species at the Study Area; and
3. Provide a comprehensive survey report detailing the results of the desktop assessment and field survey.

1.1. SRE Framework

The term Short-Range Endemic (SRE) is applied in environmental impact assessments in Western Australia to selected groups of terrestrial invertebrates species that are principally ground-dwelling and have high proportions of species with ranges less than 10,000 km^2 (EPA 2016; Harvey 2002). SREs are particularly susceptible to disturbance associated with various types of land development because they tend to live in discontinuous habitats, grow slowly, and often produce few offspring. The main types of disturbance that threaten the persistence of SRE species include habitat removal or modification, changes in fire regimens, the introduction of weeds and pathogens, and changes to local hydrology. Because of their susceptibility to disturbance, SREs have been identified by the Environmental Protection Authority (EPA) as a significant element of the terrestrial fauna community (EPA 2016, 2018, 2023).

Assessment and survey of SREs focusses on about 10 taxonomic groups (the SRE Groups) that contain some or many SREs (EPA 2016). The number of groups varies according to location and has also changed somewhat since the EPA (2016) guidance statement was written, with aquatic groups such as bivalves, decapod crustaceans and terrestrial mites rarely being considered in SRE programs, while Selenopidae spiders, Opiliones (harvestmen) and at least Geophilidae centipedes are now routinely included.

Not all species in any SRE Group are SREs but, when any member of an SRE Group is detected during an assessment process, literature and other resources must be consulted to identify its range. In areas where SRE species have not been surveyed in the past, the likelihood of SRE species occurring can be inferred from the habitats present and the known habitat preference of SRE species in general; they tend to inhabit relictual, isolated, sheltered, and moist habitats (Durrant 2011); specialist habitats including rock outcrops, south-facing slopes, gorges and gullies, drainage lines, vine thickets, and islands (EPA 2016; Harvey 2002); or semi-arid to arid areas where habitats containing suitable moisture have become restricted and isolated (Harvey 2002; Hopper *et al.* 1996).

The process of assessing the likelihood of impacts to SRE species is facilitated by assigning SRE Group species to categories of SRE status. This report uses the following categories:

- **Confirmed SREs:** well-defined species with a thoroughly surveyed range <10,000 km^2.
- **Potential SREs:** species for which there is some evidence of short-range endemism (e.g. close phylogenetic relationship to Confirmed SREs, occupation of limited habitat, etc.) but insufficient sampling has been undertaken to ascertain the species' total range unequivocally.
- **Uncertain (=Data Deficient SREs):** species from SRE Groups that cannot be classified taxonomically to sufficiently low level (i.e. genus) to provide information about their likely SRE status and/or are known from too few samples to reliably infer range. Most species known only

from single animals or one locality or identified only to higher taxonomic level, especially when collected from prospective habitat, are conservatively placed in this category.

- **Not SRE (=Widespread):** species with known ranges >10,000 km^2.

While species are considered Confirmed SREs if their known range is less than 10,000 km^2, even Confirmed SREs may be locally widespread around a project area. Thus, categorising the SRE status of a species is the first step in a filtering process used to determine which species may be threatened by a proposed development. Determining the actual level of threat requires consideration of the extent of the species' preferred habitat, both within and outside the Study Area.

1.1.1. Conservation legislation

Native flora and fauna in Western Australia are protected at both State and Commonwealth levels. At the state level, the *Biodiversity Conservation Act 2016* (BC Act) provides a legal framework for protection of species, particularly for species listed by the Minister for the Environment as threatened. In addition to the formal list of threatened species under the BC Act, the Department of Biodiversity, Conservation and Attractions (DBCA) also maintains a list of priority fauna species that are of conservation importance but, for various reasons, do not meet the criteria for listing as threatened. At the national level, the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) provides a legal framework to protect nationally (and internationally) important species, with many species being listed under both state and commonwealth acts.

The BC and EPBC Acts also provide frameworks for the protection of threatened ecological communities (TECs), where an ecological community is defined as a naturally occurring group of plants, animals, and other organisms interacting in unique habitat (with the unique habitat created by the combination of the species and their landscape setting; DEC 2013). Within Western Australia, DBCA also informally recognises communities of potential conservation concern, but for which there is little information, as priority ecological communities (PECs). The list of TECs recognised under the BC Act is larger than the EPBC Act list.

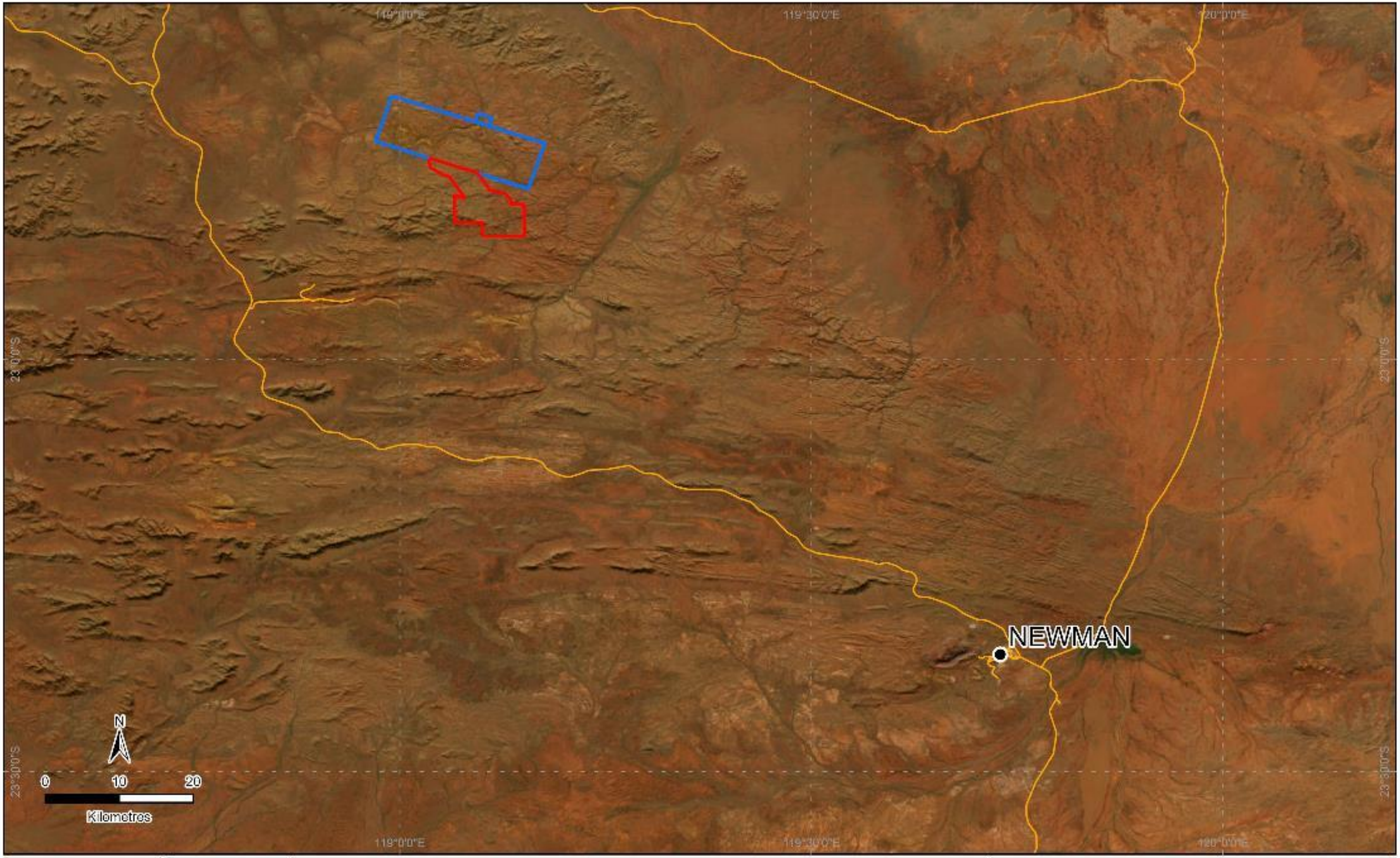
2. ENVIRONMENT

2.1. Climate

The Study Area lies within the Pilbara region of Western Australia, which is characterised by grasslands and classified as arid with desert and grassland climatic classification groups (BOM 2023b). Typically, the region has hot dry summers and mild winters. Historically, the majority of rainfall is experienced in the hot summer months between December and February, the vast majority of which is associated with cyclonic weather patterns crossing the coast from the Indian Ocean (BOM 2023b).

2.2. Biogeography

The Pilbara contains within it four Pilbara Interim Biogeographic Region of Australia (IBRA) subregions (Thackway and Cresswell 1995), the Chichester, the Fortescue, the Hamersley and the Roebourne (Figure 2). The Study Area is encompassed by the Hamersley subregion (PIL03) which extends roughly from east of Newman to within 40 km of the Pilbara coast and is closely associated with the Hamersley Ranges (Figure 2).



GCS GDA 1994
Author: hclark
Date: 20/12/2023

Legend

The Study Area	Towns
Yandi Operations	Ministers North (inset)
Roads	

Figure 1. The Study Area in relation to Newman in the Pilbara region of Western Australia

Figure 2. IBRA Bioregions of the Pilbara region of Western Australia

The Hamersley subregion is defined as a "mountainous area of Proterozoic sedimentary ranges and plateaux with Mulga low woodland over bunch grasses on fine textured soils and Snappy Gum over *Triodia brizoides* on skeletal sandy soils of the ranges" (Thackway and Cresswell 1995).

2.3. Land Systems

Four land systems are present within the Study Area (Figure 3). These include the McKay, Robe, Newman and Boolgeeda Land Systems (DPIRD 2018). Both of the McKay and Newman Land systems are widespread both throughout the Study Area and the surrounding landscape, while the Robe and Boolgeeda Land Systems form isolated patches cut off from similar habitat types in the surrounding landscape (Figure 3).

McKay Land System

The McKay Land System is described as "Hills, ridges, plateaux remnants and breakaways of meta sedimentary and sedimentary rocks supporting hard spinifex grasslands with acacias and occasional eucalypts". This Land System covers an area of approximately 4200 km^2, mostly north of the Fortescue Valley with some patchily distributed areas in the Hamersley Ranges, including 140 km^2 patch that intersects the northern part of Study Area and extends into the Yandi area (Figure 3).

Robe Land System

The Robe Land System is described as "Low plateaux, mesas and buttes of limonite supporting soft spinifex and occasionally hard spinifex grasslands". This Land System is scattered throughout the Pilbara in isolated patches associated with drainage lines and tributaries and covers a total area of approximately 1725 km^2. There is a small, isolated patch of the Robe Land System of approximately 0.5 km^2 that is completely encompassed by the Study Area and surrounded by the McKay Land System (Figure 3). There are other small patches of this Land System in the vicinity of the Study Area associated with the Marillana Creek system.

Newman Land System

Defined as "Rugged jaspilite plateaux, ridges and mountains supporting hard spinifex grasslands", this Land System is extensively distributed in the Hamersley Ranges, with a total area of approximately 19700 km^2. The Study Area overlaps approximately 445 km^2 of this Land System, which extends south, east and west (Figure 3).

Boolgeeda Land System

The Boolgeeda Land System is described as "Stony lower slopes and plains below hill systems supporting hard and soft spinifex grasslands or mulga shrublands". Covering an area of approximately 9800 km^2, this Land System is distributed throughout the Pilbara in varying degrees of patchiness. An isolated patch, approximately 6.25 km^2 in size, intrudes into the Study Area from the east, where it has wider extent (Figure 3). Similar patches of the Boolgeeda Land System lie further to the east of the Study Area.

2.4. Geology and Soils

Surface geology at the Study Area includes areas of outcropping Banded Iron Formation (BIF), Hematite-Goethite deposits, Alluvium associated with drainage channels and Pisolitic Limonite deposits (Figure 4; Thorne and Tyler 1997).

BIF is the most widespread surface geology in the Study Area and is made up of two distinct geological units, the Weeli Wolli Formation (PLHj), which outcrops throughout the northern half of the Study Area, and the Brockman Iron Formation (PLHb), which extensively outcrops throughout the southern extent of the Study Area (Figure 4). Both these formations are expressed as rocky ranges and ridges.

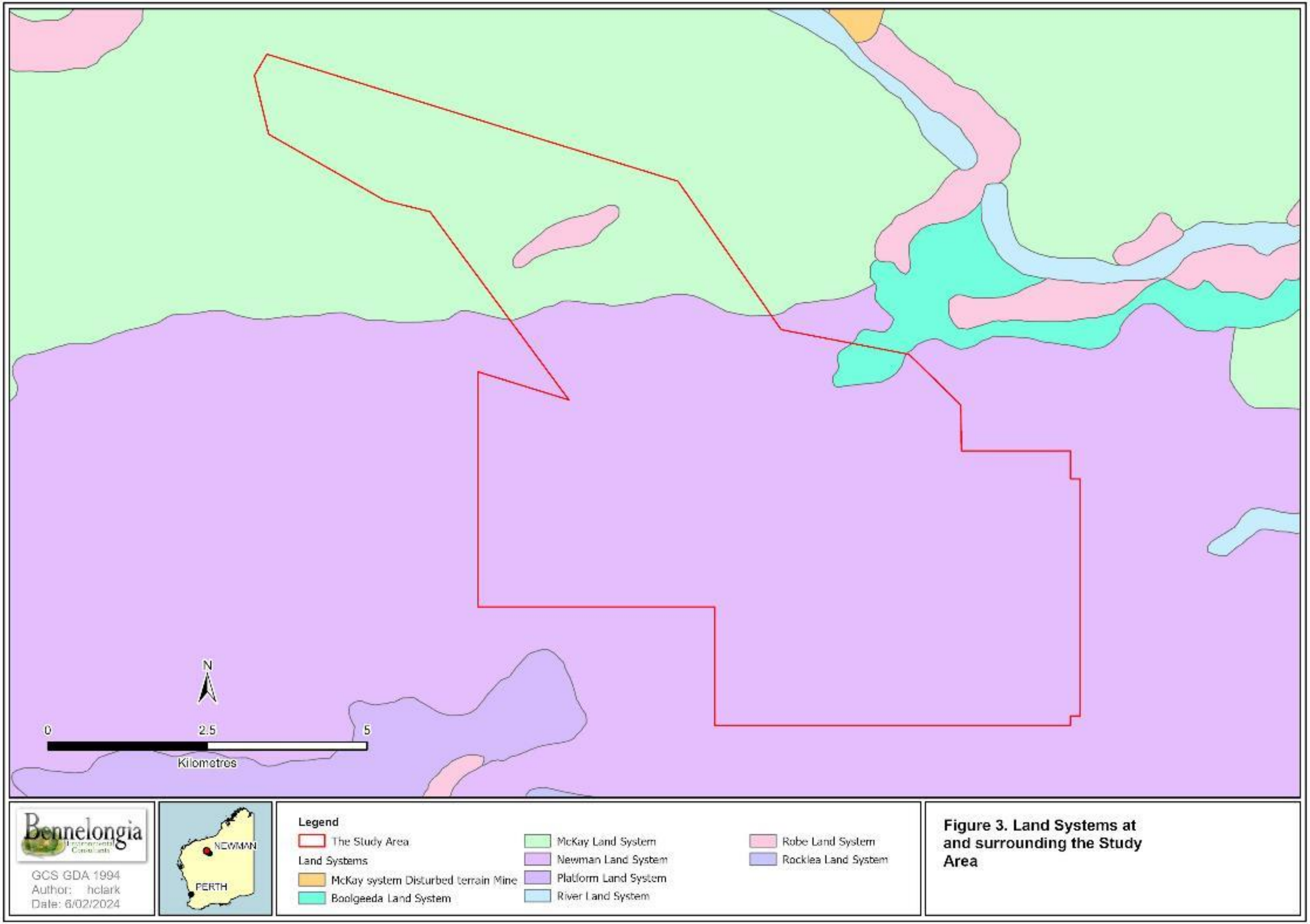


Figure 3. Land Systems at and surrounding the Study Area

A broad section of Hematite-Goethite deposits (Czr) lies above BIF in the southern central section of the Study Area (Figure 4). This area is characterised as iron rich lateritic soils and gravels, which have built up through weathering and accumulated as valley floor deposits (Thorne and Tyler 1997).

Two 'branches' of Alluvium (Qa) traverse the Study Area in creek lines and valleys between ridges of the Weeli Wolli Formation (Figure 4). This unconsolidated silt sand and gravel connects to similar geologies in the Marillana Creek to the north of the Study Area. The northern branch also has isolated patches of Robe Pisolite (Czp - Pisolitic Limonite deposits) that are expressed as steep slopes with flat top plateaus along drainage lines (Figure 4).

Two very small sections of valley fill consisting of partly consolidated Colluvium containing quartz and rock fragments in silt (Czc) marginally intersect the Study Area (Figure 4). One of these is in the far northwest of the Study Area while the second is in the south west. Each of these represents a small percentage of the surface geology in the Study Area.

2.5. Vegetation

According to Beard (1975), the vegetation across the vast majority of the Study Area is "hummock grasslands, low tree steppe; snappy gum over *Triodia wiseana*" (veg association 82 – Figure 5). This is one of the more common vegetation communities in the Hamersley Ranges and the Pilbara in general. There are three small patches of "Low woodland; mulga (*Acacia aneura*)" (veg association 18) which is also a common vegetation community in the Hamersley Ranges. While only small sections of the latter occur within the Study Area, they are connected to larger, continuous tracts of this habitat type in the surrounding landscape (Figure 5).

3. METHODS

3.1. Desktop Methods

A database and literature review was undertaken to identify SRE species that are known to occur or have the potential to occur in the Study Area. The desktop assessment combined four sources of information using GIS mapping:

- Boundary information and description of the Study Area supplied by BHP.
- Boundaries of TECs and PECs provided by DBCA and the Department of Mines, Industry Regulation, and Safety.
- SRE Group species listed in reports of surveys previously undertaken within 30 km of the Study Area. All species listed in the reports have been included in this assessment even when surveys extended outside of the 30 km radius.
- SRE Group species in databases of the Western Australian Museum (WAM), Bennelongia and BHP;
    - Searches of the WAM database were requisitioned (Table 1). These searches covered an area with a radius of 30 km centred on the Study Area (centroid at -22.815, 119.109), which is referred to as the **desktop search area**.
    - The Bennelongia database was searched for records of SRE Group species within the search area and the BHP database was checked for any records not in the Bennelongia database.
        - For all databases, trapping method and habitat, if available, was used in conjunction with available information about the species or group to distinguish terrestrial SRE Group species from subterranean and aquatic species.
    - An SRE taxon status was assigned to each record returned in searches (i.e. Confirmed SRE etc.).

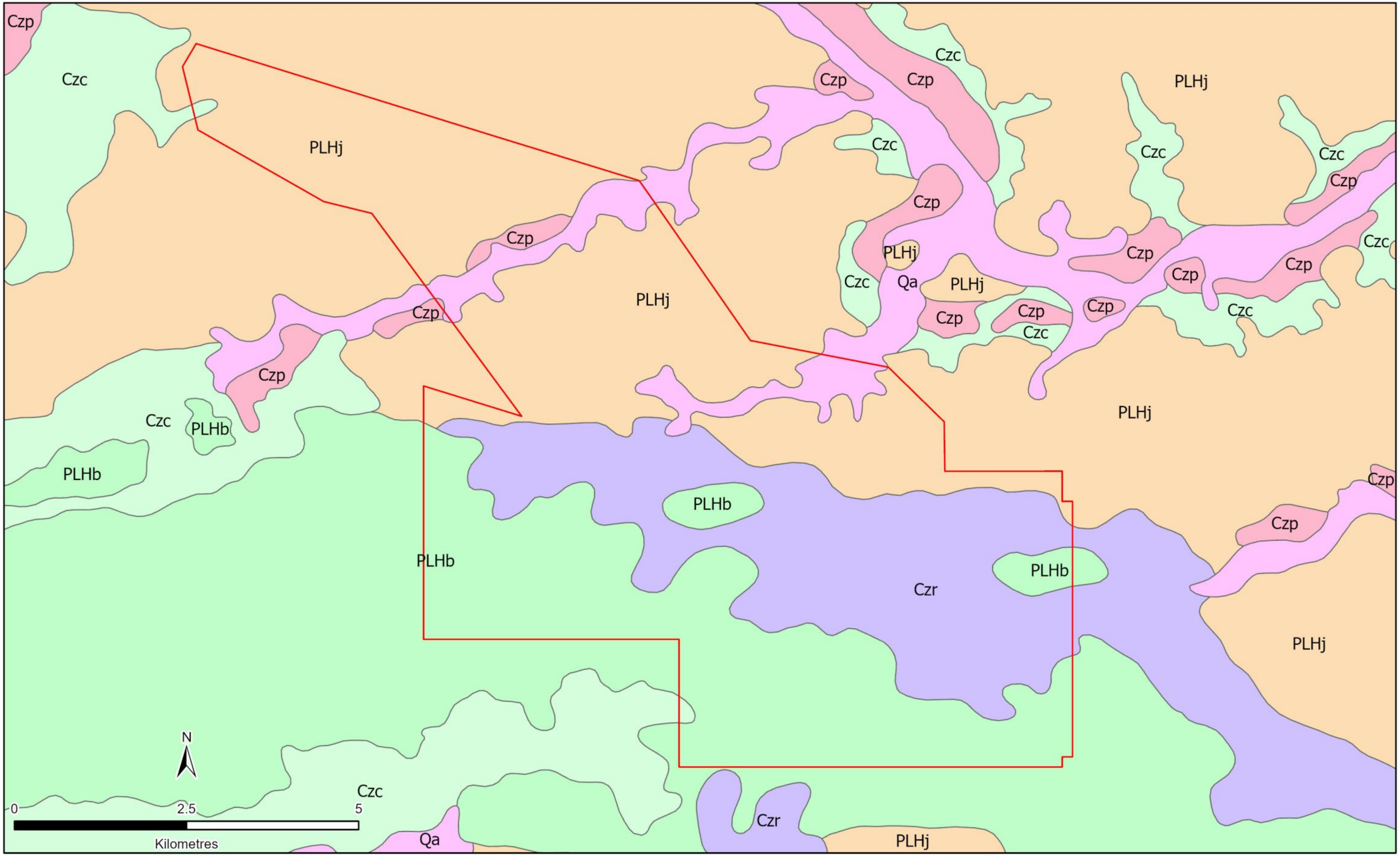
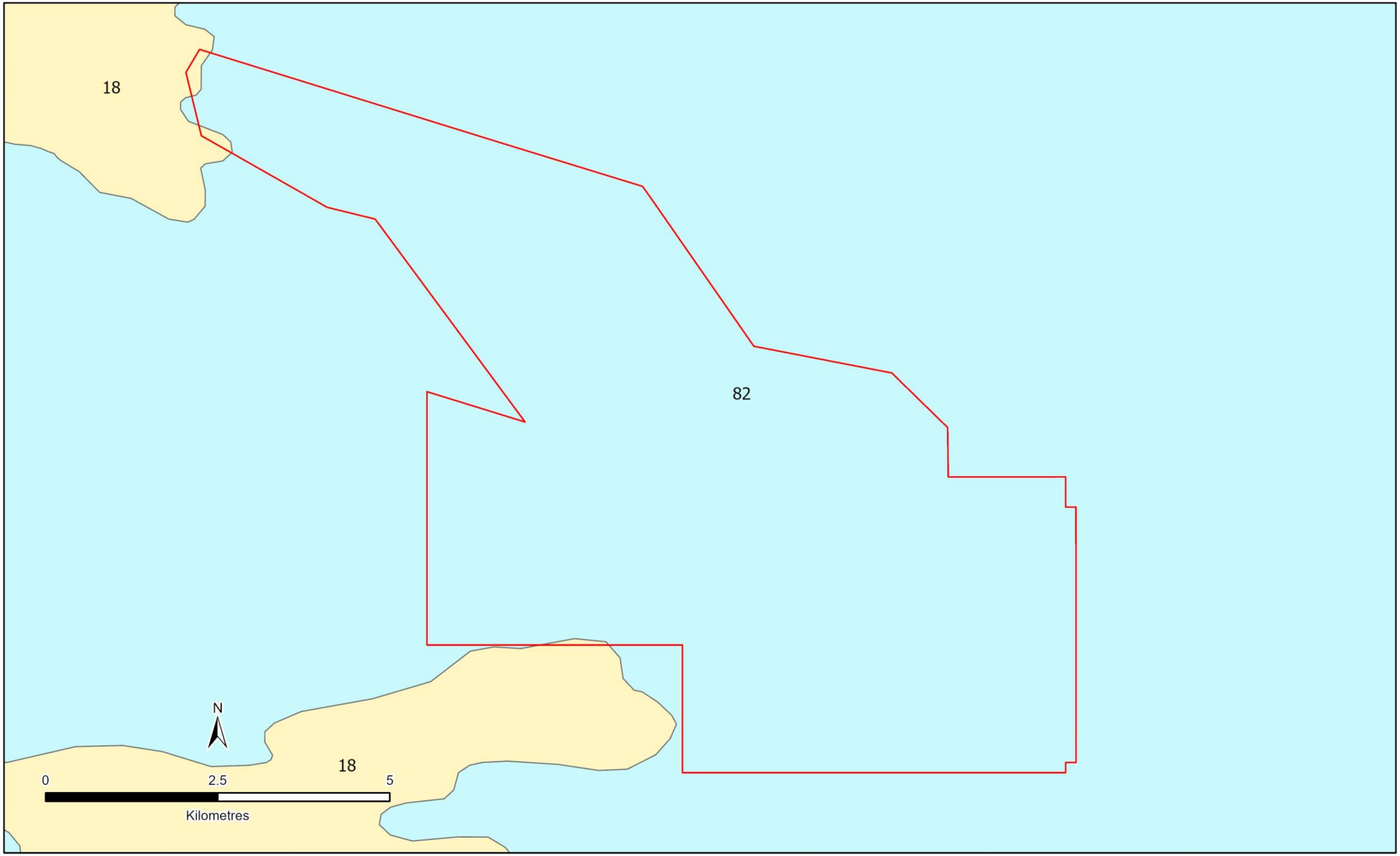


Figure 4. Surface Geology at and surrounding the Study Area



Bennelongia Environmental Consultants

GCS GDA 1994
Author: hclark
Date: 24/05/2024

Legend

The Study Area

Vegetation System

Low mulga woodland (18)

Hummock grasslands, low tree steppe (82)

Ministers North (inset)

Figure 5. Vegetation Associations at and surrounding the Study Area

- For each species, the number of records (i.e. number of times the species was found) and number of individuals collected (i.e. how many were found in all records) were collated.
- The records from the desktop search area were used to provide information about:
  - The identify of the SRE Group species present in the desktop search area. These species may occur in the Study Area if habitat is suitable.
  - The richness of the SRE Group fauna in the broad vicinity of the Study Area.
  - The known distribution of species previously recorded in the Study Area.

Analysis and mapping were undertaken using ArcGIS Pro v2.9.

Table 1. Searches requisitioned from the WAM database for areas surrounding the Study Area.

Database	Date of receipt
Hexapods (including insects)	19 August 2022
Chelicerates (including arachnids) and myriapods	27 January 2023
Crustaceans	19 August 2022
Molluscs	22 March 2023

3.2. Survey Methods

A single season field survey targeting invertebrates belonging to SRE Groups was carried out from 13-21 April 2023. The aim of the survey was to collect species from recognised SRE Groups from representative habitat types in the Study Area. Invertebrates from SRE Groups are more active following rain and, therefore, more likely to be collected at that time.

In the months leading up to the survey (January 1st – April 12th), a total of 210 mm of rain was recorded at BoM station 007176 Newman Aero (BOM 2023a). 45.8 mm was recorded in January (average rainfall in January 1971-present: 70.2 mm), 34 mm recorded in February (average rainfall in February 1971-present: 70.1 mm) and 118.4 mm in March (average rainfall in March 1971-present: 43.5 mm). The vast majority of this rainfall fell in the 17 days prior to survey (March 27th – April 12th 2023), during which time 127.2 mm of rainfall was recorded. Additionally, rain fell on the first two days of the survey (13th-14th April 2023), however no rain was subsequently recorded (Figure 6). This supports observations made by the field team on-site.

Temperatures in the months leading up to the survey (from January 1st 2023) were considered to be above average with 68 % of days recording above average temperatures (BOM 2023a). In general, January 2023 was cooler than the long term average with the mean monthly average for January 2023 being 38.7°C compared to the long term mean temperature for January of 39.1°C (BOM 2023a). 48 % of the days in January 2023 recorded above average temperatures. February was much warmer with 79 % of the days recording above average temperatures with a monthly mean for February 2023 being 39.9°C compared to the long term average of 37.6°C, March 2023 recorded similar numbers with 77 % of days being above average temperatures with the mean for that month being 38.4°C compared to the long term mean of 35.7°C. The first 12 days of April recorded 8 days above average temperatures (67 %). Only two days for the rest of April (13th to 30th) recorded above average temperatures and the mean temp for the month of April 2023 was 29.6°C compared to the long term average of 32.1°C.

Tropical Cyclone (TC) Ilsa formed in the Indian Ocean in the days leading up to the survey, officially becoming a category 1 cyclone (Damaging winds between 63 and 88 km/h; gusts up to 125 km/h) on the 11 April 2023. By the time TC Ilsa made landfall it was classed as a category 5 cyclone (extremely dangerous with maximum mean wind speed of 200 km/h and gusts up to 279 km/h), and crossed the coast in the early hours of April 14th, the second day of the survey (BOM 2023b). While initially bringing

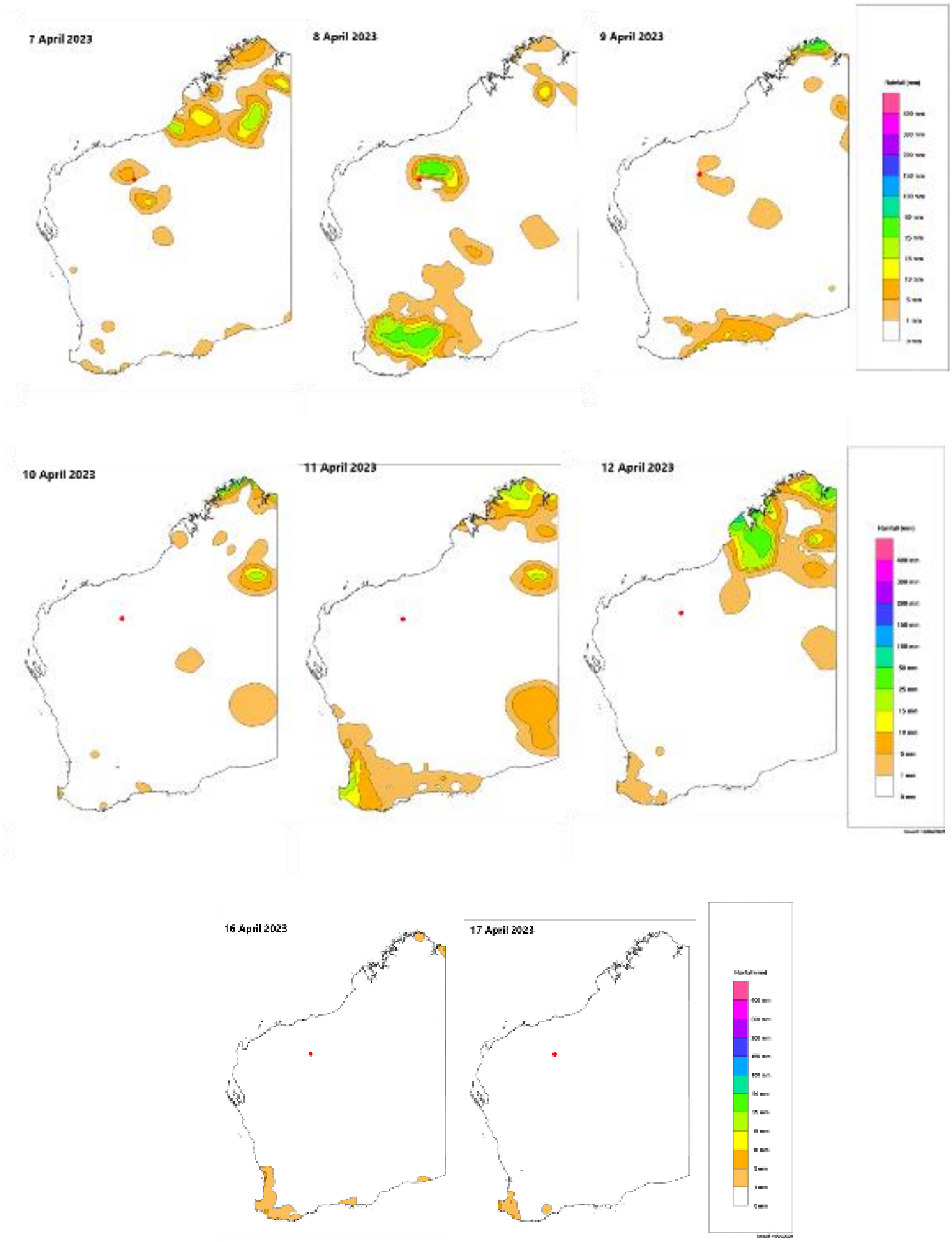


Figure 6. Rainfall in the lead up to and for the first days of the field Survey (BOM 2023a)

winds and rainfall to the region (Figure 7), as TC Ilsa passed to the north of the Study Area, cloud cover and associated rainfall was dragged toward the cyclone and away from the Study Area, resulting in drier, cooler conditions for the duration of the survey (Figure 8).

At roughly midday on April 25th, a solar eclipse was experienced in the field. The Study Area experienced approximately 95% eclipse, resulting in a temporary reduction in temperature and twilight conditions for the duration of the eclipse event.

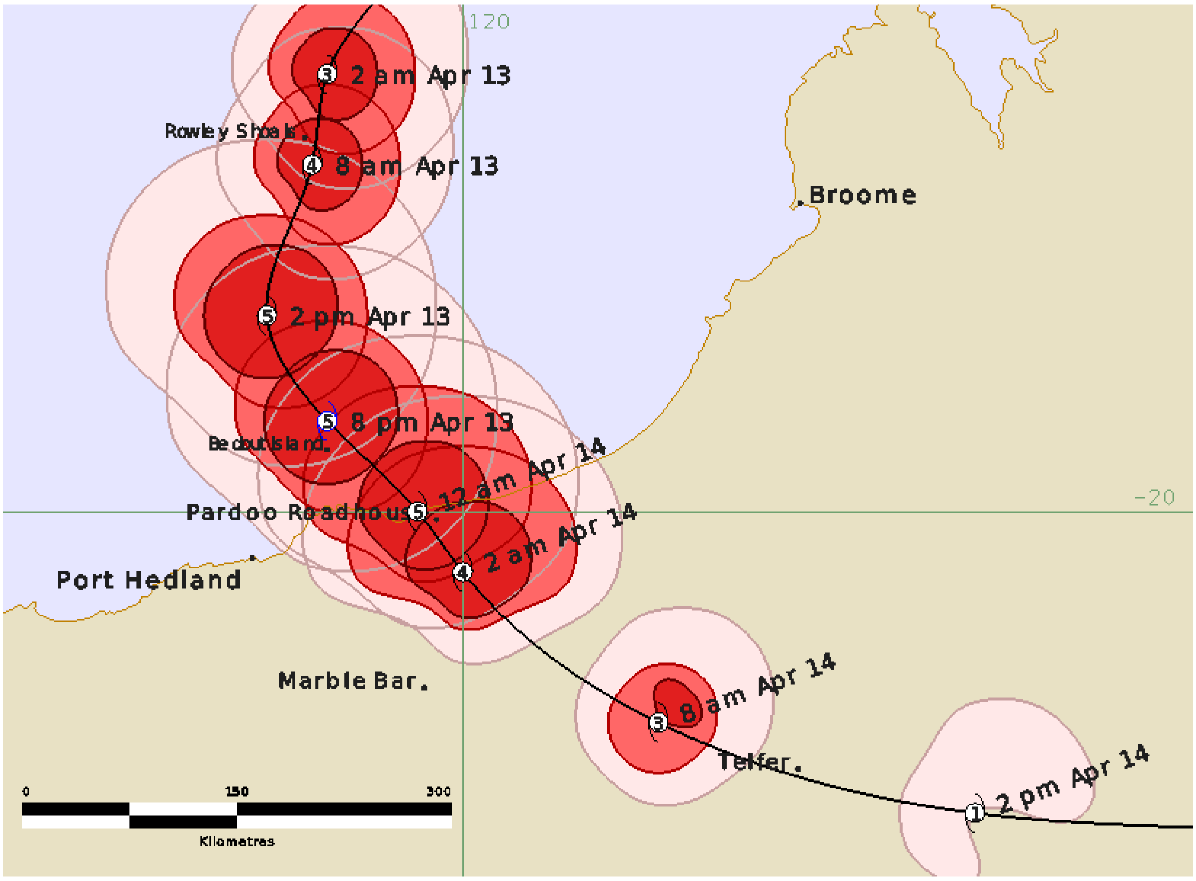


Figure 7. Path of Tropical Cyclone Ilsa (BOM 2023b)

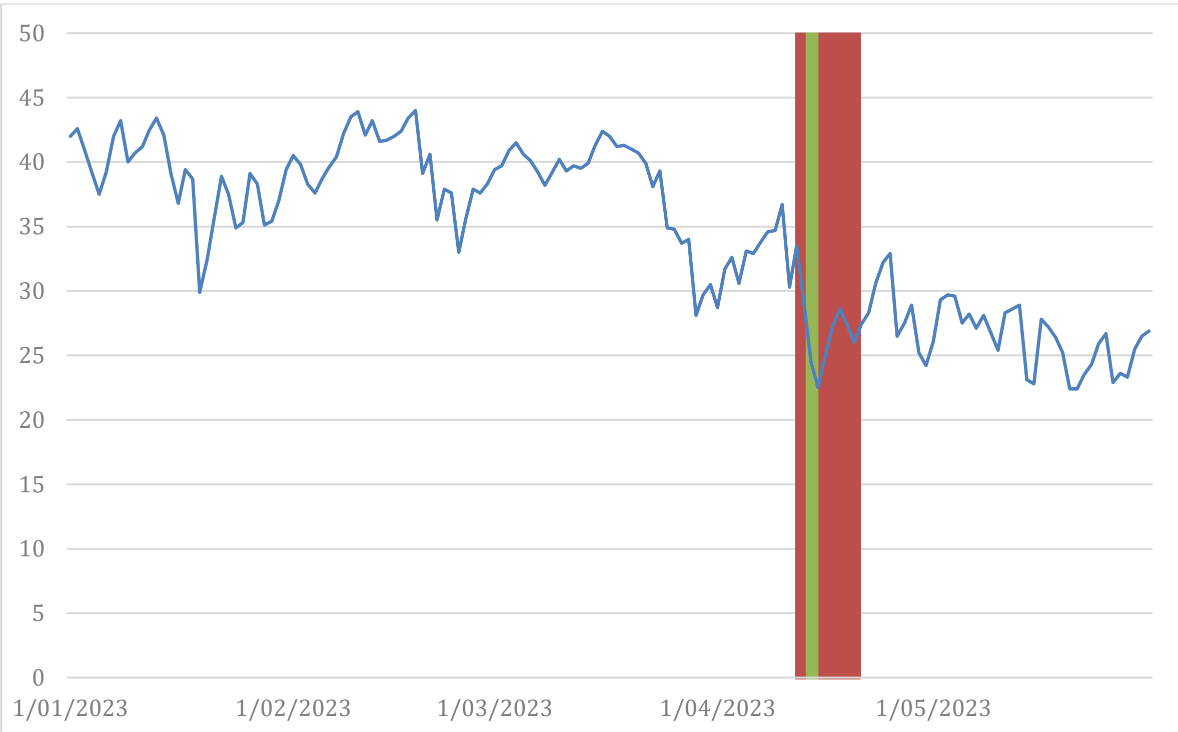


Figure 8. Temperature before, during and after the survey (BOM 2023a).
Blue solid line = recorded temperature (BoM 2023a). Blue dash line = Temperature trend line. Maroon block = Survey dates, Green Block = Cyclone made landfall (BoM 2023b).

3.2.1. Site Selection

Prior to the survey, aerial imagery of the Study Area was examined and prospective areas for SREs were identified. Prospective habitats for SREs in the Pilbara include south-facing slopes, gorges, gullies, drainage lines, and isolated habitats (Durrant 2011). Sites selected for survey were determined by the amount of each available habitat, the distribution of the various habitats throughout the Study Area and the access available to reach various habitats within the Study Area. The pre-field trip assessment determined that six habitat types (Major Drainage Lines, Minor Drainage Lines, Gorge/Gully, Slopes, Open Plains and Disturbed) would be assessed using a combination of techniques (i.e. dry trapping+active foraging+habitat characterisation, active foraging+habitat characterisation, and habitat characterisation only. Habitat-only sites were used to characterise the extent of habitat types during mapping. A breakdown of numbers of sample sites and sampling techniques is provided in Table 2.

Table 2. Survey design prior to field trip

Habitat	All Techniques employed (Trapping, Foraging and Litter)	Foraging and Litter	Habitat	Total
Major drainage lines	3	1	1	5
Minor drainage lines	2	2	2	6
Gorge / slope	1	1	0	2
Slopes	2	3	2	7
Open plains	2	2	2	6
Disturbed	2	2	0	4
Total	12	11	7	30

A list of the sites sampled in the field, their habitat types and techniques used is shown in Table 3.

Within broad habitat types, micro-habitats can be extremely important for SRE species. Some species may be restricted to one microhabitat (for example under bark) or may have a close relationship with a specific tree species (such as trapdoor spider burrow lid construction). Searching all microhabitat types within each broad habitat type is essential in collecting and understanding the SRE species and community of any given area.

3.2.2. Survey Effort

Thirty sites were visited in the Study Area (Table 3; Figure 9; Appendices 1; see Appendix 2 for photographs of field sites). This included 12 sites where all survey techniques were employed (dry trapping, active foraging, litter collection and habitat assessment), 11 sites where active foraging, litter collection and habitat assessment were conducting and seven sites where only habitat assessment was completed (Table 3 and Figure 9). Due to the identification of two spider burrows while walking to site MN24 (Gully), this site was divided into two (MN24a and MN24b) to maintain the integrity of recorded habitats of collected specimens (Table 3 and Figure 9).

Nocturnal foraging was conducted at five sites during the survey (Table 3) and an attempt made to visit all habitat types identified during the survey. For a complete list of sites and their coordinates, please refer to Appendix 1.

3.2.3. Survey Techniques

Survey techniques followed published guidelines (EPA 2016). Where foraging and litter collection occurred, one hour was spent at each site with two team members collecting litter and foraging for a total of two person-hours per site.

Foraging, litter collection and trapping are described below. Foraging consisted of actively searching for SRE Group species in their preferred habitats, according to the biology of target SRE Groups or species.

Active foraging techniques varied at each site according to habitat, biology of target taxa, and visual observations of burrows or other tell-tale signs of target species (Table 3). Techniques included:

- Log flipping and litter raking: turning over and breaking apart logs and dead wood in search of isopods, myriapods, and pseudoscorpions. Raking litter uncovers isopods, snails, centipedes, millipedes and helps to uncover camouflaged mygalomorph spider burrows and to uncover buried land snails that may aestivate below the surface.
- Rock flipping: turning over rocks and other debris in search of harvestmen, centipedes, pseudoscorpions and isopods. Rocks were returned to their natural position when possible.
- Leaf litter sieving: sieving leaf litter to target litter and/or soil-dwelling species. Leaf litter sieving also uncovers small-bodied SRE species (such as pseudoscorpions, millipedes, and land snails).
- Leaf blowing: hand-held leaf blowers were used to remove leaf litter and reveal mygalomorph spider burrows covered by litter or otherwise difficult to identify unaided. If found, burrows were examined; burrows likely to house a mygalomorph spider were then excavated.
- Burrow dig: When mygalomorph spider and scorpion burrows are found, the individual within needs to be recovered for identification. This was done with the use of trowels and cable ties, where the cable tie was inserted into the burrow as far as possible and the trowel used to excavate the burrow, carefully following the cable tie so as not to lose this or the burrow tunnel. This process was continued until either the animals is recovered, or the end of the burrow was reached (which is commonly where the animals were located).
- Bark peeling: removing pieces of bark from trees with smooth and exfoliating bark for inspection revealing invertebrate species using these spaces as refugia.
- Tree digging: removing dirt from the bases of trees to search for SRE taxa (isopods and millipedes predominately).
- Night searching: with the aid of ultraviolet torches, selected sites were visited at night in search of scorpions, which fluoresce under ultraviolet light and are thereby easily detected.

Litter collection consisted of gathering two leaf litter samples per site, which were then transported in cloth bags to the laboratory in Perth and placed in Tullgren funnels to extract litter-dwelling invertebrates. A variety of plant species litter were collected where possible.

Dry pitfall trapping comprised digging a hole in the ground and inserting a plastic cup (height: 12 cm; diameter: 9 cm) so that the mouth was level with the soil surface. The trap opening was covered by a slightly raised roof to exclude predators, direct sunlight, and rain (Richter and Freegard 2009), and a drift fence was installed. At each of 12 sites, 10 dry pitfall traps were placed on the second day of the survey (14 April 2023) and checked daily in the first hours of the morning for the duration of the survey period (15-21 April 2023), for a total of 7 nights.

3.2.4. Habitat Assessment and Mapping

During the survey, details of all sites were recorded, including the habitat type, as well as the sampling methods used. After the field survey was completed, boundaries between habitat types were drawn in ArcGIS Pro 2.9 based on available aerial imagery. Habitat continuous with a sample site was assigned the same category as that sample site; boundaries were drawn based on changes in landform identified in aerial imagery and informed by ground truthing performed by the team on-site during the survey.

3.2.5. Laboratory Processing

Specimens collected while foraging were placed in 100% ethanol and transported to Bennelongia's laboratory for identification. Litter samples were returned to the Bennelongia laboratory and placed in Tullgren funnels which were used to extract invertebrates from litter samples into vials of alcohol for later sorting and identification (although they also contain many invertebrates not belonging to SRE Groups).

Specimens extracted from litter were first sorted and separated from by-catch. All specimens belonging to SRE Groups were examined under a dissecting microscope and, where necessary, dissected and further examined under a differential interference contrast compound microscope. Specimens were identified to described species where possible using available keys and species descriptions. Most species in SRE Groups remain undescribed, however, and these species (whether identified morphologically or genetically) are usually assigned species codes (e.g. `BSY01`) to facilitate comparisons of species collected in different surveys. When specimens do not yield DNA or cannot be identified morphologically because of damage or young age etc. they are identified to the lowest taxonomic level possible (e.g. genus, family, order). These specimens carry the miscellaneous designation 'sp.'.

3.2.6. Survey Limitations

The timing of the survey in April 2023 was considered appropriate, and sites were well distributed through the Study Area. Survey access issues were resolved quickly and had minimal impact on the outcomes of the survey (see Table 4).

3.2.7. Determination of SRE Status

Not all species in SRE Groups have restricted ranges as many may be widespread. Determining whether a species belonging to an SRE Group is, in fact, an SRE is often difficult.

One approach is to assume that the distribution of a species reflects the extent of its preferred or obligate habitat(s), and that species found only in restricted or patchy habitats have smaller ranges than those collected from extensive or common habitats. However, in cases where short range endemism is driven by life history characteristics, a species may be a true SRE but inhabit a widespread, apparently well-connected habitat (Harvey 2002; Harvey et al. 2015b; Harvey et al. 2011; Rix et al. 2015).

After being identified, species were assigned into one of the SRE categories outlined in Section 1.1, i.e. Confirmed SRE, Potential SRE, Uncertain (Data Deficient), and Not SRE (Widespread). This categorisation system has been adapted from that outlined by the WAM and scientific literature, primarily (Harvey 2002), and considers several factors likely to be related to the SRE status of a species and the likelihood of threat to that species. These include the known range of the species; habitat(s) at the collection site(s) and the spatial extent and connectivity of these habitats; the distribution patterns of phylogenetically related surrogate species (ideally members of the same genus); and the biology of SRE groups and species. Information for each factor was gathered from published scientific literature, or by mapping the species records over available GIS layers such as vegetation, soil and landscape mapping.

Table 3. Survey methods employed at the Study Area
NB. Orange denotes trapping sites, blue denotes forage sites and white denotes habitat characterisation sites

Site	Habitat	Forage hours	No. Dry traps	Litter Sieves	No. of Litter bag samples	Bark peel	Tree dig	Rock flip	Log flip	Rake	Leaf blowing	No. Observed	No. Burrows Dug	Burrow Type
MN01	Undulating Low Hills	2	10	3	2	Y	Y	Y	Y	N	Y	3	0	Scorpion
MN02	Minor Drainage Line	2	10	3	2	Y	Y	Y	Y	Y	Y	4	2	Scorpion
MN03	Undulating Low Hills	2	0	2	2	Y	Y	Y	Y	Y	Y			
MN04	Hillcrest/Hillslope	2	10	3	2	Y	Y	Y	Y	Y	N			
MN05	Major Drainage Line	2	10	5	2	Y	Y	Y	Y	Y	Y	6	4	Scorpion
MN06	Minor Drainage Line	0	0		0									
MN07	Minor Drainage Line	2	0	3	2	Y	Y	Y	Y	Y	Y	1	0	Scorpion
MN08	Undulating Low Hills	0	0		0									
MN09	Gorge/Gully	2	0	3	2	N	Y	Y	N	Y	N			
MN10	Gorge/ Gully	2	10	3	2	N	Y	Y	Y	Y	Y	2	1	Spider
MN11	Minor Drainage Line	2	10	3	2	Y	Y	Y	Y	Y	Y	1	1	Scorpion
MN12	Medium Drainage Line	2	0	5	2	Y	Y	Y	Y	Y	Y			
MN13	Medium Drainage Line	0	0		0									
MN14	Undulating Low Hills	2	0	3	2	Y	Y	Y	N	Y	N			
MN15	Undulating Low Hills	2	10	4	2	Y	Y	Y	Y	Y	N			
MN16	Undulating Low Hills	2	0	3	2	Y	Y	Y	Y	Y	Y			
MN17	Undulating Low Hills	2	10	3	2	Y	Y	Y	Y	Y	Y			
MN18	Hillcrest/Hillslope	2	0	0	2	Y	Y	Y	Y	Y	Y			
MN19	Undulating Low Hills	2	10	3	2	Y	Y	Y	Y	Y	Y	6	3	Scorpion
MN20	Undulating Low Hills	2	0	2	2	Y	Y	Y	Y	Y	Y			
MN21	Undulating Low Hills	0	0		0									
MN22	Undulating Low Hills	0	0		0									
MN23	Undulating Low Hills	2	0	3	2	Y	Y	Y	N	Y	Y			
MN24a	Gorge/ Gully	2	0	2	2	Y	Y	Y	Y	Y	Y			
MN24b	Undulating Low Hills	1	0	0	0	N	N	N	N	N		2	2	Spider

Site	Habitat	Forage hours	No. Dry traps	Litter Sieves	No. of Litter bag samples	Bark peel	Tree dig	Rock flip	Log flip	Rake	Leaf blowing	No. Observed	No. Burrows Dug	Burrow Type
MN25	Minor Drainage Line	2	10	3	2	Y	Y	Y	Y	Y	Y	2	1	Scorpion
MN26	Undulating Low Hills	0	0		0									
MN27	Major Drainage Line	2	10	3	2	Y	Y	Y	Y	Y	Y			
MN28	Gorge/ Gully	0	0		0									
MN29	Minor Drainage Line	2	0	3	2	Y	Y	Y	Y	Y	Y	1	1	Scorpion
MN30	Undulating Low Hills	2	10	2	2	Y	Y	Y	Y	Y	Y			

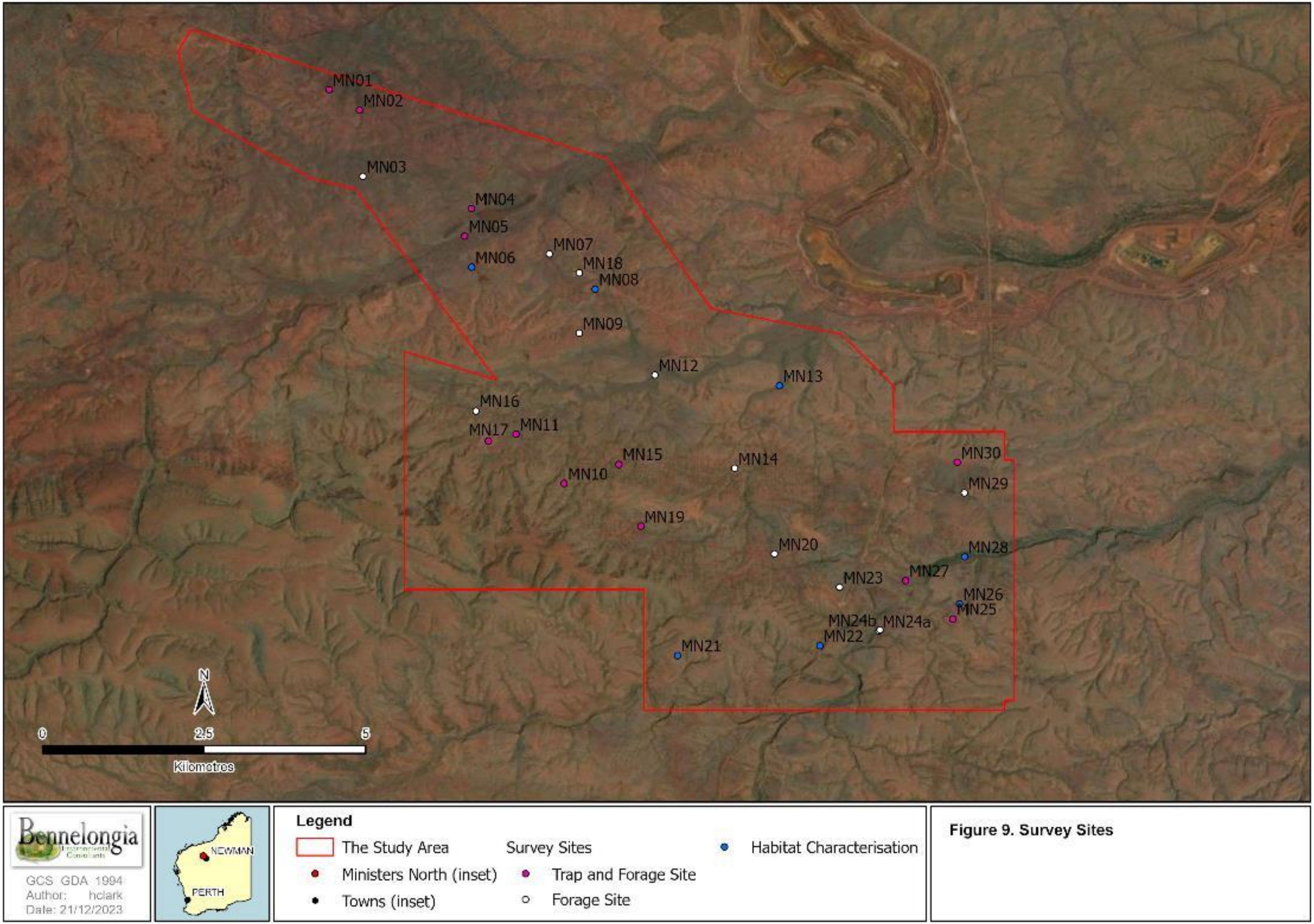


Figure 9. Survey Sites

Table 4. Limitations of the survey.

Limitation	Explanation	Mitigation
Survey access constraints	A small windrow and old signage prohibiting entry to the northern half of the Study Area was encountered on the first day of survey.	As soon as this was discovered, contact was made to our on-site representative and permission granted to access the track in question. This had minimal impact on the survey.
Survey access constraints	The northern half of the tenement had less exploration activity conducted on it and had one main track that traversed roughly through the centre of this portion of the Study Area. Survey sites were restricted to walking distance of this track.	Where possible, a variety of sites were placed through this section to get the best spatial and habitat representation of sites.
Survey access constraints	One major gorge could not be accessed due to terrain and safety issues	This site was conducted as a Habitat Assessment site and viewed from higher ground above. Similar habitats albeit smaller, were visited during the survey.
Survey access constraints	Large portions of the Study Area had restrictions to work conditions or access issues due to heritage exclusions and concerns.	Survey was designed to maximise habitat selection and spread of sites while avoiding restricted areas.

3.2.8. Personnel

Personnel involved in the creation of this report are listed in Table 5.

4. RESULTS

4.1. Desktop Results

4.1.1. Previous SRE Surveys

Sixteen historical SRE surveys conducted within (either partially of fully) the 30 km radius desktop search area have been assessed and the relevant information is presented in Table 6 below. These surveys provided a substantial proportion of the specimens identified during the desktop process and include 59 species that have previously been identified as either Confirmed or Potential SREs (Appendix 3).

Table 5. Bennelongia personnel involved in the generation of this report
Fieldwork was undertaken under Regulation 27 licence BA27000728. Licence holder: Mike Scanlon.

Role	Name	Qualifications/Experience
Fieldwork	Huon Clark	B.Sc. (Hons), Ph.D. Six years' experience of conducting SRE surveys in the Pilbara.
	Ella Carstens	B.Sc. One year's experience of conducting SRE surveys in the Pilbara.
	Kevin Sagastume	B.Sc., M.Sc. One year's experience of conducting SRE surveys in the Pilbara.
	Monique Moroney	B.Sc. (Hons). Two years' experience of conducting SRE surveys in the Pilbara.
Sample sorting	Ella Carstens	B.Sc.
	Melita Pennifold	B.Sc. (Hons)
	Megan Lewis	B.Sc., M.Sc.
Species identification	Jane McRae (pseudoscorpions)	Over 30 years of identification experience at the Australian Museum, the British Museum, DBCA, and Bennelongia. Author of 12 taxonomic papers and 9 papers on species inventory/ecology.
	Ella Carstens (centipedes)	B.Sc.
	Huon Clark (isopods)	B.Sc. (Hons), Ph.D.
	Kevin Sagastume (spiders)	B.Sc., M.Sc.
	Melita Pennifold (molluscs, myriapods)	Over 25 years of research and taxonomic identification experience.
Mapping	Huon Clark	B.Sc. (Hons), Ph.D.
Reporting	Huon Clark	B.Sc. (Hons), Ph.D.
	Stuart Halse (review)	B.Sc. (Hons), Ph.D.

4.1.2. Previous SRE records

The desktop assessment identified 7,523 records of species belonging to SRE groups previously collected from within the 30 km radius desktop search area (Figure 10). These include trapdoor spiders and tarantulas, selenopid spiders, pseudoscorpions, scorpions, centipedes, millipedes, isopods and snails. Nine of the species have previously been regarded as Confirmed SRE species and 50 have previously been reported as Potential SRE species (Appendix 3). It should be noted that in some cases changes have been made between the original report and the name assigned in this list due to advances in taxonomy. Often changes in SRE status also occur; for example, Conothele `MYG279` was originally designated a Confirmed SRE but subsequent collections resulted in it having a known linear range of approximately 350 km making it unlikely to be a true SRE. As a result, this species has been removed from Table 7, which lists the remaining eight Confirmed SRE spiders known from the desktop search area.

The list of 50 Potential SRE species includes pseudoscorpions (13 species), spiders (12 species), slaters (seven species), millipedes (seven species), scorpions (six species), centipedes (three species), snails (two species) (Appendix 3).

Table 6. Surveys previously conducted in the Study Area

Survey	Survey Type	Survey Dates	Location	Number of Sites	Methods	# of Confirmed SREs	# of Potential SREs
Bennelongia 2023	Two Season	12th-20th October 2022 28th March – 5th April 2023	Yandi	44	Dry trapping, Active Foraging, Leaf Litter	2	15
Biologic 2021	Two Season Survey	9th-13th September 2019 3rd-10th April 2020	Ministers Nth and Yandicoogina	70	Foraging, Leaf Litter	0	19
Biologic 2018a	Single Season Survey	3rd-10th April 2018	Marillana and Marillana Corridor	111	Active Foraging Leaf Litter	0	5
Biologic 2018b	Two Season Survey	9th-13th October 2017 14th-24th June 2018	Ministers Nth to Yandi	38	Active Foraging, Leaf Litter	0	7
Biologic 2016	Two Season Survey	March-April 2015 August-September 2015	Ministers Nth	72	Active Foraging, Soil and Leaf Litter	0	8
Biologic 2015	Two Season Survey	3rd-10th April 2014 9th-16th September 2014	Yandi	119	Active Foraging, Leaf Litter	0	5
Biota 2014	Three Phase Survey	25th May – 2nd June 2011 7th-15th September 2011 5th-8th February 2012	Area C to Yandi	22	*Dry Pitfall Trapping, *Funnels, Active Foraging	0	11
Subterranean Ecology 2013	Three Phase Survey	15th-17 February 2012 12th-16th March 2012 23rd-30th April 2012	Mainline Rail	80	Active Foraging, Soil and Leaf Litter	4	9
Biota 2013c	Three Phase Survey	30th March-1st April 2011 29th June-7th July 2011 6th-15th February 2012	Mudlark	62	Active Foraging	0	17
Biota 2013b	Two Season Survey	13th-22nd June 2011 7th-8th February 2012	Marillana	36	Active Searching	0	11
Biota 2011b	Targeted Survey (millipede)	19th April 2012 23rd May 2012	South Flank	20	Wet Pit Trapping	0	0

Survey	Survey Type	Survey Dates	Location	Number of Sites	Methods	# of Confirmed SREs	# of Potential SREs
Biota 2013a	Three Phase Survey	11th-20th April 2011 2nd-11th November 2011 30th January-8th February 2012	South Flank to Jinidi	21	Dry Pit Trapping, Active Searching	0	11
Biologic 2013	Single Season Survey	13th-18th May 2013	Yandi	55	Active Foraging, Soil and Leaf Litter	0	2
Biota 2011a	Two Season Survey	15th-26th February 2010 14th-17th August 2010	South Flank	27	Active Foraging	0	4
Biota 2011b	Two Season Survey	15th-26th February 2010 23rd-30th June 2010	Area C	45	Wet pitfall Trapping, Active Foraging, Soil and Leaf Litter	0	7
Outback Ecology 2008	Mining Operation Environmental Management Plan – two season survey	10th–18th April 2008 9th-18th June 2008	Area C	15	Dry Pitfall Trapping, Active Foraging, Leaf Litter	0	3

* Denotes survey methods targeting vertebrates and collecting SREs as by-catch

Table 7. Confirmed SRE species previously collected in the desktop search area.

Species	Known Linear Distribution	Known Habitats	Likelihood of Occurring in Study Area
Aname \`MYG336\`	6 km	Mulga on heavy soils (Biota 2014)	Likely
Aurecocrypta \`MYG246\`	24 km	Calcrete substate and stony clay loam substrate (Biota 2014)	Unlikely
Conothele \`MYG282\`	45 km	Mulga woodland on clay loam soils (Biota 2014) and on hilltop (Biota 2011).	Likely
Kwonkan \`MYG378\`	25 km	Mulga woodland on heavy soils and plains with sandy loams (Biota 2014)	Likely
Missulena faulderi	36 km	Floodplain habitat next to Weeli Wolli Creek (Harms and Framenau 2013). Hardpan plain under mulga scrub (Bennelongia 2023)	Likely
Missulena langlandsi	21 km	Floodplains of Weeli Wolli Creek amongst spinifex grass and scattered eucalyptus trees (Harms and Framenau 2013)	Likely
Synothele \`MYG309\`	53 km	Mulga habitat on clay loam substrate (Biota 2014)	Likely
Kwonkan MYG324-DNA	22 km	Plains with Sandy Loams (Biota 2014)	Likely

4.2. Survey Results

4.2.1. Collected SRE Specimens

The field survey collected 182 specimens (Table 8), including those identified at higher order (Table 9). Thirty-nine species belonging to SRE Groups were collected during the survey including 12 centipedes, nine pseudoscorpions, five spiders (four mygalomorphs and one selenopid), five isopods, four scorpions, three millipedes, and one snail (Table 8). For a full list of collected specimens and their locations, please refer to Appendix 4.

The survey collected one Confirmed SRE species, seven Potential SREs, 12 Uncertain (data deficient) species which conservatively are apportioned to the Potential SRE category, and 19 species classified as Not SRE (Table 8). Eleven of the species collected are currently known only from the Study Area (Table 8). However, many of these 11 species are unlikely to be SRE species. For example, none of the scolopendrid centipede species are SREs according to the criteria of Harvey (2002) who suggests centipede species are rarely SREs other than in the order Geophilida.

The single Confirmed SRE species collected in the field survey is the mouse spider *Missulena faulderi*, which was first described by Harms and Framenau (2013). The Potential SRE species are:

- Mygalomorph Spider
    - *Synothele* \`BMYG199\`,
- Scorpion
    - *Lychas* \`BSCO088\` \`pilbara1 group\`,
- Pseudoscorpions
    - *Austrohorus* \`BPS524\`,
    - *Afrosternophorus* \`BPS529\`, and
- Isopods
    - *Buddelundia* \`BIS536\`,
    - *Buddelundia* \`BIS539\`, and
    - *Laevophiloscia* \`BIS522\`

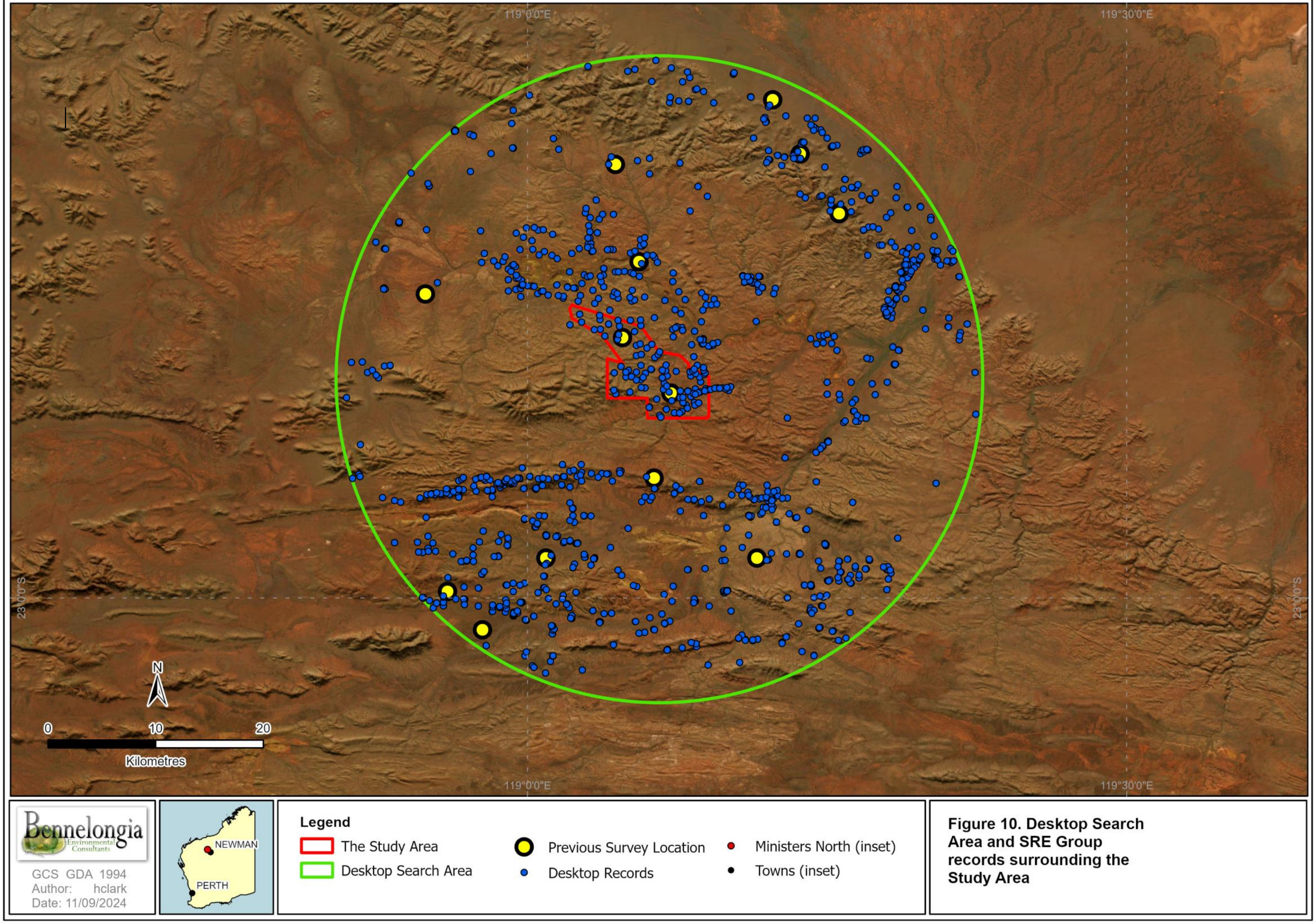


Figure 10. Desktop Search Area and SRE Group records surrounding the Study Area

Table 8. SRE Group fauna collected during the field survey.
Orange highlights indicate species that are currently known only from the Ministers North Study Area

Higher Order Identification	Lowest Identification	Number of Specimens	Sites	Habitat	Collection Methods	Species Associations	Species comments and Linear Distribution	SRE Status
Mollusca								
Gastropoda								
Stylommatophora								
Subulinidae	*Eremopeas interioris*	2	MN11	Minor Drainage Line	Leaf Litter Sample	*Eucalyptus* sp.	Pilbara wide distribution	Not SRE (Widespread)
Arthropoda								
Arachnida								
Scorpiones								
Buthidae	*Lychas* \`BSCO056\`	5	MN05, MN14, MN15, MN23	Minor Drainage Line, Undulating Low Hills	UV Search, Leaf Litter Rake, Bark Peel	*Eucalyptus* sp. including Ghost Gum	96.3 km	Uncertain (Data Deficient)
	Lychas \`BSCO058\`	2	MN12	Medium Drainage Line	UV Search		290 km Throughout Hamersley Ranges	Not SRE (Widespread)
	Lychas \`BSCO088\` \`pilbara1 group\`	2	MN02, MN30	Minor Drainage Line, Undulating Low Hills	Dry Trap		20.5 km Also found at Yandi in drainage area	Potential

Higher Order Identification	Lowest Identification	Number of Specimens	Sites	Habitat	Collection Methods	Species Associations	Species comments and Linear Distribution	SRE Status
Urodacidae	*Urodacus* \`BSCO045\`	11	MN05, MN11, MN19, MN25, MN29	Major Drainage Line, Minor Drainage Line, Undulating Low Hills	Burrow Dig, Cup Trap	Alluvial soils in Drainage Lines or under small Breakaways in Undulating Low Hills	107 km	Uncertain (Data Deficient)
Pseudoscorpiones								
Garypidae	*Synsphyronus xynus*	2	MN17	Undulating Low Hills	Bark Peel	*Eucalyptus* sp.	Pilbara Wide	Not SRE (Widespread)
Olpiidae	*Austrohorus* \`BPS508\`	1	MN29	Gully	Leaf Litter Sample	*Eucalyptus* sp.	16.4 km. Also collected at Yandi in three habitat types	Uncertain (Data Deficient)
	Austrohorus \`BPS524\`	5	MN14, MN17, MN20	Undulating Low Hills	Litter Sieve	*Eucalyptus* sp.	4.45 km Ministers Nth Only. Collected from one habitat type that extends beyond the Study Area however true distribution remains unknown	Potential

Higher Order Identification	Lowest Identification	Number of Specimens	Sites	Habitat	Collection Methods	Species Associations	Species comments and Linear Distribution	SRE Status
	Beierolpium 8/3 \`BPS527\`	5	MN07, MN23, MN27	Undulating Low Hills, Major Drainage Line, Minor Drainage Line	Litter Sieve	*Eucalyptus* sp. and *Acacia* sp.	7.2 km Ministers Nth Only. New Species however members of this genus tend not to be SRE	Uncertain (Data Deficient)
	Beierolpium 8/4 \`BPS522\`	4	MN03, MN18	Undulating Low Hills, Hillslopes	Leaf Litter Sample, Rock Flip	*Eucalyptus* sp.	3.4 km Ministers Nth Only. New Species however members of this genus tend not to be SRE	Uncertain (Data Deficient)
	Indolpium \`BPS526\`	5	MN09, MN25, MN30	Undulating Low Hills, Gully, Minor Drainage Line	Leaf Litter Sample and Litter Sieve	*Acacia* sp. and mixed *Eucalyptus/Hakea* sp.	6.9 km Ministers Nth Only	Uncertain (Data Deficient)
	Indolpium \`BPS528\`	2	MN03, MN18	Undulating Low Hills	Rock flip		3.4 km Ministers Nth Only	Uncertain (Data Deficient)
	Olpiidae Genus 7/4 \`BPS525\`	16	MN,02, MN05, MN11, MN14, MN15, MN16	Undulating Low Hills, Major Drainage Line, Minor	Leaf Litter Sample, Litter Sieve, Bark Peel	*Eucalyptus* sp., *Hakea/Eucalyptus* mix, Ghost Gum, Mallee	7.7 km Ministers Nth Only	Uncertain (Data Deficient)

Higher Order Identification	Lowest Identification	Number of Specimens	Sites	Habitat	Collection Methods	Species Associations	Species comments and Linear Distribution	SRE Status
				Drainage Line				
Sternophoridae	*Afrosternophorus* \`BPS529\`	3	MN30	Undulating Low Hills	Bark Sieve	*Eucalyptus* sp.	Singleton Ministers Nth Only	Potential
Araneae								
Actinopodidae	*Missulena faulderi*	1	MN24b	Undulating Low Hills	Burrow Dig	Burrow positioned under small dead shrub	36 km	Confirmed
Anamidae	*Aname mellosa*	1	MN10	Gully	Dry Trap		Pilbara distribution	Not SRE (Widespread)
Barychelidae	*Aurecocrypta* \`MYG316\`	3	MN10, MN17, MN19	Undulating Low Hills, Gully	Burrow Dig	Under small overhanging rock ledge in base of Gully	110 km	Uncertain (Data Deficient)
	Synothele \`BMYG199\`	1	MN24b	Undulating Low Hills	Burrow Dig	On Open Sand Plain	Singleton Ministers Nth Only. Single record from a single habitat that extends outside the Study Area	Potential

Higher Order Identification	Lowest Identification	Number of Specimens	Sites	Habitat	Collection Methods	Species Associations	Species comments and Linear Distribution	SRE Status
Selenopidae	*Karaops* cf. *banyjima*	1	MN04	Hillslope	Rock Flip		Widespread Most likely this species based on distribution and external morphology however the key internal features could not be dissected.	Not SRE (Widespread)
Malacostraca								
Isopoda								
Armadillidae	*Buddelundia* \`BIS374\`	2	MN04, MN14	Undulating Low Hills, Hillslopes	Rock Flip		100 km. Less likely to be an SRE due to variety of habitats and known distribution	Uncertain (Data Deficient)
	Buddelundia \`BIS520\`	32	MN01, MN03, MN10, MN11, MN12, MN15, MN17, MN18,	Undulating Low Hills, Hillslopes, Gully, Major Drainage Line, Meduim Drainage	Dry Trap, Log Flip, Rock Flip, Litter Sieve, Tree Dig, Litter Rake	*Eucalyptus* sp., *Acacia* sp., *Hakea* sp.	21.3 km. Also collected from the Yandi Study Area	Uncertain (Data Deficient)

Higher Order Identification	Lowest Identification	Number of Specimens	Sites	Habitat	Collection Methods	Species Associations	Species comments and Linear Distribution	SRE Status
			MN19, MN20, MN23, MN27	Line, Minor Drainage Line				
	Buddelundia \`BIS536\`	6	MN11, MN15, MN19, MN23	Undulating Low Hills, Minor Drainage Line	Dry Trap, Tree dig	*Eucalyptus* sp.	18 km. Also collected at Yandi from a number of habitats	Potential
	Buddelundia \`BIS539\`	1	MN09	Gully	Rock Flip		Singleton Ministers Nth Only. Sigle record from restricted habitats	Potential
Philosciidae	*Laevophiloscia* \`BIS522\`	2	MN12, MN15	Undulating Low Hills, Medium Drainage Line	Log Flip, Litter Rake	*Eucalyptus* sp.	16.2 km. Also collected at Yandi from multiple habitat types	Potential
Chilopoda								
Geophilida								

Higher Order Identification	Lowest Identification	Number of Specimens	Sites	Habitat	Collection Methods	Species Associations	Species comments and Linear Distribution	SRE Status
Geophilidae	Geophilidae sp.	1	MN11	Minor Drainage Line	Rock Flip		Higher Order. Difficult to ascertain distribution. This species is in poor condition and the Identification cannot be taken further.	Not SRE (Widespread)
Mecistocephalidae	*Mecistocephalus* \`BGE075\`	7	MN12, MN14, MN17	Undulating Low Hills, Medium Drainage Line	Litter Sieve, Litter Rake	*Eucalyptus* sp.	3.5 km Ministers Nth Only	Not SRE (Widespread)
	Mecistocephalus \`BGE076\`	1	MN20	Undulating Low Hills	Litter Rake	*Eucalyptus* sp.	19.5 km. Also collected from the Yandi Study Area	Not SRE (Widespread)
Oryidae	*Orphnaeus brevilabiatus*	1	MN19	Undulating Low Hills	Rock Flip		WA distribution	Not SRE (Widespread)
Scolopendrida								
Cryptopidae	*Cryptops spinipes*	2	MN16, MN29	Undulating Low Hills, Minor Drainage Line	Log Flip and Litter Rake	*Acacia* sp.	WA distribution	Not SRE (Widespread)

Higher Order Identification	Lowest Identification	Number of Specimens	Sites	Habitat	Collection Methods	Species Associations	Species comments and Linear Distribution	SRE Status
Scolopendridae	*Arthrorhabdus mjobergi*	3	MN24, MN27, MN29	Gully, Major Drainage Line, Minor Drainage Line	Dry Trap, Litter Rake	*Acacia* sp.	Australian distribution	Not SRE (Widespread)
	Arthrorhabdus paucispinus	1	MN18	Hillslopes	Rock Flip		WA distribution	Not SRE (Widespread)
	Colobopleurus \`BSCOL102\`	1	MN11	Minor Drainage Line	Dry Trap		Singleton, Ministers Nth Only	Not SRE (Widespread)
	Cormocephalus rubriceps	2	MN11, MN17	Minor Drainage Line, Undulating Low Hills	Litter Rake	*Eucalyptus* sp.	Australian distribution. Keys to this species however may be different. This group of animals is considered to be widespread	Not SRE (Widespread)
	Cormocephalus similis	1	MN15	Undulating Low Hills	Tree Dig	*Eucalyptus* sp.	WA distribution. Keys to this species however may be different. This group of animals is	Not SRE (Widespread)

Higher Order Identification	Lowest Identification	Number of Specimens	Sites	Habitat	Collection Methods	Species Associations	Species comments and Linear Distribution	SRE Status
							considered to be widespread	
	Scolopendra morsitans	22	MN01, MN02, MN03, MN04, MN05, MN07, MN10, MN11, MN15, MN16, MN17, MN23, MN25, MN27, MN29, MN30	Undulating Low Hills, Hillslopes, Gully, Major Drainage Line, Minor Drainage Line	Dry Trap, Litter Rake, Tree Dig, Rock Flip, Log Flip	*Eucalyptus* sp. including Mallee, *Hakea* sp.	WA distribution	Not SRE (Widespread)
Scutigeromorpha								
Scutigeridae	Scutigeridae sp.	7	MN01, MN15, MN17, MN24, MN25	Undulating Low Hills, Gully, Minor Drainage Line	Dry Trap, Litter Rake, Litter Sieve, Rock Flip	*Eucalyptus* sp.	Higher Order. Difficult to ascertain distribution. This group is not considered to contain SRE species.	Not SRE (Widespread)

Higher Order Identification	Lowest Identification	Number of Specimens	Sites	Habitat	Collection Methods	Species Associations	Species comments and Linear Distribution	SRE Status
Arthropoda								
Diplopoda								
Polydesmida								
Paradoxosomatidae	*Antichiropus* sp.	1	MN15	Undulating Low Hills	Rock Flip		Higher Order. Difficult to ascertain distribution. This species is in poor condition and the Identification cannot be taken further.	Uncertain (Data deficient)
Polyxenida								
Synxenidae	*Phryssonotus novaehollandiae*	1	MN20	Undulating Low Hills	Leaf Litter Sample		WA distribution	Not SRE (Widespread)
Spirobolida								
Trigoniulidae	*Austrostrophus stictopygus*	1	MN11	Minor Drainage Line	Dry Trap		Pilbara wide distribution	Not SRE (Widespread)

Table 9. Specimens collected during the field survey that could only be identified as higher order.

Higher Order Identification	Lowest Available Identification	Number of Specimens	Possible species match
Arthropoda			
Arachnida			
Scorpiones			
Urodacidae	*Urodacus* sp.	1	*Urodacus* \`BSCO045\`
Chilopoda			
Geophilida			
Mecistocephalidae	Mecistocephalidae sp.	2	*Mecistocephalus* \`BGE075\`, *Mecistocephalus* \`BGE076\`
Scolopendrida			
Cryptopidae	*Cryptops* sp.	1	*Cryptops spinipes*
Scolopendridae	*Cormocephalus* sp.	1	*Cormocephalus rubriceps, Cormocephalus similis*
Scolopendridae	*Scolopendra* sp.	4	*Scolopendra morsitans*
	Scolopendrida sp.	1	*Cryptops spinipes, Arthrorhabdus mjobergi, Arthrorhabdus paucispinus, Colobopleurus* \`BSCOL102\`, *Cormocephalus rubriceps, Cormocephalus similis Scolopendra morsitans*
Diplopoda			
Polyxenida			
Synxenidae	*Phryssonotus* sp.	4	*Phryssonotus novaehollandiae*
Spirobolida			
Trigoniulidae	*Austrostrophus* sp.	1	*Austrostrophus stictopygus*

4.2.2. Habitat Assessment

The field survey identified the presence of six broad habitats within the Study Area (Figure 12). The following sections list the major habitat types and discuss the potentially important microhabitats within each of these broad habitats. Table 10 lists the major habitats surveyed and key characteristics of these. Photos of survey sites representative of these habitat types are shown in Appendix 2. Collection habitat and SRE status for each species is listed in Table 9.

Table 10. Collection numbers of Confirmed, Potential and Uncertain SREs in each Habitat.

Habitat	Number of Sites	Area (km^2)	Area (%)	Number of Confirmed, Potential and Uncertain SREs
Major Drainage Line	2	2	4	Uncertain SREs: 4
Medium Drainage Line	2	0.5	1	Potential SREs: 1 Uncertain SREs: 1
Minor Drainage Line	6	1.2	3	Potential SREs: 2 Uncertain SREs: 6
Undulating Low Hills	15	44	77	Confirmed SREs: 1 Potential SREs: 6 Uncertain SREs: 10
Hillslopes	2	3	4	Uncertain SREs: 3
Gorge/Gully	4	7	11	Potential SREs: 1 Uncertain SREs: 4

Major Drainage Line

Major Drainage Lines in the Study Area mostly consist of a channel with a rocky substrate of large rocks and boulders. The banks of these drainage lines are alluvial clays and support a greater range of smaller shrubs and grasses and, usually, large *Eucalyptus* sp. and/or *Melaleuca* sp. trees. Due to the presence of the larger tree species, fallen logs and a build-up of litter are common in these habitat types.

Two Major Drainage Lines intersect the Study Area in an east/west direction (Figure 12). While these are major features in the Study Area, and extend into the surrounding landscape, they make up only 4% of available habitat within the Study Area.

Six species were collected in Major Drainage Lines; however none of these were Confirmed or Potential SREs (Figure 13 - Figure 23).

Medium Drainage Line

Medium Drainage Lines tend to contain a rocky bed with gravel to large rocks. These habitats support a variety of shrubs and often contain scattered tress along the bank. These trees have litter at their base and the odd log sits in the creek line.

Medium Drainage Lines make up 1% of the available habitat within the Study Area. While discrete from the surrounding landscape, these habitats often connect, and share characteristics, with both Major Drainage Lines and/or Minor Drainage Lines (Figure 12) and, therefore, it is common for species collected in Medium Drainage Lines to extend their distributions into the related habitat types.

Three species were collected in Medium Drainage Lines. One species, the isopod *Laevophiloscia* `BIS522`, is regarded as a **Potential SRE** and is the only Potential or Confirmed SRE collected within this habitat type (Figure 13 - Figure 23). It represents 12.5% of the eight Confirmed or Potential SREs collected study wide. *Laevophiloscia* `BIS522` was also collected within the Undulating Low Hills Habitat type.

Minor Drainage Line
Minor Drainage Lines tend to have sandy or silty beds with scattered rocks and gravel. They often support a dense shrub layer dominated by *Acacia* sp. Trees are present, however they are smaller and more scattered in distribution. Leaf litter build up is common amongst the shrub layer and at the base of isolated trees.

While scattered throughout the Study Area, Minor Drainage Lines are narrow corridors of habitat usually bordered by harsher, more extensive habitat types (Figure 12). Making up 3% of the available habitat in the study area, these features often feed into and share habitat characteristics with Medium and Major drainage lines.

Seventeen of the species collected during the survey were found at least once within the Minor Drainage Line habitat. This included two **Potential SRE** species, *Buddelundia* `BIS536`, and *Lychas* `BSCO088` `pilbara1 group` (see Figure 13 - Figure 23). This equates to 25 % of the eight Potential and Confirmed SREs collected throughout the course of the survey being. The remaining 15 species collected within Minor Drainage Lines consisted of widespread (nine) and Uncertain (six) species.

Undulating Low Hills
Undulating Low Hills tend to be sandy or rocky (with rock ranging from gravel to outcropping). Most rock in the area has a high iron content. Vegetation is dominated by spinifex grass with a few scattered small trees (*Eucalyptus* sp.) and shrubs (*Acacia* and *Hakea* sp.).

Undulating Low Hills are widespread throughout both the Study Area and the surrounding landscape. This is the most common habitat making up 77% of the Study Area. This habitat is generally uniform with rock size and sand content being the major variable.

Twenty-eight species were collected from sites within the Undulating Low Hills habitat. This includes the **Confirmed SRE** species, *Missulena faulderi,* and six **Potential SRE** species *Laevophiloscia* `BIS522`, *Buddelundia* `BIS536`, *Synothele* `BMYG199`, *Afrosternophorus* `BPS529`, *Austrohorus* `BPS524`, and *Lychas* `BSCO088` `pilbara1 group` (Figure 13 - Figure 23). Of the eight Confirmed or Potential SRE species collected during the entire survey, 87.5% were collected at least once from the Undulating Low Hills habitat.

Hillslopes
Similar to the Undulating Low Hills, Hillslopes have a rocky covering ranging from iron rich small rocks to rocky outcrops. Small patches of colluvial soils build up between the rocks where spinifex grasses dominate. Scattered *Acacia* sp. and *Hakea* sp. shrubs occur at these sites as well as some small *Eucalyptus* sp. trees. Scattered leaf litter can be found under shrubs and trees and occasionally between rocky outcrops.

Hillslopes make up 4% of the Study Area (Figure 12) and are often isolated, although they can share characteristics with surrounding habitats such as Undulating Low Hills. South Facing Slopes are considered to be particularly conducive to the presence of SRE species because these locations are often protected from harsh environmental conditions (such as heat from prolonged exposure to direct sunlight). Additionally, iron rich rocky outcrops and rock piles often form protected microhabitats that have the potential to provide refugia for SRE species. Alluvial soils also build up at the base of these features providing soil for burrowing animals.

The field survey resulted in the collection of five species from the Hillslopes habitat; however, no Confirmed or Potential SREs were collected from Hillslopes (Figure 13 - Figure 23).

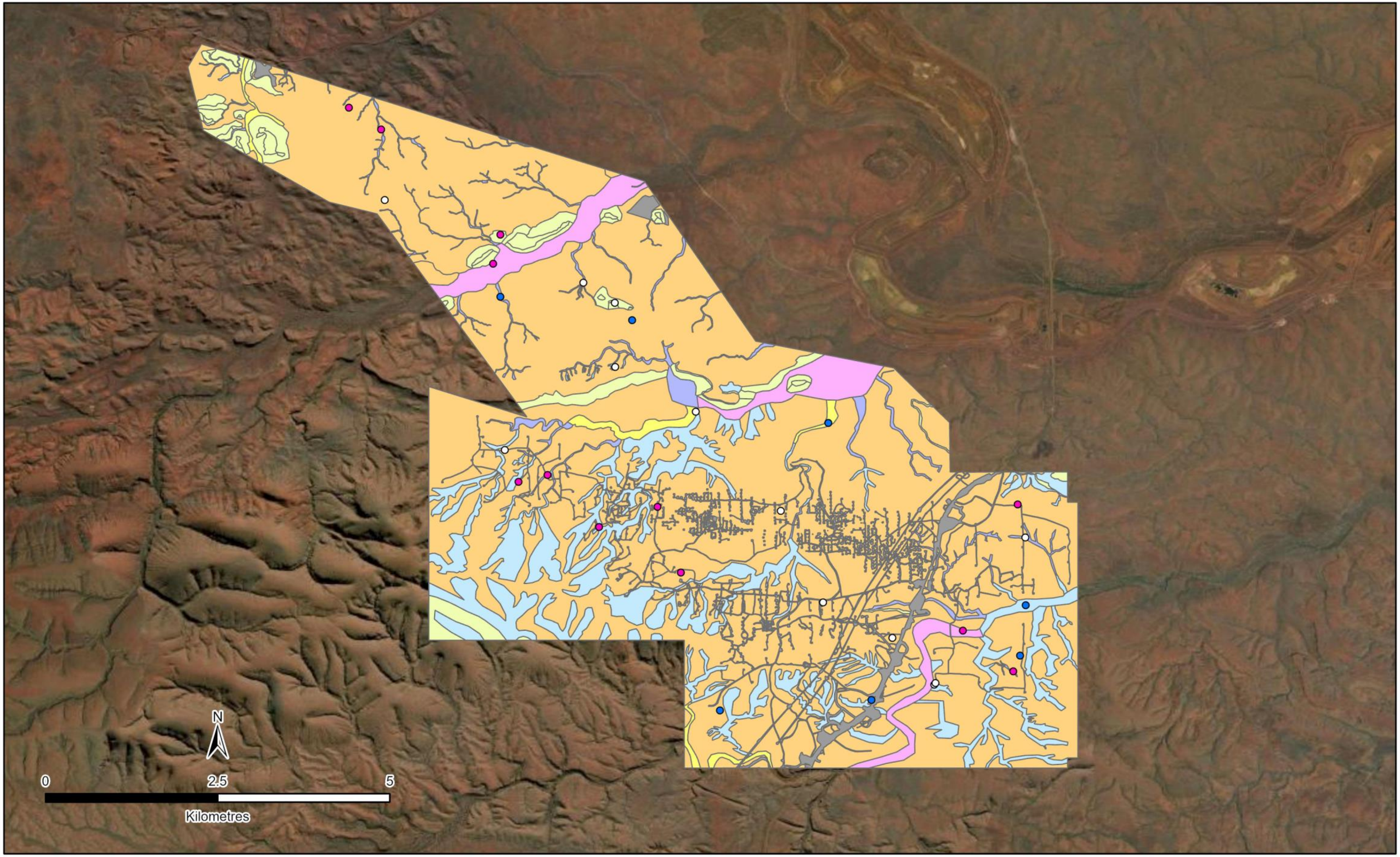
Gorge/Gully
Like drainage lines, Gorges and Gullies can contain water long after rainfall and are protected from extreme weather in a similar way to South Facing Slopes. Cliffs and Breakaways are a common feature of Gorges and Gullies as are rocky slopes that retain both moisture and detritals washed from higher surfaces. Trees may grow in the detritals to provide bark, litter and logs.

One major Gorge exists in the south-eastern section of the Study Area (Figure 12). This feature in the landscape contains significant large trees, with a grassy undergrowth. Either side of the Gorge there are rock cliffs. Unfortunately, this site could not be accessed due to the height and steep sides (cliffs) of the Gorge and the distance from any access tracks providing entry to the geological feature. Therefore, this site was surveyed only for habitat characteristics sighted from higher ground.

The Study Area has Gullies scattered throughout, particularly in the south (Figure 12). Aerial imagery does not always highlight the size, and therefore the significance, of Gullies as refugia. Gullies tend to contain a complex set of microhabitats. Sediment often builds up in the base and among boulders and outcropping rock, providing space for grasses to grow amongst taller shrubs and trees, and places for burrowing animals to dig (Figure 11). Litter and bark build up amongst this vegetation and substrate, fallen logs are more abundant in these sites than on the more widely distributed and exposed Undulating Low Hills. Gullies make up 11% of the Study Area and, while they are common outside of the Study Area, they are often isolated from each other by harsher, more exposed habitat types. SRE species are often found in Gullies due to the protection they provide from extreme weather.

Of the nine species collected within the Gorge/Gully habitat, one species (the isopod *Buddelundia* `BIS539`) is regarded as a **Potential SRE**. This equates to 12.5 % of the total eight Confirmed or Potential SRE species recorded in the entire survey (Figure 13 - Figure 23). The remaining eight species in Gorge/Gully habitat consist of widespread (four) and uncertain (four) SRE species. *Buddelundia* `BIS539` is only known from the Gorge/Gully habitat type at the Project.

Figure 11. Two spider burrows (one old and inactive, one sealed but active) identified in Gully at site MN10



Bennelongia Environmental Consultants

GCS GDA 1994
Author: hclark
Date: 12/09/2024

Figure 12. Habitat Mapping of the Study Area

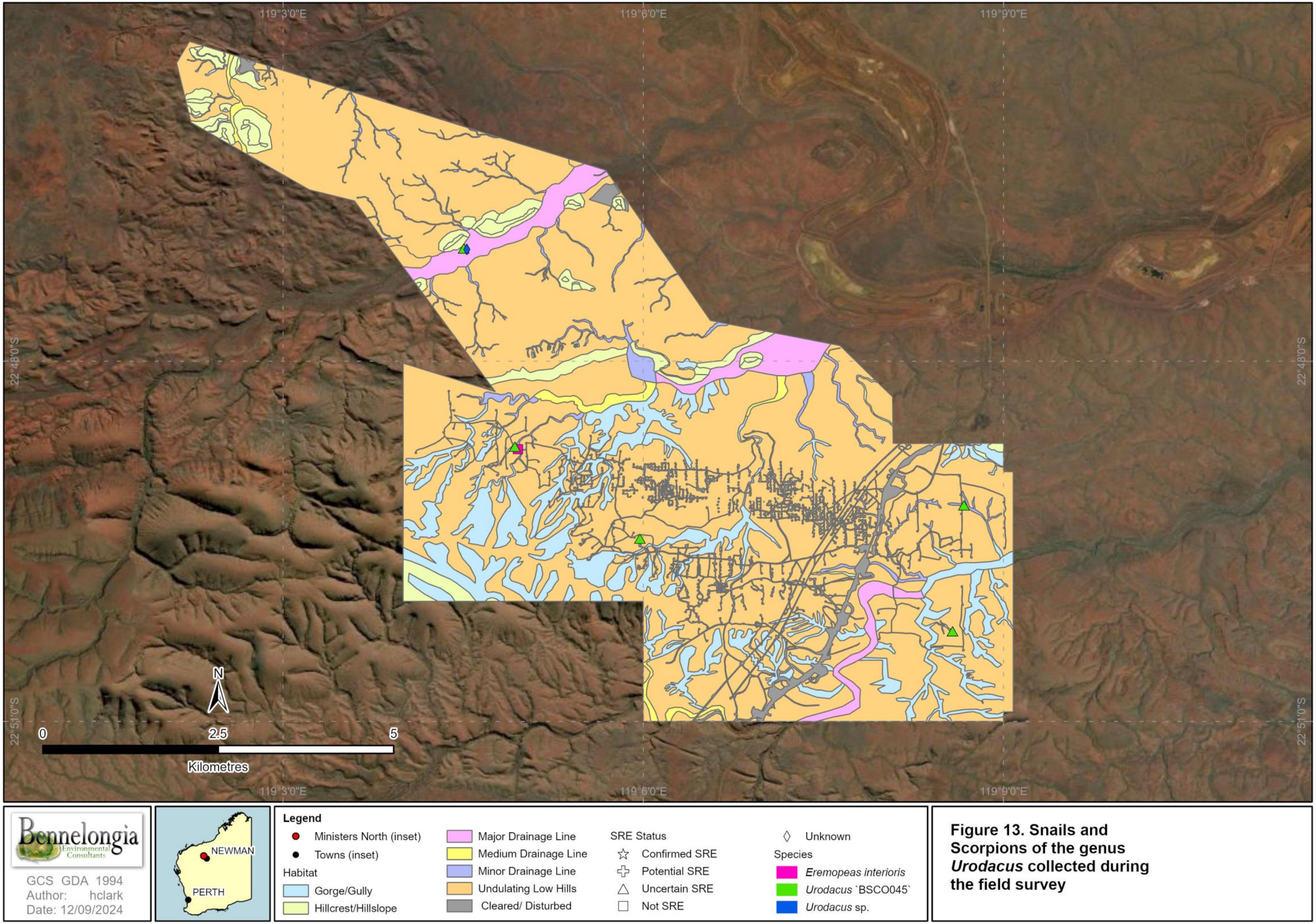


Figure 13. Snails and Scorpions of the genus *Urodacus* collected during the field survey

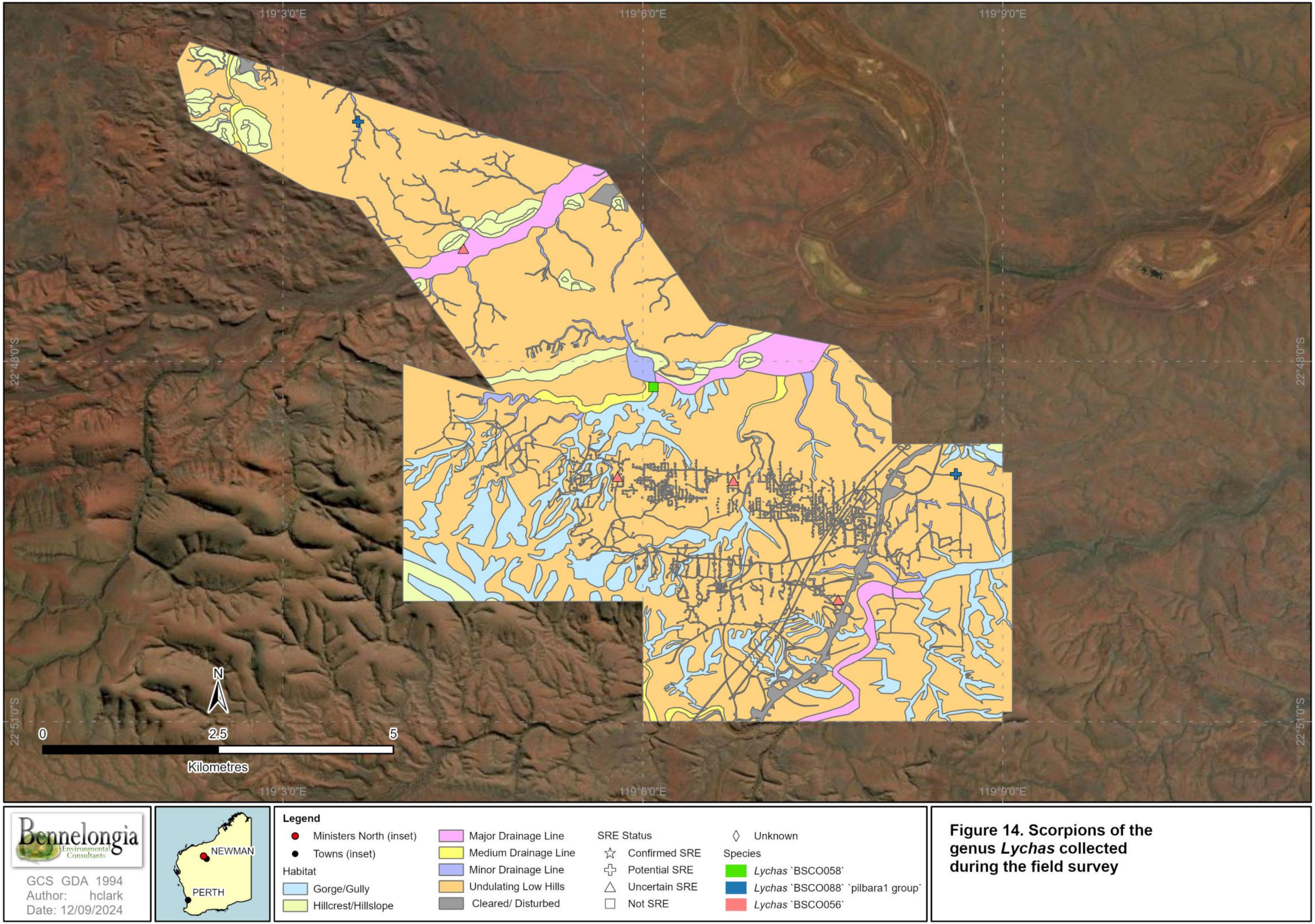
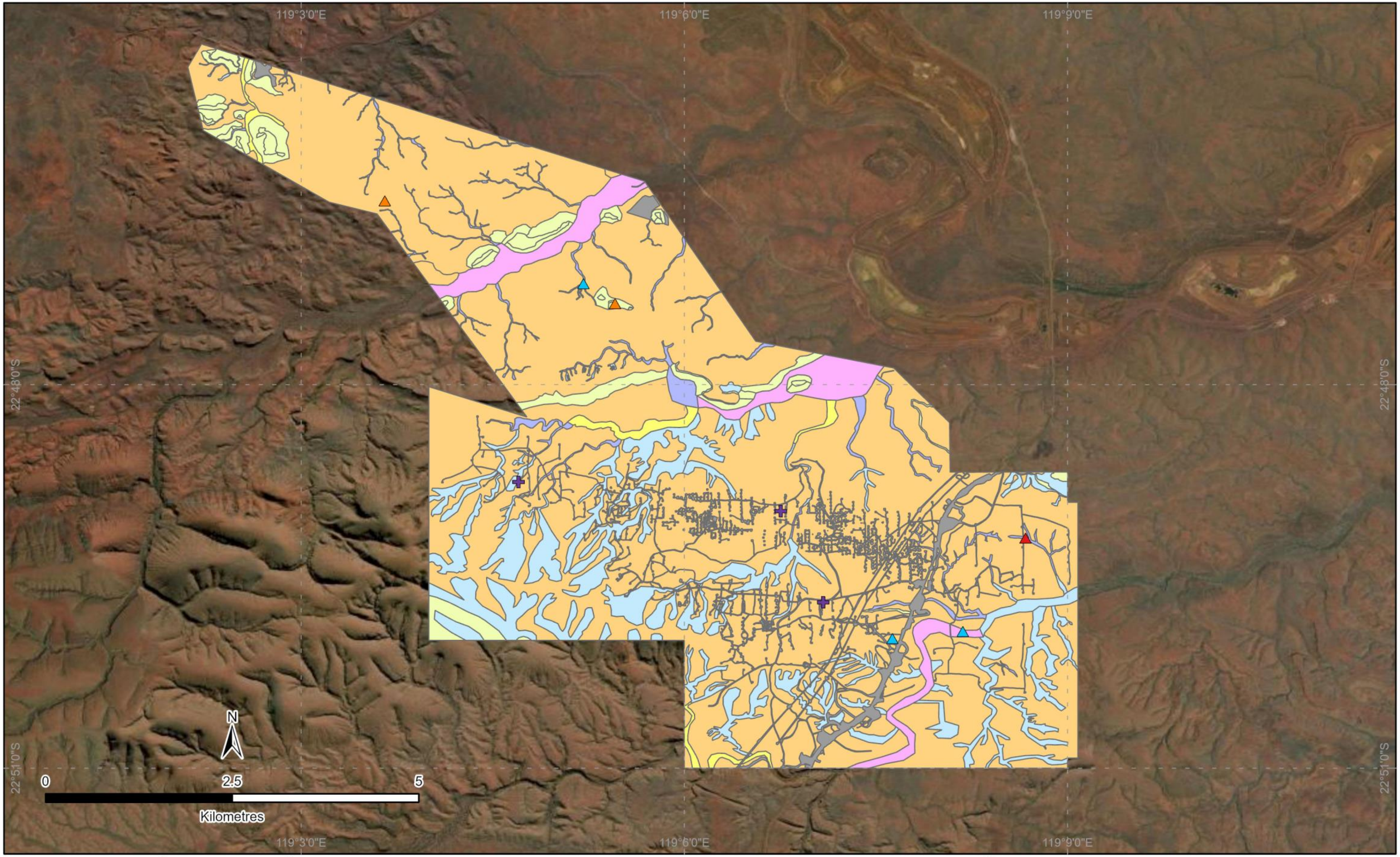


Figure 14. Scorpions of the genus *Lychas* collected during the field survey



Bennelongia Environmental Consultants

GCS GDA 1994
Author: hclark
Date: 12/09/2024

Legend

- Ministers North (inset)
- Towns (inset)

Habitat

- Gorge/Gully
- Hillcrest/Hillslope
- Major Drainage Line
- Medium Drainage Line
- Minor Drainage Line
- Undulating Low Hills
- Cleared/ Disturbed

SRE Status

- Confirmed SRE
- Potential SRE
- Uncertain SRE
- Not SRE
- Unknown

Species

- *Austrohorus* `BPS524`
- *Austrohorus* `BPS508`
- *Beierolpium* 8/3 `BPS527`
- *Beierolpium* 8/4 `BPS522`

Figure 15. Pseudoscorpions of the genera *Austrohorus* and *Beierolpium* collected during the field survey

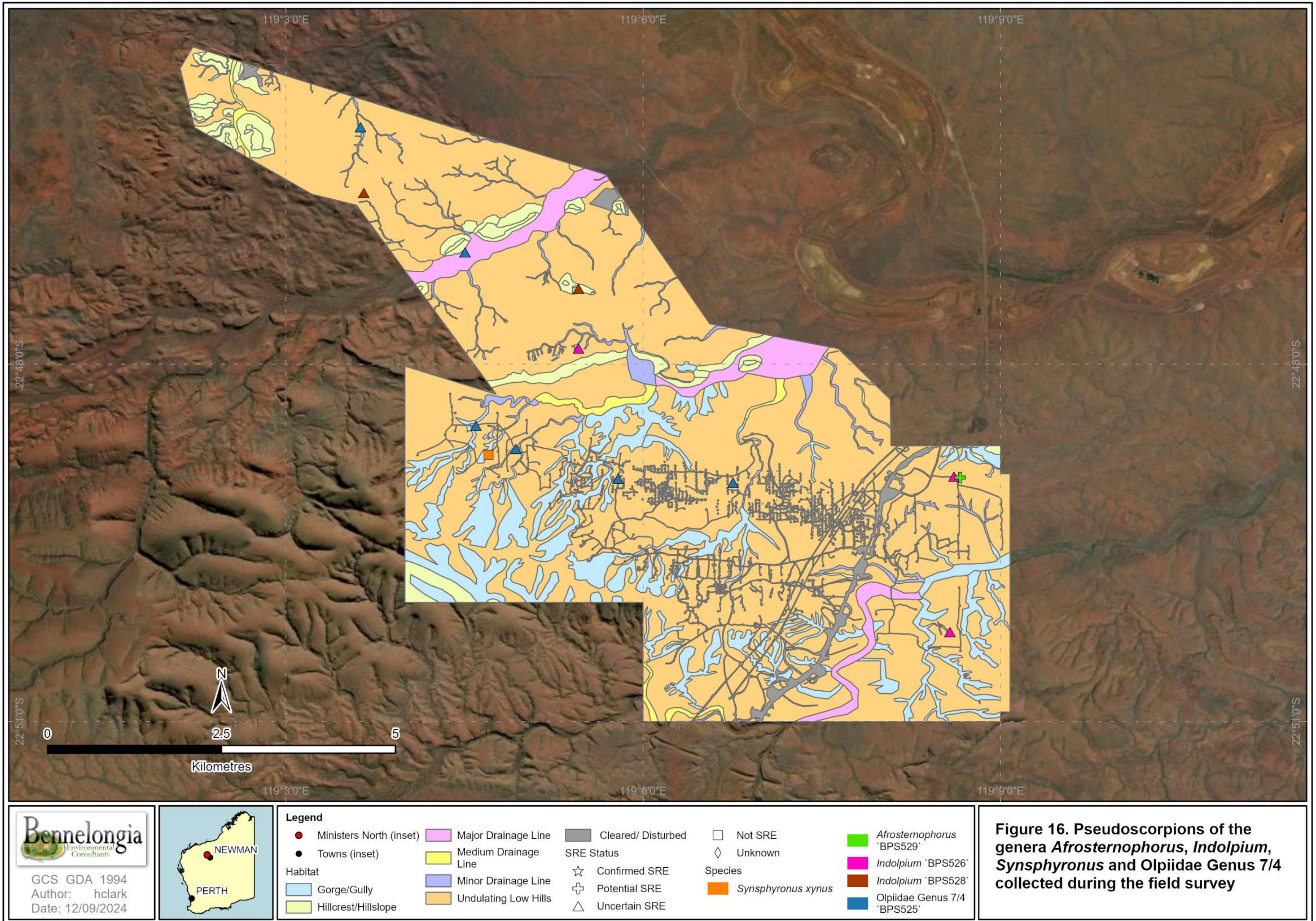


Figure 16. Pseudoscorpions of the genera *Afrosternophorus*, *Indolpium*, *Synsphyronus* and Olpiidae Genus 7/4 collected during the field survey

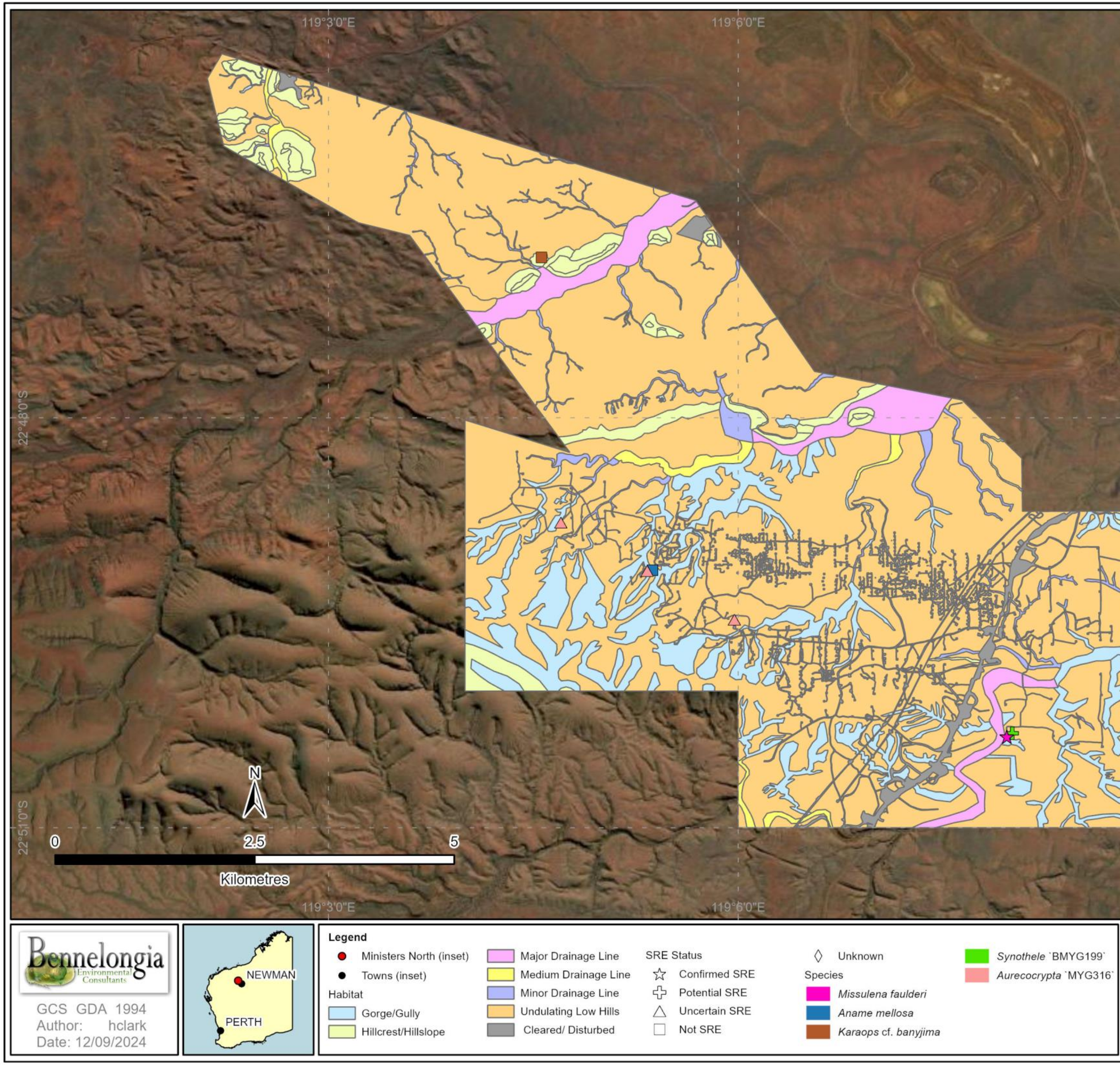


Figure 17. Mygalomorph and Selenopid spiders collected during the field survey

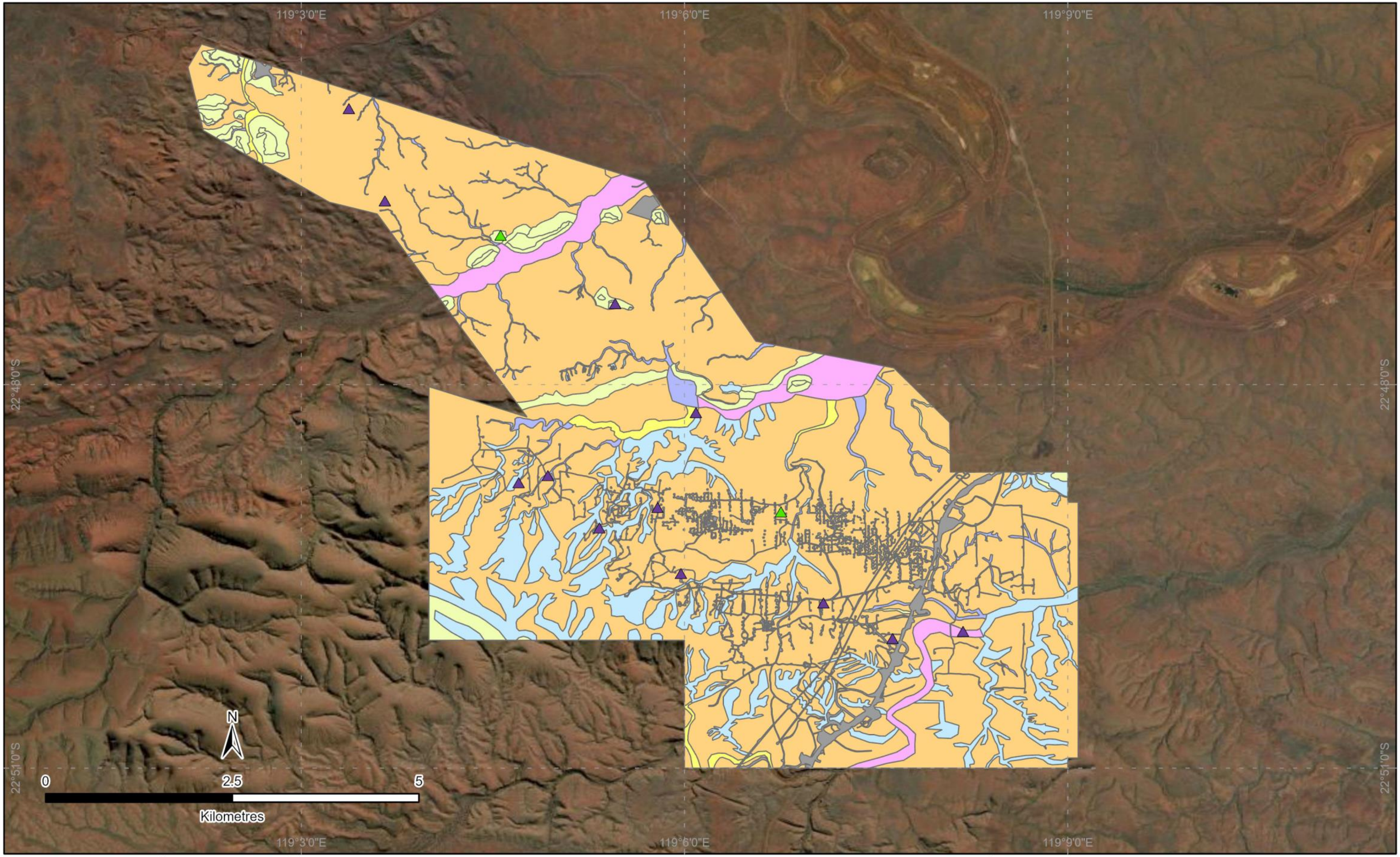
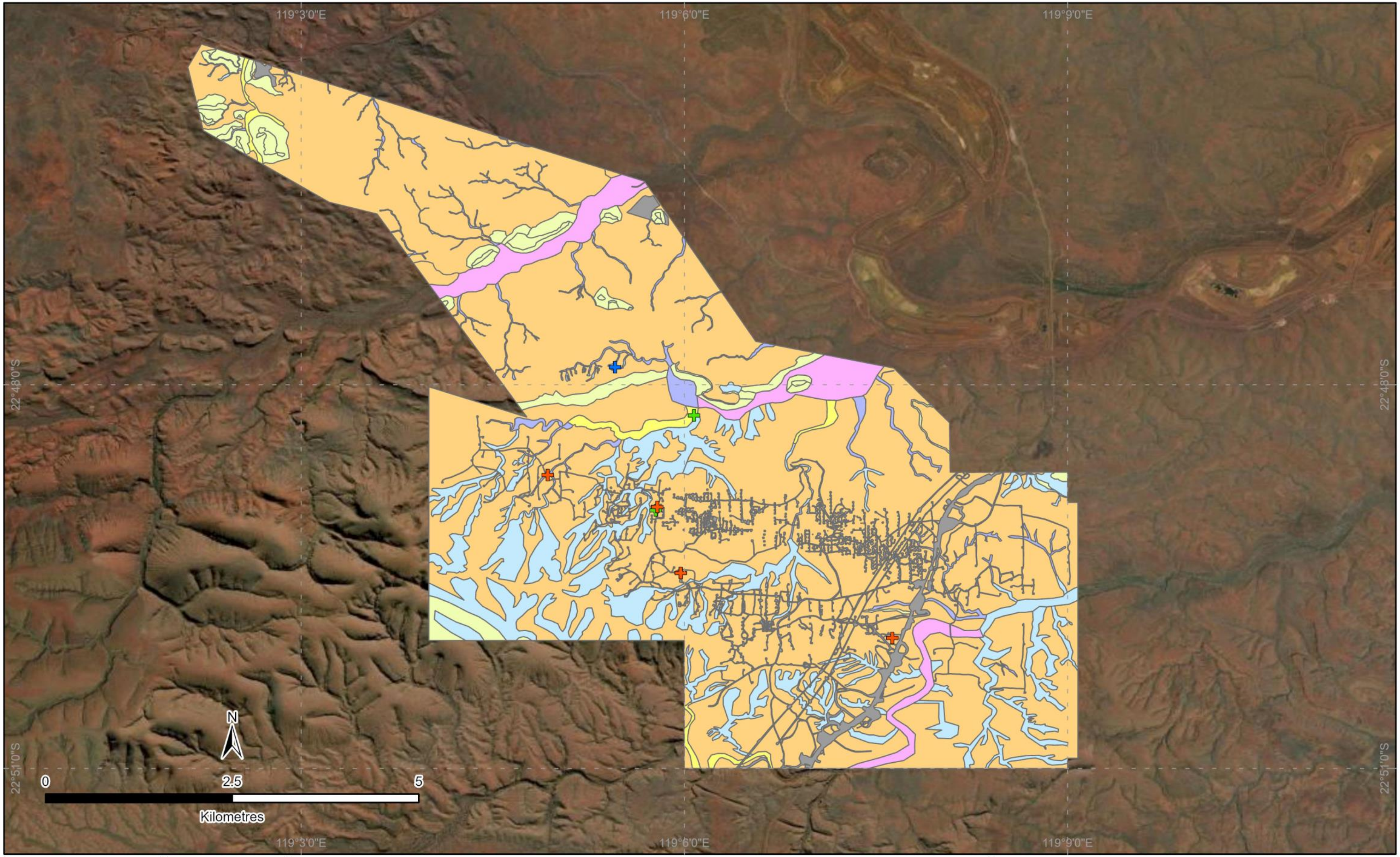


Figure 18. Isopod species *Buddelundia* `BIS374` and *Buddelundia* `BIS520` collected during the field survey



Bennelongia Environmental Consultants

GCS GDA 1994
Author: hclark
Date: 12/09/2024

Legend

- Ministers North (inset)
- Towns (inset)

Habitat
- Gorge/Gully
- Hillcrest/Hillslope
- Major Drainage Line
- Medium Drainage Line
- Minor Drainage Line
- Undulating Low Hills
- Cleared/ Disturbed

SRE Status
- Confirmed SRE
- Potential SRE
- Uncertain SRE
- Not SRE
- Unknown

Species
- *Buddelundia* `BIS536`
- *Buddelundia* `BIS539`
- *Laevophiloscia* `BIS522`

Figure 19. Isopod species *Buddelundia* `BIS836`, *Buddelundia* `BIS539` and *Laevophiloscia* `BIS522` collected during the field survey

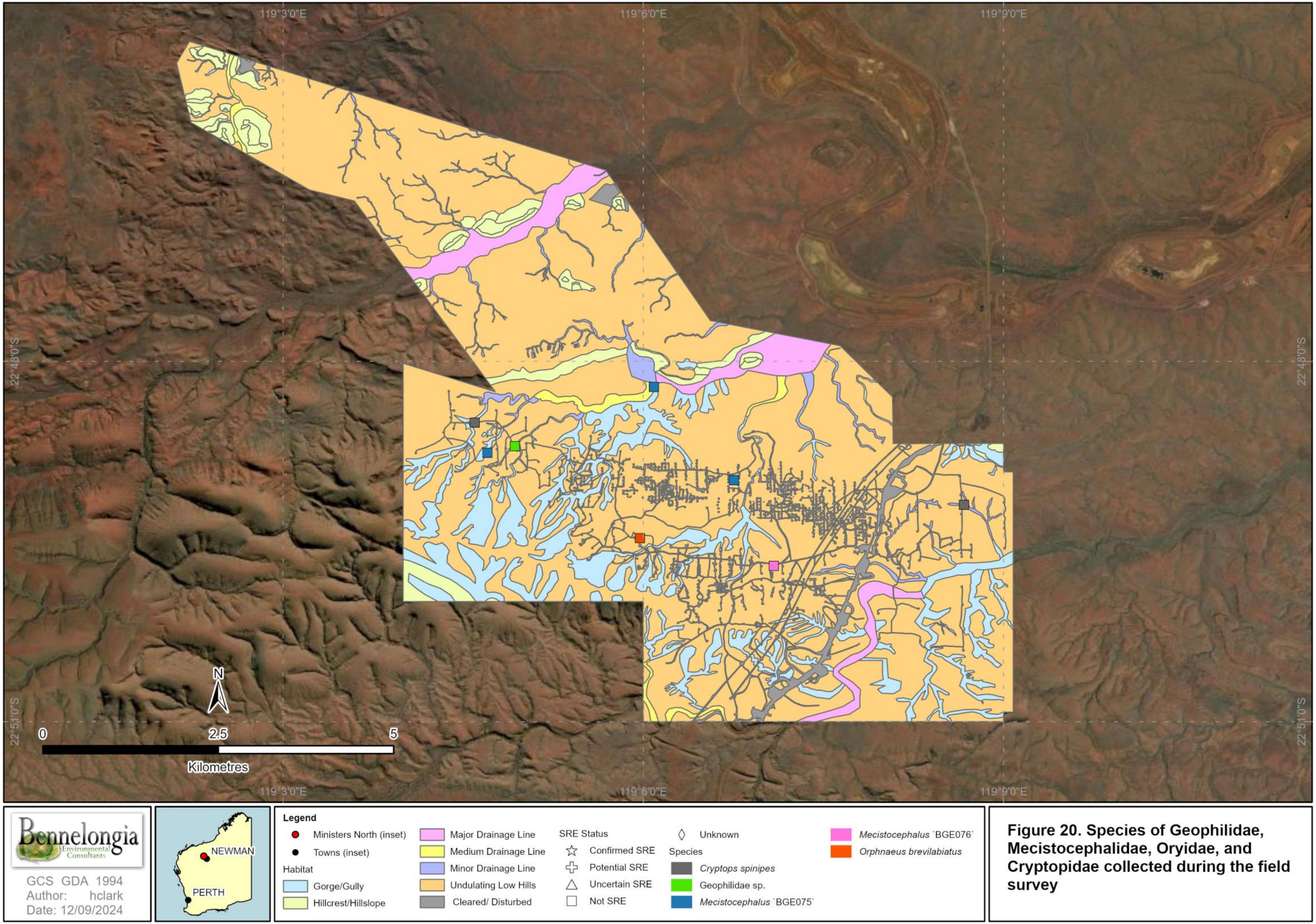


Figure 20. Species of Geophilidae, Mecistocephalidae, Oryidae, and Cryptopidae collected during the field survey

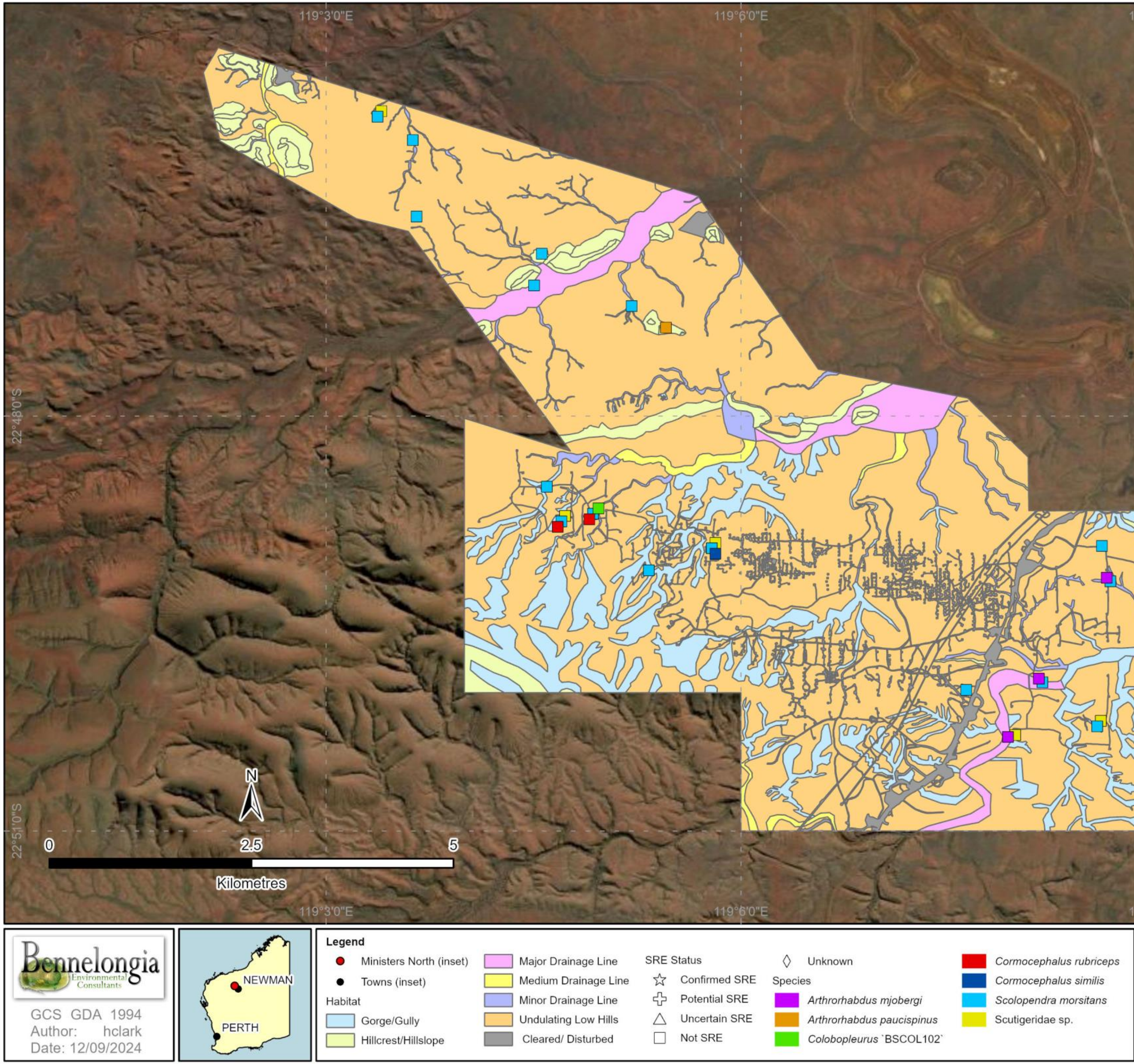


Figure 21. Species of Scolopendridae and Scutigeridae collected during the field survey

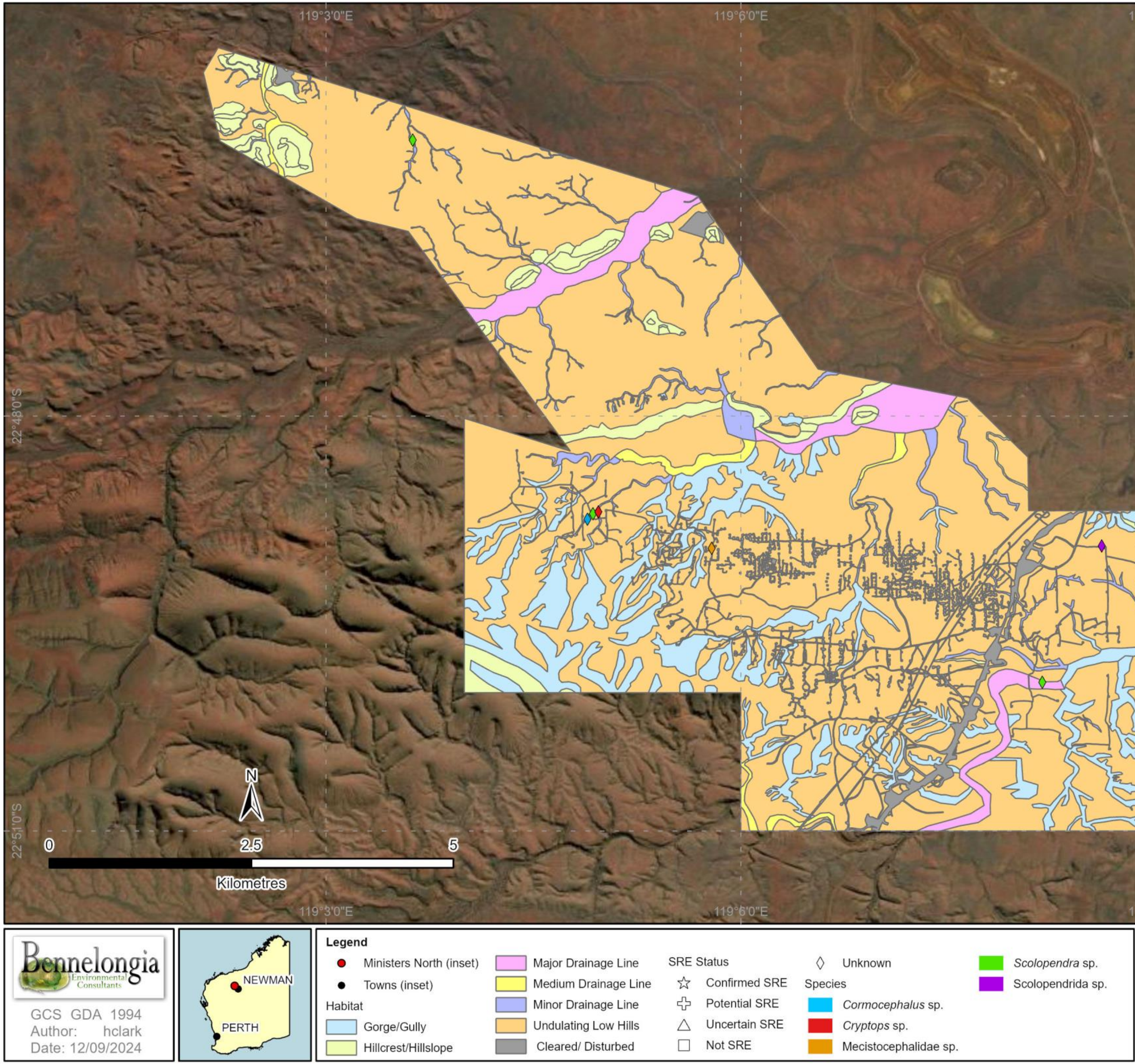


Figure 22. Higher order centipedes collected during the field survey

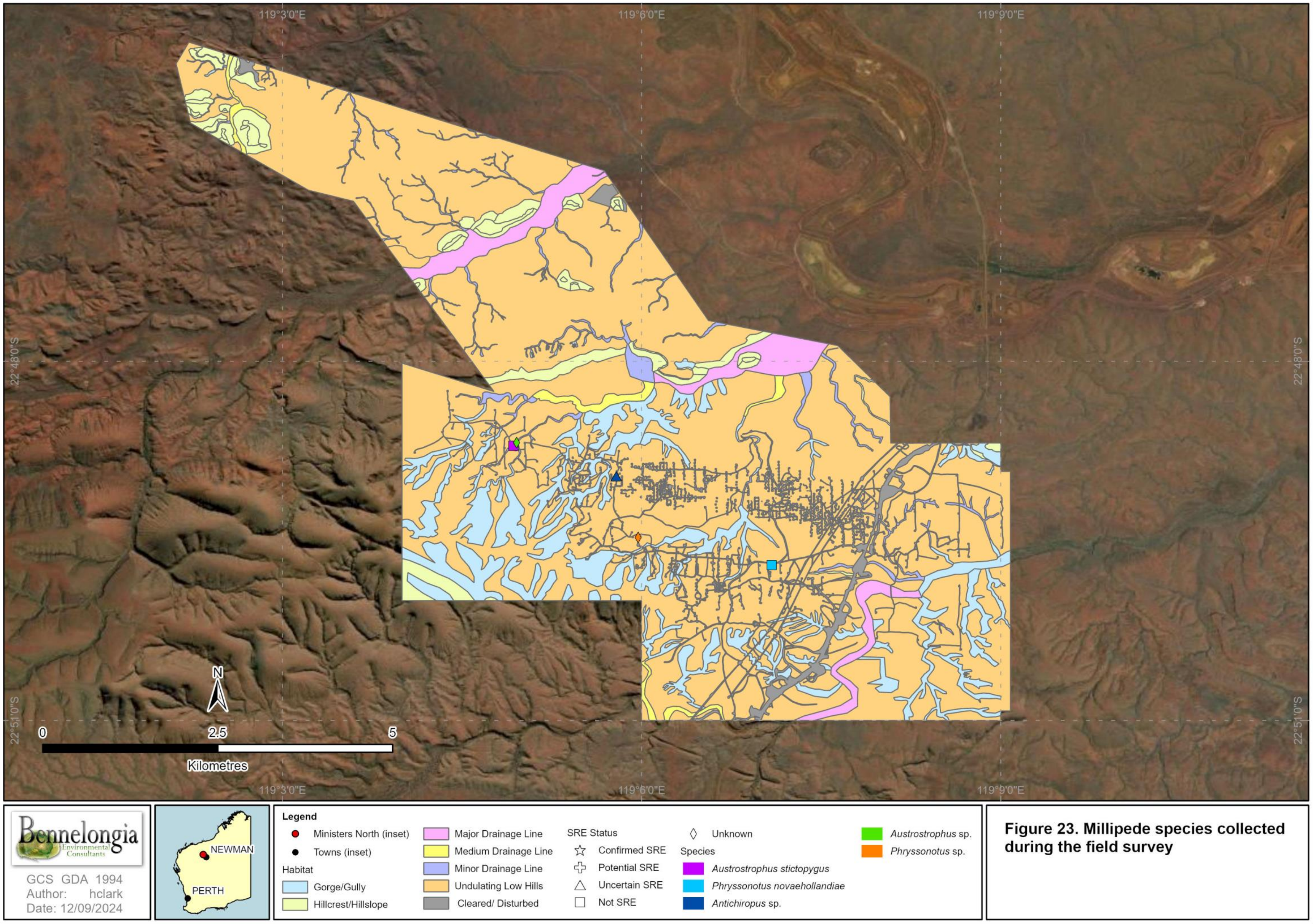


Figure 23. Millipede species collected during the field survey

5. DISCUSSION

Both the desktop review and field survey have identified the prevalence of SRE Group species within and around the Ministers North Study Area. The desktop identified that nine species previously identified as Confirmed SREs and 50 species previously identified as Potential SREs had been previously collected within 30 km of, or inside, the Study Area. Eighteen of the records of Potential SRE in this list are higher order identifications and therefore should be treated with a degree of caution. Of the 41 Potential and Confirmed SREs in the desktop search area that were identified to species level, 12 species were collected in the Study Area.

The field survey subsequently recollected one of the Confirmed SRE species and a further seven Potential SRE species (three of which had also been previously collected). The collection of species known from earlier surveys extends our knowledge of the distribution and biology of these species.

5.1. Confirmed SRE

Mygalomorph Spiders

The mouse spider *Missulena faulderi* (Figure 24) is a Confirmed SRE mygalomorph spider that was identified during the desktop and was recollected during the field survey (Table 8 and Figure 24). First described by Harms and Framenau (2013) from the banks of Weeli Wolli Creek amongst spinifex, the recently collected specimen comes from a sandy plain at site MN24b. The burrow was located at the base of a dead shrub and the female specimen was retrieved by burrow digging. This follows collection of a male at Yandi by Bennelongia (2023). This species has a known linear range of approximately 36 km. It is known from beyond the Study Area and is not considered of conservation concern in this case.

Figure 24. Female *Missulena faulderi* collected in Sandy Plain on Undulating Low Hills at site 24b in the Study Area

5.2. Potential SREs

Scorpions

Lychas `BSCO088` `pilbara1 group` has been previously collected at Yandi and is thus represented in the desktop search. However, also in the desktop species list is *Lychas* `pilbara 1`, which may also be either *Lychas* `BSCO088` `pilbara1 group` or another species in the same species complex. The distance between Yandi and the Study Area collection sites is 20.5 km. The two individuals from the current survey were collected in dry traps from a Minor Drainage Line and Undulating Low Hills (sites MN02 and MN30) while the Yandi individual was collected in a drainage line (Bennelongia 2023). It should be noted that the taxonomy of most scorpions in Australia requires formal revision (Koch 1977; Volschenk *et al.* 2010; Volschenk *et al.* 2012; Volschenk *et al.* 2000), making clear determinations on species challenging. Historically, the genus *Lychas* was represented in Australia by four described species (Fet *et al.* 2000); however, this greatly underestimates the true diversity of this species within the Australian landscape as ongoing work is uncovering a significant number of new, undescribed species (Volschenk *et al.* 2010). While the collection of two specimens increases the known distribution of *Lychas* \`BSCO088\` \`pilbara1 group\`, the small distributional range currently known for this species, paired with the under described diversity of scorpions, results in the conservative approach of labelling it a Potential SRE.

Pseudoscorpions

Five individuals of *Austrohorus* \`BPS524\` were collected from three sites (MN14, MN17, MN20), all from within a single habitat type (Undulating Low Hills). The genus *Austrohorus* belongs to the Olpiidae family, which is often considered to contain cosmopolitan species collected under rocks and in litter of xeric environments (Harvey and Leng 2008). The only known collection method for this species is from sieving *Eucalyptus* sp. litter, a somewhat rare and isolated micro-habitat within a relative widespread broad habitat. Additionally, this species has a known linear distribution of just 4.45 km, resulting in the conservative approach of classifying this species as a Potential SRE.

Austrohorus \`BPS524\` was compared against two of the eight species of the genus *Austrohorus* identified in the desktop search (Appendix 3). These two species (*Austrohorus* \`BPS508\` and *Austrohorus* \`BPS509\`) were collected by Bennelongia (2023) and are clearly distinct. Without access to the specimens, it is unknown whether any of the other six species listed in the desktop review is synonymous with *Austrohorus* \`BPS524\`.

Three specimens of *Afrosternophorus* \`BPS529\` were collected at site MN30 while bark sieving under a *Eucalyptus* sp. tree in Undulating Low Hills and represent the only known records of the species, which belongs to the family Sternophoridae. This family is characterised by species living under bark and having a pale colour and are not well represented in collections (Harvey 1985). Despite the widespread nature of the habitat within which *Afrosternophorus* \`BPS529\` was collected, the isolated nature of trees throughout the landscape and the low collection numbers result in it being classified as a Potential SRE. The desktop search identified two other species of the genus *Afrosternophorus* from the desktop search area. *Afrosternophorus* \`BPS506\`, which was collected at Yandi (Bennelongia 2023), does not represent the same species. *Afrosternophorus* sp1. was collected at Marillana Creek approximately 10 km east of the Study Area. Determining whether it is synonymous with *Afrosternophorus* \`BPS506\` requires access to the specimen.

Mygalomorph Spiders

Field survey yielded a single specimen of *Synothele* \`BMYG199\` at site MN24b from Open Sand Plain habitat within Undulating Low Hills. There was no obvious association with any plant species for this specimen, which was collected by excavating its burrow in red sandy clay. The burrow was sealed at the time of collection. A sister species, *Synothele* \`MYG309\`, collected in Mulga woodland on Clay Loam Substrate approximately 13 km from the Study Area, has previously been classified as a Confirmed SRE (Biota 2014). This is in contrast to Raven's (1994) statement that no barychelid species are SREs but Biota (2014) assessment represented updated data. Further collections have shown more barychelid spider species have apparently restricted ranges and, therefore, *Synothele* \`BMYG199\` has been classified as a Potential SRE

Isopods

The taxonomic framework for isopods in Australia is poor, with inappropriate assignment of animals to northern hemisphere genera and families. Descriptions from the early 1900s provide the only available information for large components of the isopod fauna (Budde-Lund 1907, 1912; Wahrberg 1922). More recent work has increased the number of known species but also shown that currently available descriptions are inadequate. The vast majority of species are undescribed (Judd 2004; Judd and Tati 2011) but we do know that many isopod species are likely to be SREs (Harvey 2002).

Six specimens of *Buddelundia* `BIS536` (Figure 25) were collected from four sites at the Study Area (MN11, MN15, MN19, MN23). These individuals were collected from Undulating Low Hills, Minor Drainage Line, from a dry trap and a *Eucalyptus* sp. tree dig. This species was also identified during the desktop search as it was collected at Yandi in Hillcrest/Hillslope and Gorge/Gully habitats (Bennelongia 2023, Appendix 3). The species has a known linear range of 18 km and is treated as a Potential SRE.

Buddelundia `BIS539` was collected as a single specimen while rock flipping in a Gully at site MN09 (Table 8). This is the only known record of this species and, as a result of being collected in a relatively isolated habitat and as a single specimen, the species has been classified as a Potential SRE.

The desktop search recorded 15 species from the genus *Buddelundia*, seven of which have been collected by Bennelongia and ruled out as a match to *Buddelundia* `BIS539`. *Buddelundia* `BIS536` matched individuals collected at Yandi and has been named accordingly. The other eight species identified during the desktop search could not be compared to *Buddelundia* `BIS536` or *Buddelundia* `BIS539`. However, however five of them have previously been classified as Potential SREs (*Buddelundia* `10ma`, *Buddelundia* `14`, *Buddelundia* `48`, *Buddelundia* `49`, *Buddelundia* `sp. 15`).

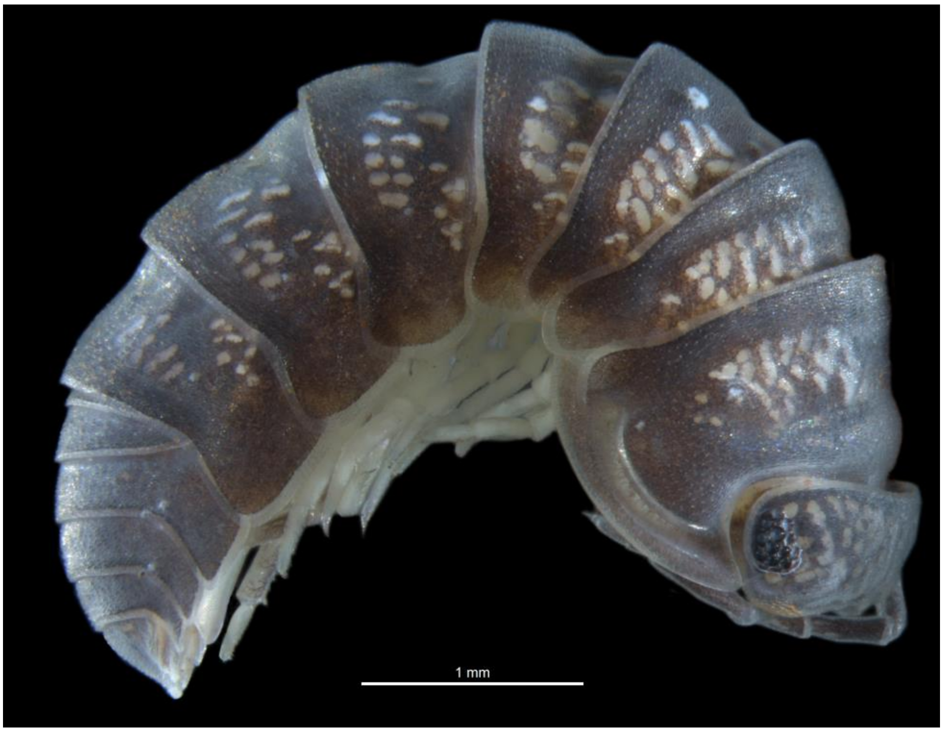


Figure 25. *Buddelundia* `BIS536` specimen collected during the field survey.

Laevophiloscia `BIS522` was represented by two individuals during the current survey from two sites (MN12, MN15) in Undulating Low Hills and Medium Drainage Line. These two individuals were collected from log flip and litter raking in *Eucalyptus* sp. litter. Also collected at Yandi (Appendix 3), this species has a known linear distribution of 16.2 km. The Yandi animals were the only other *Laevophilocia* identified in the desktop search (Appendix 3).

5.3. SRE Habitats

Most of the species collected during the survey and categorised as either Confirmed, Potential or Uncertain SRE have been collected from within the Undulating Low Hills habitat (Table 10). This may reflect the dominance of this habitat across the Study Area, as it represented up to 77 % of the available habitat and 45 % of sample sites were located in this habitat type (Figure 12 and Table 10). Despite the perceived uniformity of this habitat and relative lack of microhabitat diversity, the only Confirmed SRE, *Missulena faulderi*, was collected here as well as six Potential and 10 Uncertain SRE species (Table 10). It is not uncommon for SRE species to occupy only a portion of widespread habitats (Harvey 2002; Harvey *et al.* 2011; Rix *et al.* 2015). Microhabitats in Undulating Low Hills habitat included sheltered under rocks, and leaf litter at the base of trees and shrubs (Table 8). This highlights the importance of the isolated trees and shrubs for harbouring small invertebrate species.

Gullies are scattered throughout the Study Area, particularly to the south (Figure 12), and make up 11 % of the Study Area (Table 10). Four sites were surveyed in this habitat type, making up 13 % of the survey effort (Table 10). Animals collected in Gullies were evenly collected by dry trapping and hand foraging. Animals collected while hand foraging were primarily found in leaf litter, under rocks or burrowing in available soil. This resulted in the collection of one Potential and four Uncertain SRE species from within Gullies. The limitation of not accessing one major Gorge within the study area may have influenced the collection numbers within this habitat type. It should be noted, however, that while Gullies are expected to be prospective for SRE species, Gorges may be less so due to the destructive nature of flooding events within them (Durrant 2011).

Drainage lines tend to support microhabitats suitable for SRE species owing to water being retained after rainfall events. The relatively high level of water entering these systems allows for the growth of larger trees than in the wider landscape, resulting in larger available microhabitat in the form of bark (on the trees themselves), leaf litter and fallen logs, all important microhabitats for some SRE species (i.e. pseudoscorpions, slaters, centipedes, millipedes, snails). Depending on the substrate of the drainage system, rocks (slaters, centipedes), or sand (mygalomorph spiders and burrowing scorpions) can also provide microhabitats that support some species.

Minor Drainage Lines make up only 3 % of the Study Area (Figure 12 and Table 10) but they yielded two Potential SREs and six Uncertain SRE species. Six sites within minor drainage lines were surveyed, making up 20 % of the survey effort. The majority of animals in this habitat were hand collected from under loose rocks and logs, in leaf litter or under bark on trees and also burrowing in the soil. This demonstrates the diversity of microhabitats held within a small percentage of the Study Area.

Despite only making up 1 % of the Study Area and 6 % of survey effort (Figure 12 and Table 10), Medium Drainage Lines yielded one Potential SRE species and one Uncertain SRE species. Species in this habitat were primarily collected within leaf litter, often at the base of trees and shrubs. Animals were also collected wandering at night during nocturnal searching with ultraviolet (UV) torches.

Two Major Drainage Lines exist within the Study Area, making up 4 % of the habitat while sites surveyed within Major drainage Lines made up 6 % of the survey effort (Figure 12 and Table 10). Animals collected in this habitat were most commonly located in leaf litter, under bark on trees or burrowing in soil. Dry trapping was also a successful collection technique in Major Drainage Lines. Four Uncertain SREs were collected within this habitat while no Confirmed or Potential SREs were found. Durrant (2011) asserts that due to flooding disturbance of these systems, localised SRE species are less likely to be found within Major Drainage Lines, which may explain the results from this survey.

Hillslopes make up 4 % of the Study Area and 6 % of the survey effort (Table 10 and Figure 12). This resulted in the collection of three Uncertain SRE species most commonly collected within leaf litter, often at the base of trees or shrubs. Loose rocks were also common refugia for invertebrates on hillslopes.

The general consensus of the scientific community is that habitat heterogeneity is one of the key drivers of species richness in any given area (Hortal *et al.* 2009; Stein *et al.* 2014). This supports the notion that areas containing a variety of microhabitats will contain a more diverse SRE community. This positive relationship between environmental heterogeneity and species richness is often clouded by spatial scale, since larger areas will often automatically contain greater habitat diversity than smaller areas (Stein *et al.* 2014). This may partially explain why a widespread habitat such as Undulating Low Hills, which makes up 77 % of the Study Area and accounts for 45 % of survey effort, contained the greater number of Confirmed and Potential SRE species. The Study Area itself contains a wide variety of habitat types, which is reflected in the broad collections of animals from SRE groups, with only snails and millipedes being under-represented.

5.4. Conclusion

The desktop search identified the presence of habitats suitable for SRE species. Additionally, the desktop search identified 7,523 records of 313 species belonging to SRE Groups from within the 30 km radius desktop search area (Figure 10). The species include members of the trapdoor spiders and tarantulas, selenopid spiders, pseudoscorpions, scorpions, centipedes, millipedes, isopods and snails. A number of these species were previously recorded as Confirmed (nine) or Potential (50) SRE species. Some of the records of Potential SREs were higher order identifications however 12 of the Potential SREs that were identified to species level were collected from within the Study Area. This highlighted that SRE species are likely to occur in the Study Area.

Field survey subsequently collected 182 specimens of 39 species belonging to SRE Groups (Table 8). This includes 12 centipede species, nine pseudoscorpions, five spiders (four mygalomorphs and one seelenopid spider), five isopods, four scorpions, three millipedes, and one snail (Table 8). A sole Confirmed SRE was collected in Undulating Low Hills habitat, while seven species were categorised as Potential SREs and 12 Uncertain (data deficient) SRE species were collected. The remaining 19 species were classified as Not SRE.

The single Confirmed SRE species was the Mouse Spider *Missulena faulderi*. This collection was off the back of a male collected within Yandi in the previous few weeks and extends the known distribution of this species. Since this species is known from outside the Study Area it is not considered to be of conservation concern.

The potential SRE species were:

- Scorpion- *Lychas* \`BSCO088\` \`pilbara1 group\` (also collected at Yandi),
- Pseudoscorpion- *Austrohorus* \`BPS524\` (only known from Ministers North),
- Pseudoscorpion- *Afrosternophorus* \`BPS529\` (only known from Ministers North),
- Mygalomorph spider- *Synothele* \`BMYG199\` (only known from Ministers North),
- Isopod- *Buddelundia* \`BIS536\` (also collected at Yandi),
- Isopod- *Buddelundia* \`BIS539\` (only known from Ministers North) and
- Isopod- *Laevophiloscia* \`BIS522\` (also collected at Yandi).

The vast majority of Confirmed, Potential and Uncertain SRE species were collected from the Undulating Low Hills habitat which makes up most of the available habitat within the Study Area (see Section 5.3). Additionally, this habitat accounted for 45 % of the survey effort which may explain the high numbers of collected SREs within this habitat type. Species collected in widespread habitats are perceived to have widespread distributions but it is not uncommon for different species to occupy only part of a widespread habitat (Harvey 2002; Harvey *et al.* 2011; Rix *et al.* 2015). Minor Drainage Lines and Gullies collected the next most numbers of Potential and Uncertain SRE species, despite making up a smaller percentage of both available habitat (3 % and 11% respectively) and survey effort (20 % and 13%) in the Study Area. This maybe reflective of the greater environmental heterogeneity providing more microhabitats for SRE species.

References

Beard, J.S. (1975) The vegetation survey of Western Australia. *Plant Ecology* **30**, 179-187.

Bennelongia (2023) Yandi Operations short-range endemic fauna survey report (draft). 609, Perth, 96 pp.

Biologic (2013) Yandi Mine short-range endemic invertebrate survey and impact assessment. Biologic Environmental Survey, Perth, 148 pp.

Biologic (2015) Yandi tenement short-range endemic invertebrate survey. Perth, 120 pp.

Biologic (2016) Ministers North short-range endemic invertebrate survey. Biologic Environmental Survey, Perth, 50 pp.

Biologic (2018a) Marillana and Marillana Corridor SRE invertebrate fauna survey. Biologic Environmental Survey, Perth, 66 pp.

Biologic (2018b) Ministers North to Yandi Corridor SRE invertebrate fauna survey. Perth, 58 pp.

Biologic (2021) Ministers North and Yandicoogina Creek short-range endemic invertebrate fauna survey. Biologic, Perth, 79 pp.

Biota (2011) Area C and Surrounds Short Range Endemic Invertebrate Fauna Survey. Biota, Leederville, WA, 213 pp.

Biota (2013a) A survey of the short range endemic invertebrate fauna of South Flank to Jinidi. Biota Environmental Sciences, Leederville, 125 pp.

Biota (2013b) Targeted survey for short range endemic fauna in the Marillana survey area. Biota Environmental Sciences, Leederville, 189 pp.

Biota (2013c) Targeted Survey for Short Range Endemic Fauna in the Mudlark Survey Area. Biota, Leederville, WA, 135 pp.

Biota (2014) A survey of the Short Range Endemic Invertebrate Fauna of Area C West to Yandi. Biota, Leederville, WA, 90 pp.

Biota Environmental Sciences (2011a) Short range endemic invertebrate survey - South Flank. Biota Environmental Sciences, Leederville, 128 pp.

Biota Environmental Sciences (2011b) South Flank targeted millipede survey. Biota Environmental Sciences, Leederville, 6 pp.

BOM (2023a) Climate Statistics for Australian Locations - Newman Aero. http://www.bom.gov.au/jsp/ncc/cdio/weatherData/av?p_nccObsCode=136&p_display_type=dailyDataFile&p_startYear=&p_c=&p_stn_num=007176.

BOM (2023b) Long Range Weather and Climate. http://www.bom.gov.au/climate/index.shtml.

Budde-Lund, G., 1907. Oniscoidea, nachgelassenes fragment. In: W Michaelsen, F Hamburger Südwest-Australische, R Hartmeyer and W Michaelsen (Eds.), Die Fauna südwest-Australiens. Ergebnisse der Hamburger südwest-australischen Forschungsreise 1905. G. Fischer, Copanhagen.

Budde-Lund, G. (1912) No. XXII.—TERRESTRIAL ISOPODA, PARTICULARLY CONSIDERED IN RELATION TO THE DISTRIBUTION OF THE SOUTHERN INDO-PACIFIC SPECIES*. *Transactions of the Linnean Society of London. 2nd Series: Zoology* **15**, 367-394.

DEC (2013) Definitions, categories and criteria for threatened and priority ecological communities. Government of Western Australia, Perth.

DPIRD (2018) Rangeland land system mapping Western Australia. In '.' April 2018 edn. (Ed. DPIRD): Western Australia)

Durrant, B.J. (2011) Short-range endemism in the Central Pilbara. Department of Environment and Conservation, Woodvale, 33 pp.

EPA (2016) Technical Guidance - Sampling of short range endemic invertebrate fauna. Environmental Protection Authority, Perth, WA, 35 pp.

EPA (2018) Statement of Environmental Principles, Factors and Objectives. Environmental Protection Authority, Perth, WA, 6 pp.

EPA (2023) Statement of environmental pricipalsm factors, objectives and aims of EIA. EPA, Joondalup, 11 pp.

Fet, V., Sissom, W.D., Lowe, G., and Braunwalder, M.E., 2000. Catalog of the Scorpions of the World (1758-1998). New York Entomological Society, New York.

Harms, D., and Framenau, V.W. (2013) New species of mouse spiders (Araneae: Mygalomorphae: Actinopodidae: Missulena) from the Pilbara region, Western Australia. *Zootaxa* **3637**, 521-540.

Harvey, M.S. (1985) The systematics of the famly Sternophoridae (Pseudoscorpionida). *Journal of Arachnology* **13**, 141-209.

Harvey, M.S. (2002) Short-range endemism amongst the Australian fauna: some examples from non-marine environments. *Invertebrate Systematics* **16**, 555-570.

Harvey, M.S., and Leng, M.C. (2008) The first troglomorphic pseudoscorpion of the family Olpiidae (Pseudoscorpiones), with remarks on the composition of the family. *Records of the Western Australian Museum* **24**, 387-394.

Harvey, M.S., Rix, M.G., Framenau, V.W., Hamilton, Z.R., Johnson, M.S., Teale, R.J., Humphreys, G., and Humphreys, W.F. (2011) Protecting the innocent: studying short-range endemic taxa enhances conservation outcomes. *Invertebrate Systematics* **25**, 1-10.

Hopper, S.D., Harvey, M.S., Chappill, J.A., Main, A.R., and Main, B.Y., 1996. The Western Australian biota as Gondwanan heritage - a review. In: SD Hopper, JA Chappill, MS Harvey and A George (Eds.), Gondwanan heritage: past, present and future of the Western Australian biota. Surrey Beatty & Sons, Sydney, pp. 1-46.

Hortal, J., Triantis, K.A., Meiri, S., Thébault, E., and Sfenthourakis, S. (2009) Island species richness increases with habitat diversity. *The American Naturalist* **174**, E205-E217.

Judd, S. (2004) Terrestrial isopods (Crustacea: Oniscidea) and biogeographical patterns from south-western Australia. B. Sc. (Hons.), Edith Cowan University, Joondalup, WA

Judd, S., and Tati, S. (2011) Preliminary taxonomy and biogeography of the subfamily Buddelundiinae Vandel (Armadillidae) in Western Australia. In 'Proceedings of 8th International Symposium of Terrestrial Isopod Biology, 19-23 June 2011, Bled, Slovenia.')

Koch, L.E. (1977) The taxonomy, geographic distribution and evolutionary radiation of Australo-Papuan scorpions. *Records of the Western Australian Museum* **5**, 83-367.

Outback Ecology (2008) Area C Mining Operation Environmental Management Plan (Revision 4) A, D, P1 and P3 Deposits: Terrestrial Invertebrate Short-Range Endemic Assessment. Outback Ecology Services, Jolimont, WA, 90 pp.

Raven, R.J. (1994) Mygalomorph spiders of the Barychelidae in Australia and the Western Pacific. *Memoirs of the Queensland Museum* **35**, 291-706.

Richter, V., and Freegard, C. (2009) Dry pitfall trapping for vertebrates and invertebrates. *Standard Operating Procedure*.

Rix, M.G., Edwards, D.L., Byrne, M., Harvey, M.S., Joseph, L., and Roberts, J.D. (2015) Biogeogaphy and speciation of terrestrial fauna in the south-western Australian biodiversity hotspot. *Biological Reviews* **90**, 762-793.

Stein, A., Gerstner, K., and Kreft, H. (2014) Environmental heterogeneity as a universal driver of species richness across taxa, biomes and spatial scales. *Ecology letters* **17**, 866-880.

Subterranean Ecology (2013) Mainline Rail Expansion Project Short Range Endemic Invertebrate Fauna Survey. Subterranean Ecology, Stirling, WA, 263 pp.

Thackway, R., and Cresswell, I.D. (Eds) (1995) 'An Interim biogeographic regionalisation for Australia: A framework for establishing the national system of reserves, Version 4.0.' (Australian Nature Conservation Agency: Canberra)

Thorne, A.M., and Tyler, I.M. (1997) Explanatory notes: Roy Hill 1:250 000 sheet, Western Australia, second edition (2nd edition). 29.

Volschenk, E.S., Burbidge, A.H., Durrant, B.J., and Harvey, M.S. (2010) Spatial distribution patterns of scorpions (Scorpiones) in the arid Pilbara region of Western Australia. A Biodiversity Survey of the Pilbara Region of Western Australia, 2002 – 2007. Records of the Western Australian Museum, Perth, WA, 271–284 pp. pp.

Volschenk, E.S., Harvey, M.S., and Prendini, L. (2012) A new species of *Urodacus* (Scorpiones: Urodacidae) from Western Australia. *American Museum Novitates* **3748**, 1-18.

Volschenk, E.S., Smith, G.T., and Harvey, M.S. (2000) A new species of *Urodacus* from Western Australia, with additional descriptive notes for *Urodacus megamastigus* (Scorpiones). *Records of the Western Australian Museum* **20**.

Wahrberg, R. (1922) Terrestre Isopoden aus Australien. Results of Dr. E. M, Jöberg's Swedish Scientific Expeditions to Australia, 1910–13. No. 30. *Ark. Zool* **15**, 1-298.

Appendix 1: Survey site coordinates.

Site	Latitude	Longitude
MN01	-22.7639	119.0562
MN02	-22.7667	119.0605
MN03	-22.776	119.0609
MN04	-22.7804	119.076
MN05	-22.7843	119.0751
MN06	-22.7886	119.076
MN07	-22.7867	119.0868
MN08	-22.7916	119.0932
MN09	-22.7977	119.091
MN10	-22.8186	119.0889
MN11	-22.8118	119.0822
MN12	-22.8036	119.1015
MN13	-22.805	119.1188
MN14	-22.8165	119.1126
MN15	-22.8159	119.0965
MN16	-22.8085	119.0766
MN17	-22.8127	119.0784
MN18	-22.7893	119.091
MN19	-22.8245	119.0995
MN20	-22.8284	119.1181
MN21	-22.8425	119.1046
MN22	-22.8411	119.1244
MN23	-22.833	119.1271
MN24a	-22.8391	119.1326
MN24b	-22.8389	119.1328
MN25	-22.8374	119.1429
MN26	-22.8353	119.1438
MN27	-22.8321	119.1363
MN28	-22.8288	119.1445
MN29	-22.8199	119.1445
MN30	-22.8157	119.1435

Appendix 2. Site photos.

Site	Photo 1	Photo 2	Landform	Veg Condition	Slope	Slope Aspect	Fire
MN01							
			Sandy/Stony Plain	Good	Low	South/East	Old (6+ yr)
MN02							
			Minor Drainage Line	Good	Flat		Old (6+ yr)

Site	Photo 1	Photo 2	Landform	Veg Condition	Slope	Slope Aspect	Fire
MN03							
			Sandy/Stony Plain	Very Good	Flat		Old (6+ yr)
MN04							
			South Facing Slope	Good	Steep	South/East	Old (6+ yr)

Site	Photo 1	Photo 2	Landform	Veg Condition	Slope	Slope Aspect	Fire
MN05			Major Drainage Line	Very Good	Low	South/West	Old (6+ yr)
MN06			Minor Drainage Line	Good	Low	North	Old (6+ yr)

Site	Photo 1	Photo 2	Landform	Veg Condition	Slope	Slope Aspect	Fire
MN07							
			Minor Drainage Line	Very Good	Low	North	Moderate (3 to 5 yr)
MN08							
			Sandy/Stony Plain	Poor	Low	West	Old (6+ yr)

Site	Photo 1	Photo 2	Landform	Veg Condition	Slope	Slope Aspect	Fire
MN09			Shallow Gully	Good	Moderate	North/East	Old (6+ yr)
MN10			Gully	Very Good	Moderate	South/East	Old (6+ yr)

Site	Photo 1	Photo 2	Landform	Veg Condition	Slope	Slope Aspect	Fire
MN11							
			Minor Drainage Line	Good	Low	North	Old (6+ yr)
MN12							
			Medium Drainage Line	Good	Low	North	Old (6+ yr)

Site	Photo 1	Photo 2	Landform	Veg Condition	Slope	Slope Aspect	Fire
MN13			Medium Drainage Line	Very Good	Flat		Old (6+ yr)
MN14			Sandy/Stony plain	Poor	Low	North/East	Old (6+ yr)

Site	Photo 1	Photo 2	Landform	Veg Condition	Slope	Slope Aspect	Fire
MN15							
			Sandy/Stony Plain	Poor	Flat		Old (6+ yr)
MN16							
			Sandy/Stony Plain	Very Good	Low	South	Old (6+ yr)

Site	Photo 1	Photo 2	Landform	Veg Condition	Slope	Slope Aspect	Fire
MN17							
			Sandy/Stony Plain	Good	Steep	South	Old (6+ yr)
MN18							
			South Facing Slope	Very Good	Steep	South	Old (6+ yr)

Site	Photo 1	Photo 2	Landform	Veg Condition	Slope	Slope Aspect	Fire
MN19							
			Sandy/Stony Plain	Good	Moderate	South/East	Old (6+ yr)
MN20							
			Sandy/Stony Plain	Good	Low	South	Old (6+ yr)

Site	Photo 1	Photo 2	Landform	Veg Condition	Slope	Slope Aspect	Fire
MN21			Sandy/Stony PLain	Good	Moderate	South	Old (6+ yr)
MN22			Sandy/Stony Plain	Poor	Moderate	South	Old (6+ yr)

Site	Photo 1	Photo 2	Landform	Veg Condition	Slope	Slope Aspect	Fire
MN23			Sandy/Stony Plain	Good	Moderate	South	Old (6+ yr)
MN24a			Gully	Good	Steep	South	Old (6+ yr)

Site	Photo 1	Photo 2	Landform	Veg Condition	Slope	Slope Aspect	Fire
MN24b			Sandy/Stony Plain	Good	Flat		Old (6+ yr)
MN25			Minor Drainage Line	Good	Low	North/West	Old (6+ yr)

Site	Photo 1	Photo 2	Landform	Veg Condition	Slope	Slope Aspect	Fire
MN26							
			Sandy/Stony PLain	Poor	Low	West	Old (6+ yr)
MN27							
			Major Drainage Line	Good	Flat		Old (6+ yr)

Site	Photo 1	Photo 2	Landform	Veg Condition	Slope	Slope Aspect	Fire
MN28			Gorge	Very Good	Low	North/East	Old (6+ yr)
MN29			Minor Drainage Line	Good	Flat		Old (6+ yr)

Site	Photo 1	Photo 2	Landform	Veg Condition	Slope	Slope Aspect	Fire
MN30							
			Sandy/Stony Plain	Good	Flat		Old (6+ yr)

Appendix 3: List of species recorded in databases and reports.

Higher Order Identification	Lowest Identification	Number of Specimens	Previous SRE Status
Mollusca	Mollusca sp.	8	
Gastropoda	Gastropoda sp.	48	
Stylommatophora			
Bothriembryontidae	*Bothriembryon* \`Pilbara\` n.sp.	363	
	Bothriembryon sp.	3	Potential SRE
Punctidae	*Paralaoma* sp.	1	
Pupillidae	Pupillidae sp.	52	
	cf. *Pupisoma* sp.	2	
	Gastrocopta hedleyi	3	
	Gastrocopta larapinta	40	
	Gastrocopta mussoni	218	
	Gastrocopta sp.	34	
	Pupoides beltianus	26	
	Pupoides cf. *beltianus*	13	
	Pupoides cf. *eremicolus*	14	
	Pupoides pacificus	17	
	Pupoides cf. *pacificus*	6	
	Pupoides lepidulus	7	
	Pupoides sp.	12	
Subulinidae	Subulinidae sp.	23	
	Allopeas sp.	1	
	Eremopeas interioris	91	
Succineidae	Succineidae sp.	1	Potential SRE
	Austrosuccinea australis	2	
	Austrosuccinea sp.	1	
Charopidae	*Discocharopa aperta*	1	
Arthropoda			
Arachnida			
Scorpiones	Scorpiones sp.	8	
Buthidae	Buthidae sp.	8	
	Isometroides \`SCO025, pilbara 1\`	4	
	Isometroides sp.	3	
	Lychas \`adonis\`	17	
	Lychas \`austroccidentalis?\`	1	
	Lychas \`Biologic-SCOR001\`	2	Potential SRE
	Lychas \`BSCO056\`	14	
	Lychas \`BSCO058\`	1	
	Lychas \`BSCO088\` \`pilbara1 group\`	1	
	Lychas \`hairy tail group\`	96	Potential SRE
	Lychas \`harveyi group\`	14	

Higher Order Identification	Lowest Identification	Number of Specimens	Previous SRE Status
	Lychas `mjobergi?`	1	
	Lychas `pilbara 1`	22	
	Lychas `racing stripe`	2	
	Lychas `sp. 1`	2	
	Lychas `sp. 2`	1	
	Lychas `sp. 3`	13	
	Lychas `sp. 4`	8	
	Lychas `sp. 6`	1	
	Lychas annulatus group	14	Potential SRE
	Lychas bituberculatus group	18	Potential SRE
	Lychas jonesae	2	
	Lychas sp.	49	
Urodacidae	*Urodacus* `BSCO045`	3	
	Urodacus `butleri group`	2	
	Urodacus `firetail`	19	Potential SRE
	Urodacus `HD1`	1	
	Urodacus `megamastigus grp`	6	
	Urodacus `pilbara 8`	2	
	Urodacus `sp. 1`	1	
	Urodacus `sp. 9`	17	
	Urodacus sp.	14	Potential SRE
Pseudoscorpiones	Pseudoscorpiones sp.	160	
Atemnidae	*Oratemnus* `BPS502`	4	
	Oratemnus `BPS503`	1	
	Oratemnus sp.	32	
Cheiridiidae	Cheiridiinae sp.	1	
	`PSEAAA` sp.	4	
Chernetidae	Chernetidae sp.	6	
	`PSEAAF` sp.	1	
	Austrochernes `PSE072`	5	
	Austrochernes sp.	1	
	Haplochernes sp. 1	105	
	Haplochernes sp. 2	57	
	Haplochernes sp.	13	
	Nesidiochernes sp.	1	
	Sundochernes `PSE090`	1	Potential SRE
	Troglochernes sp.	1	Potential SRE
Chthoniidae	Chthoniidae sp.	1	
	Austrochthonius `BPS507`	10	
	Austrochthonius `pilbara`	1	
	Austrochthonius `PSE135, pilbara`	10	
	Austrochthonius sp.	8	Potential SRE
	Tyrannochthonius aridus	27	

Higher Order Identification	Lowest Identification	Number of Specimens	Previous SRE Status
	Tyrannochthonius \`aridus?\`	1	
Garypidae	*Synsphyronus* \`BPS511\`(*lathrius*?)	10	
	Synsphyronus \`paradoxus complex\`	12	
	Synsphyronus \`PSE014\`	7	Potential SRE
	Synsphyronus heptatrichus	16	
	Synsphyronus xynus	61	
	Synsphyronus sp.	9	
Garypinidae	*Solinus* sp.	17	
Olpiidae	Olpiidae sp.	159	Potential SRE
	Olpiidae \`Helix-PO009\`	1	
	Olpiidae \`Helix-PO016\`	2	
	Olpiidae sp. MA	2	
	Austrohorus \`BPS508\`	12	
	Austrohorus \`BPS509\`	1	
	Austrohorus \`M1\`	2	
	Austrohorus \`M2\`	1	
	Austrohorus \`PSE119\`	18	
	Austrohorus \`PSE121\`	10	Potential SRE
	Austrohorus \`PSE122\`	5	Potential SRE
	Austrohorus \`PSE126\`	1	
	Austrohorus sp.	49	Potential SRE
	Beierolpium \`M1\`	1	
	Beierolpium sp. 1	34	
	Beierolpium 8/2 \`BPS521\`	1	
	Beierolpium 8/2 sp.	4	
	Beierolpium 8/3 sp.	42	
	Beierolpium 8/4 \`BPS505\`	13	
	Beierolpium 8/4 small sp.	3	
	Beierolpium 8/4 sp.	107	
	Beierolpium sp.	88	
	Beierolpium? sp.	1	
	Euryolpium sp.	22	Potential SRE
	Indolpium \`PSE118\`	6	Potential SRE
	Indolpium \`PSE123\`	19	Potential SRE
	Indolpium \`PSE124\`	1	
	Indolpium \`PSE125\`	11	
	Indolpium sp.	569	
	Olpiidae Genus 7/4 \`PSE118\`	2	
	Olpiidae Genus 7/4 \`PSE176\`	4	
	Olpiidae Genus 7/4 sp.	58	
	Xenolpium \`Biologic-PSEU028\`	2	Potential SRE
	Xenolpium \`BPS510\`	5	

Higher Order Identification	Lowest Identification	Number of Specimens	Previous SRE Status
	Xenolpium `PSE033`	4	Potential SRE
	Xenolpium `PSE120`	2	
	Xenolpium sp. 1	43	
	Xenolpium sp. 2	1	
	Xenolpium sp.	99	
Sternophoridae	*Afrosternophorus* `BPS506`	2	
	Afrosternophorus sp. 1	27	
	Afrosternophorus sp.	24	
Cheliferidae	Cheliferidae `BPS504`	11	
Araneae	Araneae sp.	2	
	Mygalomorphae sp.	28	
Actinopodidae	*Missulena* `A3`	1	
	Missulena `MYG045`	17	
	Missulena `MYG253`	1	
	Missulena `MYG311-DNA`	1	
	Missulena davidi	4	
	Missulena faulderi	3	Confirmed SRE
	Missulena langlandsi	4	Confirmed SRE
	Missulena rutraspina	2	
	Missulena sp.	6	Potential SRE
Anamidae	Anamidae sp.	9	
	Anaminae sp.	7	
	Aname `marillana grp`	9	
	Aname `mellosa group`	6	
	Aname `MYG004`	7	
	Aname `MYG098` (or *Kwonkan*)	2	
	Aname `MYG104`	1	Potential SRE
	Aname `MYG195`	1	Potential SRE
	Aname `MYG321-DNA`	2	
	Aname `MYG322`	9	
	Aname `MYG323`	1	Potential SRE
	Aname `MYG336`	2	Confirmed SRE
	Aname `MYG339`	3	
	Aname `MYG340`	1	
	Aname `MYG370`	1	
	Aname `MYG377`	2	
	Aname mellosa	234	
	Aname whitei	24	
	Aname sp.	84	Potential SRE
	Chenistonia (*Kwonkan*) `MYG088`	3	
	Kwonkan `MYG006`	26	
	Kwonkan `MYG033`	6	

Higher Order Identification	Lowest Identification	Number of Specimens	Previous SRE Status
	Kwonkan `MYG195`	39	
	Kwonkan `MYG197`	2	
	Kwonkan `MYG321`	1	
	Kwonkan `MYG325`	6	
	Kwonkan `MYG337`	5	
	Kwonkan `MYG338`	4	
	Kwonkan `MYG339`	3	
	Kwonkan `MYG340`	2	
	Kwonkan `MYG341`	3	
	Kwonkan `MYG378`	2	Confirmed SRE
	Kwonkan `MYG379`	9	
	Kwonkan `MYG484`	8	
	Kwonkan `MYG648`	2	
	Kwonkan `MYG683`	1	Potential SRE
	Kwonkan `MYG324-DNA`	3	Confirmed SRE
	Kwonkan sp.	63	
	Swolnpes `MYG234`	1	
	Teyl `MYG027`	2	
Barychelidae	Barychelidae sp.	9	Potential SRE
	Aurecocrypta `chichester`	1	Potential SRE
	Aurecocrypta `HD1`	1	
	Aurecocrypta `MYG057`	2	
	Aurecocrypta `MYG246`	1	Confirmed SRE
	Aurecocrypta `MYG315`	1	
	Aurecocrypta `MYG316`	10	
	Aurecocrypta `MYG316-DNA`	2	
	Aurecocrypta `MYG317`	2	
	Aurecocrypta sp.	4	
	Aurecocrypta? sp.	1	
	Idiommata sp.	3	
	Synothele `MYG127`	9	
	Synothele `MYG309`	3	Confirmed SRE
	Synothele `MYG311`	4	
	Synothele `xkarara`	3	
	Synothele sp.	5	Potential SRE
Idiopidae	Idiopidae sp.	8	
	Eucyrtops sp.	2	
	Gaius tealei	5	
	Idiosoma `MYG083`	2	
	Idiosoma `MYG286`	1	
	Idiosoma `MYG384`	5	
	Idiosoma sp.	37	
	Idiosoma? sp.	6	

Higher Order Identification	Lowest Identification	Number of Specimens	Previous SRE Status
Halonoproctidae	*Conothele* \`BMYG220\`	1	
	Conothele \`MYG002\`	6	
	Conothele \`MYG279\`	8	Confirmed SRE
	Conothele \`MYG280\`	10	
	Conothele \`MYG282\`	39	Confirmed SRE
	Conothele \`MYG533\`	1	
	Conothele \`MYG534\`	1	
	Conothele \`MYG539\`	2	
	Conothele sp.	2	
Theraphosidae	Theraphosidae sp.	1	
Selenopidae	Selenopidae sp.	30	
	Karaops \`ARA001\`	17	Potential SRE
	Karaops \`ARA002\`	1	Potential SRE
	Karaops banyjima	5	
	Karaops nyangumarta	3	
	Karaops sp.	113	Potential SRE
	Karaops? sp.	8	
Opiliones	Opiliones sp.	2	
Malacostraca			
Isopoda	Isopoda sp.	168	
Armadillidae	Armadillidae sp.	32	
	?*Hybodillo* sp. B03	5	
	Acanthodillo \`BIS523\`	2	
	Acanthodillo \`BIS524\`	1	
	Acanthodillo sp.	3	
	Buddelundia \`10ma\`	9	Potential SRE
	Buddelundia \`14\`	4	Potential SRE
	Buddelundia \`48\`	9	Potential SRE
	Buddelundia \`49\`	7	Potential SRE
	Buddelundia \`BIS374\`	68	
	Buddelundia \`BIS375\`	9	
	Buddelundia \`BIS391\`	1	
	Buddelundia \`BIS520\`	193	
	Buddelundia \`BIS521\`	3	
	Buddelundia \`BIS536\`	2	
	Buddelundia \`sp. 15\`	8	Potential SRE
	Buddelundia \`sp. 16?\`	1	
	Buddelundia \`sp. 16\`	12	
	Buddelundia \`sp. 77\`	2	
	Buddelundia sp. B07	5	
	Buddelundia sp.	223	Potential SRE
	Buddelundia? sp.	1	
	Pseudodiploexochus sp.	1	

Higher Order Identification	Lowest Identification	Number of Specimens	Previous SRE Status
	Troglarmadillo sp.	2	
Oniscidae	Oniscidae sp.	1	
Philosciidae	Philosciidae sp.	44	Potential SRE
	Laevophiloscia `BIS522`	26	
Chilopoda	Chilopoda sp.	12	
Geophilida	Geophilida sp.	21	
Chilenophilidae	Chilenophilidae sp.	9	Potential SRE
	Sepedonophilus `HD1`	2	
	Sepedonophilus sp.	1	
Geophilidae	Geophilidae sp.	15	
	Geophilidae sp. B01	2	
Mecistocephalidae	*Mecistocephalus* `HD1`	2	
	Mecistocephalidae sp.	20	Potential SRE
Oryidae	Oryidae sp.	1	
Scolopendrida	Scolopendrida sp.	37	
Cryptopidae	Cryptopidae sp.	2	
	Cryptops australis	1	
	Cryptops sp.	13	Potential SRE
Scolopendridae	*Arthrorhabdus paucispinus*	2	
	Cormocephalus aurantiipes	2	
	Cormocephalus michaelseni	3	
	Cormocephalus similis	3	
	Cormocephalus strigosus	1	
	Cormocephalus turneri	13	
	Cormocephalus westangelasensis	2	
	Cormocephalus sp.	1	
	Ethmostigmus curtipes	9	
	Notiasemus glauerti	2	
	Scolopendra laeta	48	
	Scolopendra morsitans	146	
	Scolopendra sp.	28	
Scutigeromorpha	Scutigeromorpha sp.	21	
Scutigeridae	Scutigeridae sp.	9	
	Thereuoneminae sp.	1	
	Allothereua sp.	1	
	Pesvarus sp.	3	
	Pilbarascutigera incola	39	
	Pilbarascutigera sp.	1	
	Thereuopodina sp.	2	
Diplopoda	Diplopoda sp.	2	
Polydesmida			
Dalodesmidae	Dalodesmidae sp.	6	

Higher Order Identification	Lowest Identification	Number of Specimens	Previous SRE Status
Paradoxosomatidae	*Antichiropus* `DIP006, Area C, species1`	4	Potential SRE
	Antichiropus `DIP007, Area C, species2`	2	Potential SRE
	Antichiropus `DIP173, danberrin5`	2	
	Antichiropus cirratus	21	
	Antichiropus pendiculus	25	Potential SRE
	Antichiropus sp.	24	Potential SRE
Polyxenida	Polyxenida sp.	86	
	Polyxenida sp. S05	14	
Lophoproctidae	Lophoproctidae sp.	2	
Polyxenidae	Polyxenidae sp.	1168	
	Unixenus `mjoebergi complex`	6	
	Unixenus attemsi	4	
	Unixenus sp.	134	
Synxenidae	*Phryssonotus novaehollandiae*	39	
	Phryssonotus sp.	5	
Polyzoniida	Polyzoniida sp.	1	
Spirobolida	Spirobolida sp.	2	Potential SRE
Trigoniulidae	Trigoniulidae sp.	4	
	Austrostrophus `clade A NGQ-2020`	3	
	Austrostrophus `clade A`	2	
	Austrostrophus `clade E`	2	
	Austrostrophus `DIP018`	4	
	Austrostrophus stictopygus	87	Potential SRE
	Austrostrophus sp.	95	Potential SRE
Spirostreptida	Spirostreptida sp.	14	

Appendix 4: Collected specimens from the 2023 field survey.

Site Name	Latitude	Longitude	Lowest Identification	Number of specimens	SRE Status
MN01	-22.76392	119.05621	*Buddelundia* `BIS520`	1	Uncertain (Data Deficient)
MN01	-22.76392	119.05621	*Scolopendra morsitans*	1	Not SRE (Widespread)
MN01	-22.76392	119.05621	Scutigeridae sp.	1	Not SRE (Widespread)
MN02	-22.76674	119.06045	*Lychas* `BSCO088` `pilbara1 group`	1	Potential SRE
MN02	-22.76674	119.06045	Olpiidae Genus 7/4 `BPS525`	1	Uncertain (Data Deficient)
MN02	-22.76674	119.06045	*Scolopendra morsitans*	2	Not SRE (Widespread)
MN02	-22.76674	119.06045	*Scolopendra* sp.	2	Higher Order
MN03	-22.77595	119.06091	*Beierolpium* 8/4 `BPS522`	2	Uncertain (Data Deficient)
MN03	-22.77595	119.06091	*Buddelundia* `BIS520`	4	Uncertain (Data Deficient)
MN03	-22.77595	119.06091	*Indolpium* `BPS528`	1	Uncertain (Data Deficient)
MN03	-22.77595	119.06091	*Scolopendra morsitans*	1	Not SRE (Widespread)
MN04	-22.78044	119.076	*Buddelundia* `BIS374`	1	Uncertain (Data Deficient)
MN04	-22.78044	119.076	*Karaops* cf. *banyjima*	1	Not SRE (Widespread)
MN04	-22.78044	119.076	*Scolopendra morsitans*	2	Not SRE (Widespread)
MN05	-22.78426	119.07507	*Lychas* `BSCO056`	1	Uncertain (Data Deficient)
MN05	-22.78426	119.07507	Olpiidae Genus 7/4 `BPS525`	1	Uncertain (Data Deficient)
MN05	-22.78426	119.07507	*Scolopendra morsitans*	1	Not SRE (Widespread)
MN05	-22.78426	119.07507	*Urodacus* `BSCO045`	5	Uncertain (Data Deficient)

Site Name	Latitude	Longitude	Lowest Identification	Number of specimens	SRE Status
MN05	-22.78426	119.07507	*Urodacus* sp.	1	Higher Order
MN07	-22.78674	119.08683	*Beierolpium* 8/3 `BPS527`	2	Uncertain (Data Deficient)
MN07	-22.78674	119.08683	*Scolopendra morsitans*	1	Not SRE (Widespread)
MN09	-22.79772	119.09096	*Buddelundia* `BIS539`	1	Potential SRE
MN09	-22.79772	119.09096	*Indolpium* `BPS526`	3	Uncertain (Data Deficient)
MN10	-22.81859	119.08889	*Aname mellosa*	1	Not SRE (Widespread)
MN10	-22.81859	119.08889	*Aurecocrypta* `MYG316`	1	Uncertain (Data Deficient)
MN10	-22.81859	119.08889	*Buddelundia* `BIS520`	3	Uncertain (Data Deficient)
MN10	-22.81859	119.08889	*Scolopendra morsitans*	3	Not SRE (Widespread)
MN11	-22.81177	119.08217	*Austrostrophus* sp.	1	Higher Order
MN11	-22.81177	119.08217	*Austrostrophus stictopygus*	1	Not SRE (Widespread)
MN11	-22.81177	119.08217	*Buddelundia* `BIS520`	3	Uncertain (Data Deficient)
MN11	-22.81177	119.08217	*Buddelundia* `BIS536`	1	Potential SRE
MN11	-22.81177	119.08217	*Colobopleurus* `BSCOL102`	1	Not SRE (Widespread)
MN11	-22.81177	119.08217	*Cormocephalus rubriceps*	1	Not SRE (Widespread)
MN11	-22.81177	119.08217	*Cormocephalus* sp.	1	Higher Order
MN11	-22.81177	119.08217	*Cryptops* sp.	1	Higher Order
MN11	-22.81177	119.08217	*Eremopeas interioris*	2	Not SRE (Widespread)
MN11	-22.81177	119.08217	Geophilidae sp.	1	Not SRE (Widespread)
MN11	-22.81177	119.08217	Olpiidae Genus 7/4 `BPS525`	2	Uncertain (Data Deficient)
MN11	-22.81177	119.08217	*Scolopendra morsitans*	1	Not SRE (Widespread)
MN11	-22.81177	119.08217	*Scolopendra* sp.	1	Higher Order

Site Name	Latitude	Longitude	Lowest Identification	Number of specimens	SRE Status
MN11	-22.81177	119.08217	*Urodacus* `BSCO045`	1	Uncertain (Data Deficient)
MN12	-22.80356	119.10148	*Buddelundia* `BIS520`	2	Uncertain (Data Deficient)
MN12	-22.80356	119.10148	*Laevophiloscia* `BIS522`	1	Potential SRE
MN12	-22.80356	119.10148	*Lychas* `BSCO058`	2	Not SRE (Widespread)
MN12	-22.80356	119.10148	*Mecistocephalus* `BGE075`	3	Not SRE (Widespread)
MN14	-22.81649	119.11258	*Austrohorus* `BPS524`	1	Potential SRE
MN14	-22.81649	119.11258	*Buddelundia* `BIS374`	1	Uncertain (Data Deficient)
MN14	-22.81649	119.11258	*Lychas* `BSCO056`	1	Uncertain (Data Deficient)
MN14	-22.81649	119.11258	*Mecistocephalus* `BGE075`	1	Not SRE (Widespread)
MN14	-22.81649	119.11258	Olpiidae Genus 7/4 `BPS525`	6	Uncertain (Data Deficient)
MN15	-22.81593	119.09648	*Antichiropus* sp.	1	Uncertain (Data Deficient)
MN15	-22.81593	119.09648	*Buddelundia* `BIS520`	6	Uncertain (Data Deficient)
MN15	-22.81593	119.09648	*Buddelundia* `BIS536`	3	Potential SRE
MN15	-22.81593	119.09648	*Cormocephalus similis*	1	Not SRE (Widespread)
MN15	-22.81593	119.09648	*Laevophiloscia* `BIS522`	1	Potential SRE
MN15	-22.81593	119.09648	*Lychas* `BSCO056`	1	Uncertain (Data Deficient)
MN15	-22.81593	119.09648	Mecistocephalidae sp.	2	Higher Order
MN15	-22.81593	119.09648	Olpiidae Genus 7/4 `BPS525`	5	Uncertain (Data Deficient)
MN15	-22.81593	119.09648	*Scolopendra morsitans*	2	Not SRE (Widespread)
MN15	-22.81593	119.09648	Scutigeridae sp.	1	Not SRE (Widespread)

Site Name	Latitude	Longitude	Lowest Identification	Number of specimens	SRE Status
MN16	-22.80852	119.0766	*Cryptops spinipes*	1	Not SRE (Widespread)
MN16	-22.80852	119.0766	Olpiidae Genus 7/4 `BPS525`	1	Uncertain (Data Deficient)
MN16	-22.80852	119.0766	*Scolopendra morsitans*	1	Not SRE (Widespread)
MN17	-22.81269	119.07836	*Aurecocrypta* `MYG316`	1	Uncertain (Data Deficient)
MN17	-22.81269	119.07836	*Austrohorus* `BPS524`	2	Potential SRE
MN17	-22.81269	119.07836	*Buddelundia* `BIS520`	2	Uncertain (Data Deficient)
MN17	-22.81269	119.07836	*Cormocephalus rubriceps*	1	Not SRE (Widespread)
MN17	-22.81269	119.07836	*Mecistocephalus* `BGE075`	3	Not SRE (Widespread)
MN17	-22.81269	119.07836	*Scolopendra morsitans*	1	Not SRE (Widespread)
MN17	-22.81269	119.07836	Scutigeridae sp.	2	Not SRE (Widespread)
MN17	-22.81269	119.07836	*Synsphyronus xynus*	2	Not SRE (Widespread)
MN18	-22.78934	119.09095	*Arthrorhabdus paucispinus*	1	Not SRE (Widespread)
MN18	-22.78934	119.09095	*Beierolpium* 8/4 `BPS522`	2	Uncertain (Data Deficient)
MN18	-22.78934	119.09095	*Buddelundia* `BIS520`	1	Uncertain (Data Deficient)
MN18	-22.78934	119.09095	*Indolpium* `BPS528`	1	Uncertain (Data Deficient)
MN19	-22.82453	119.09953	*Aurecocrypta* `MYG316`	1	Uncertain (Data Deficient)
MN19	-22.82453	119.09953	*Buddelundia* `BIS520`	1	Uncertain (Data Deficient)
MN19	-22.82453	119.09953	*Buddelundia* `BIS536`	1	Potential SRE
MN19	-22.82453	119.09953	*Orphnaeus brevilabiatus*	1	Not SRE (Widespread)
MN19	-22.82453	119.09953	*Phryssonotus* sp.	4	Higher Order

Site Name	Latitude	Longitude	Lowest Identification	Number of specimens	SRE Status
MN19	-22.82453	119.09953	*Urodacus* `BSCO045`	3	Uncertain (Data Deficient)
MN20	-22.82838	119.11812	*Austrohorus* `BPS524`	2	Potential SRE
MN20	-22.82838	119.11812	*Buddelundia* `BIS520`	3	Uncertain (Data Deficient)
MN20	-22.82838	119.11812	*Mecistocephalus* `BGE076`	1	Not SRE (Widespread)
MN20	-22.82838	119.11812	*Phryssonotus novaehollandiae*	1	Not SRE (Widespread)
MN23	-22.833	119.12714	*Beierolpium* 8/3 `BPS527`	1	Uncertain (Data Deficient)
MN23	-22.833	119.12714	*Buddelundia* `BIS520`	5	Uncertain (Data Deficient)
MN23	-22.833	119.12714	*Buddelundia* `BIS536`	1	Potential SRE
MN23	-22.833	119.12714	*Lychas* `BSCO056`	2	Uncertain (Data Deficient)
MN23	-22.833	119.12714	*Scolopendra morsitans*	1	Not SRE (Widespread)
MN24a	-22.8391	119.13261	*Arthrorhabdus mjobergi*	1	Not SRE (Widespread)
MN24a	-22.8391	119.13261	Scutigeridae sp.	1	Not SRE (Widespread)
MN24b	-22.83892	119.13278	*Missulena faulderi*	1	Confirmed SRE
MN24b	-22.83892	119.13278	*Synothele* `BMYG199`	1	Potential SRE
MN25	-22.83739	119.14292	*Indolpium* `BPS526`	1	Uncertain (Data Deficient)
MN25	-22.83739	119.14292	*Scolopendra morsitans*	1	Not SRE (Widespread)
MN25	-22.83739	119.14292	Scutigeridae sp.	2	Not SRE (Widespread)
MN25	-22.83739	119.14292	*Urodacus* `BSCO045`	1	Uncertain (Data Deficient)
MN27	-22.83208	119.13633	*Arthrorhabdus mjobergi*	1	Not SRE (Widespread)
MN27	-22.83208	119.13633	*Beierolpium* 8/3 `BPS527`	2	Uncertain (Data Deficient)

Site Name	Latitude	Longitude	Lowest Identification	Number of specimens	SRE Status
MN27	-22.83208	119.13633	*Buddelundia* `BIS520`	1	Uncertain (Data Deficient)
MN27	-22.83208	119.13633	*Scolopendra morsitans*	1	Not SRE (Widespread)
MN27	-22.83208	119.13633	*Scolopendra* sp.	1	Higher Order
MN29	-22.81991	119.14451	*Arthrorhabdus mjobergi*	1	Not SRE (Widespread)
MN29	-22.81991	119.14451	*Austrohorus* `BPS508`	1	Uncertain (Data Deficient)
MN29	-22.81991	119.14451	*Cryptops spinipes*	1	Not SRE (Widespread)
MN29	-22.81991	119.14451	*Scolopendra morsitans*	2	Not SRE (Widespread)
MN29	-22.81991	119.14451	*Urodacus* `BSCO045`	1	Uncertain (Data Deficient)
MN30	-22.81565	119.14349	*Afrosternophorus* `BPS529`	3	Potential SRE
MN30	-22.81565	119.14349	*Indolpium* `BPS526`	1	Uncertain (Data Deficient)
MN30	-22.81565	119.14349	*Lychas* `BSCO088` `pilbara1 group`	1	Potential SRE
MN30	-22.81565	119.14349	*Scolopendra morsitans*	1	Not SRE (Widespread)
MN30	-22.81565	119.14349	*Scolopendrida* sp.	1	Higher Order