Bennelongia Environmental Consultants

East Jimblebar Baseline Subterranean Fauna Survey

Prepared for:

BHP Western Australian Iron Ore

July 2021

Final Report

Short-Range Endemics | Subterranean Fauna

Waterbirds | Wetlands

East Jimblebar Baseline Subterranean Fauna Survey

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EXECUTIVE SUMMARY

The East Jimblebar area ('the Study Area') is located 50 km east of the town of Newman, immediately east of current mining operations at the BHP Western Australian Iron Ore (WAIO) Jimblebar hub. The Study Area encompasses the Hashimoto and East Jimblebar iron ore deposits. Any future mining at the iron ore deposits in the Study Area has the potential to impact the subterranean fauna communities occurring in this area in two ways. First, as a result of the direct removal of habitat during mine pit excavation. Second, as a result of groundwater drawdown associated with dewatering around the mine pits to enable mining below the water table.

BHP commissioned Bennelongia Environmental Consultants (Bennelongia) to prepare a subterranean fauna assessment to inform the future approvals process for mining. This report represents a baseline assessment that is general in nature for the Study Area as a whole, as no detailed developments are currently planned. The specific aims of this report are to: (1) provide a desktop assessment of previous records and literature to determine the likelihood, based on sub-regional information, of the Study Area supporting subterranean fauna, including conservation significant species and/or communities; (2) provide the results of a two-season subterranean fauna survey, covering parts of the Study Area that have not previously been sampled, and (3) to determine on the basis of current results and earlier work in the Study Area whether there are any species that may potentially be restricted to the Study Area.

A comprehensive review of previous subterranean fauna records was conducted for an area of approximately 100 x 100 km around the Study Area (final decimal degrees search area, top left: -22.9°S:119.7°E, bottom right -23.9°S:120.7°E). The desktop review identified at least 109 troglofauna species and 149 stygofauna species within the wider search area around the Study Area. This included 95 troglofauna species and 136 stygofauna species within Bennelongia's database (reflecting work previously commissioned by BHP), and an additional 14 troglofauna species and 13 stygofauna species from the database of the Western Australian Museum.

Two rounds of subterranean fauna sampling were conducted in 2020. Troglofauna were sampled by scraping and trapping, while stygofauna were sampled by net hauling in bores. Specimens were sorted in the laboratory and, as far as possible, all troglofauna and stygofauna were identified to species or morphospecies level. DNA analysis was conducted to support some morphological identifications. The first round was conducted from 4-11 March (scrapes and net samples taken, traps set) and 11-13 May (traps collected); the second round was conducted from 25 June – 2 July (scrapes and net samples taken, traps set) and 8-9 September (traps collected). Totals of 90 stygofauna samples and 140 troglofauna samples (including scrapes and traps) were collected across the two rounds.

Combining historical sampling in 2008-2009 with results of the 2020 survey, 552 troglofaunal specimens belonging to at least 29 species have been collected from the Study Area, including representatives of three orders of arachnids, four classes of myriapods, six orders of hexapods, and a two species of crustacean. Seven species were very widespread, whereas all other species have minimum linear ranges varying from 940 m to 76 km. Thirteen species are currently only known from the Study Area, and seven of these species are known from single specimens. Additionally, Pauropodidae sp. B01 s.l. and *Nocticola quartermainei* s.l. represent species complexes that could be restricted to the Study Area as well.

For stygofauna, 839 specimens from 15 species have been collected, including nematodes (grouped together as one species), at least nine species of earthworms, one species of bathynellid crustacean from the superorder Syncarida, three species of copepod (one new - *Schizopera* \`BHA285\`) and at least one species of ostracod. With the exception of the new copepod species *Schizopera* \`BHA285\`, which was collected as a single animal representing a new species known only from the Study Area, all species seem likely to be widespread. However, four of the earthworm and the ostracod species could represent species complexes, and we were not able to estimate the ranges of the syncarid, one copepod and two of the earthworm species, due to taxonomic uncertainty.

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1. INTRODUCTION

The East Jimblebar area ('the Study Area') is located 50 km east of the town of Newman, immediately east of current mining operations at the BHP Western Australian Iron Ore (WAIO) Jimblebar hub (Figure 1). The Study Area encompasses the Hashimoto and East Jimblebar iron ore deposits. Any future mining at the iron ore deposits in the Study Area has the potential to impact subterranean fauna occurring there through the direct removal of habitat, and could impact the subterranean fauna of surrounding areas if groundwater drawdown is necessary for mining below the water table.

BHP commissioned Bennelongia Environmental Consultants (Bennelongia) to prepare a subterranean fauna assessment to inform the future approvals process for mining. This report represents a baseline assessment that is general in nature for the Study Area as a whole, as no detailed developments are currently planned. The specific aims of this report are to:

- provide a desktop assessment of previous records and literature to determine the likelihood, based on sub-regional information, of the Study Area supporting subterranean fauna, including conservation significant species and/or communities;
- provide the results of a two-season subterranean fauna survey, covering parts of the Study Area that have not previously been sampled, to determine in conjunction with previous sampling whether there are any species that may potentially be restricted to the Study Area; and
- determine on the basis of current results and earlier work in the Study Area whether there are any species that may potentially be restricted to the Study Area.

1.1. Subterranean Fauna

Subterranean fauna include two distinct animal communities: aquatic stygofauna and air-breathing troglofauna. Due to their evolutionary history in underground habitats, subterranean fauna typically exhibit many convergent morphological and physiological characteristics; for example, reduced or absent eyes, deficient pigmentation, vermiform bodies, elongate sensory structures, loss of wings, increased lifespan, a shift towards K-selection breeding strategy and decreased metabolism (Gibert and Deharveng 2002). The overwhelming majority of subterranean fauna species in Western Australia are invertebrates, apart from a few species of fish and snakes. Troglofauna include a wide variety of invertebrate groups such as isopods, palpigrades, spiders, schizomids, pseudoscorpions, harvestmen, millipedes, centipedes, pauropods, symphylans, bristletails, silverfish, cockroaches, true bugs, beetles and fungus-gnats. On the other hand, stygofauna are mostly crustaceans, although they can also include earthworms, beetles, snails and some other groups that have poorly defined taxonomy, such as nematodes and rotifers (Halse 2018b).

Although inconspicuous, subterranean fauna contribute markedly to the overall biodiversity of Australia. Most subterranean species satisfy Harvey (2002) criterion for short-range endemism (SRE), having total geographic ranges of less than 10,000 km^2 and occupying patchy or discontinuous habitats within those ranges. Given that species with small ranges are more vulnerable to extinction following habitat degradation than wider ranging species (Ponder and Colgan 2002), it follows that subterranean taxa are highly susceptible to anthropogenic threats, particularly large-scale excavation and groundwater abstraction.

Subterranean species that are only found in deeper subterranean environments throughout their life cycle are referred to as troglobites and stygobites, while species that move to the surface during a life stage (or have surface populations) are referred to as troglophiles and stygophiles. Troglophiles and stygophiles usually have larger distributions than troglobites and stygobites, given that there are greater dispersal opportunities at the surface. Species that use subterranean spaces only opportunistically are referred to as trogloxenes and stygoxenes, and are generally much more widespread than more obligate subterranean species.

Understanding of the subterranean fauna in the Pilbara has progressed immensely since the late 1990s (Humphreys 1999; Eberhard *et al.* 2005), in large part due to extensive sampling for the assessments of potential mining impacts on these communities. The diversity of the region is now recognised as globally significant, with at least 1,500 species of troglofaunal and around 1,300 species of stygofauna (Halse 2018a, Halse 2018b), although reliable estimates are hindered by a developing and sometimes non-existent taxonomic framework for some of the animal groups. It is, however, well established that the diversity of subterranean fauna is closely linked to geology, because these animals can only colonise areas with appropriate spaces to provide habitat. Geologies supporting rich troglofauna communities include mineralised or weathered iron formations, calcrete, alluvium, and, sometimes, mafic volcanic rocks. Stygofauna communities are usually richest in alluvial and calcrete aquifers, especially within palaeochannels, although they may also be found in iron formations, especially detrital and channel iron (Halse 2018a). As a result of their dependence on the distribution of underground spaces, the composition and richness of both stygofauna and troglofauna communities often vary significantly over short distances. Therefore, to achieve reliable estimates of the diversity and composition of the subterranean fauna of an area, knowledge of local geology and hydrogeology needs to be coupled with biological surveys.

1.2. Conservation Framework

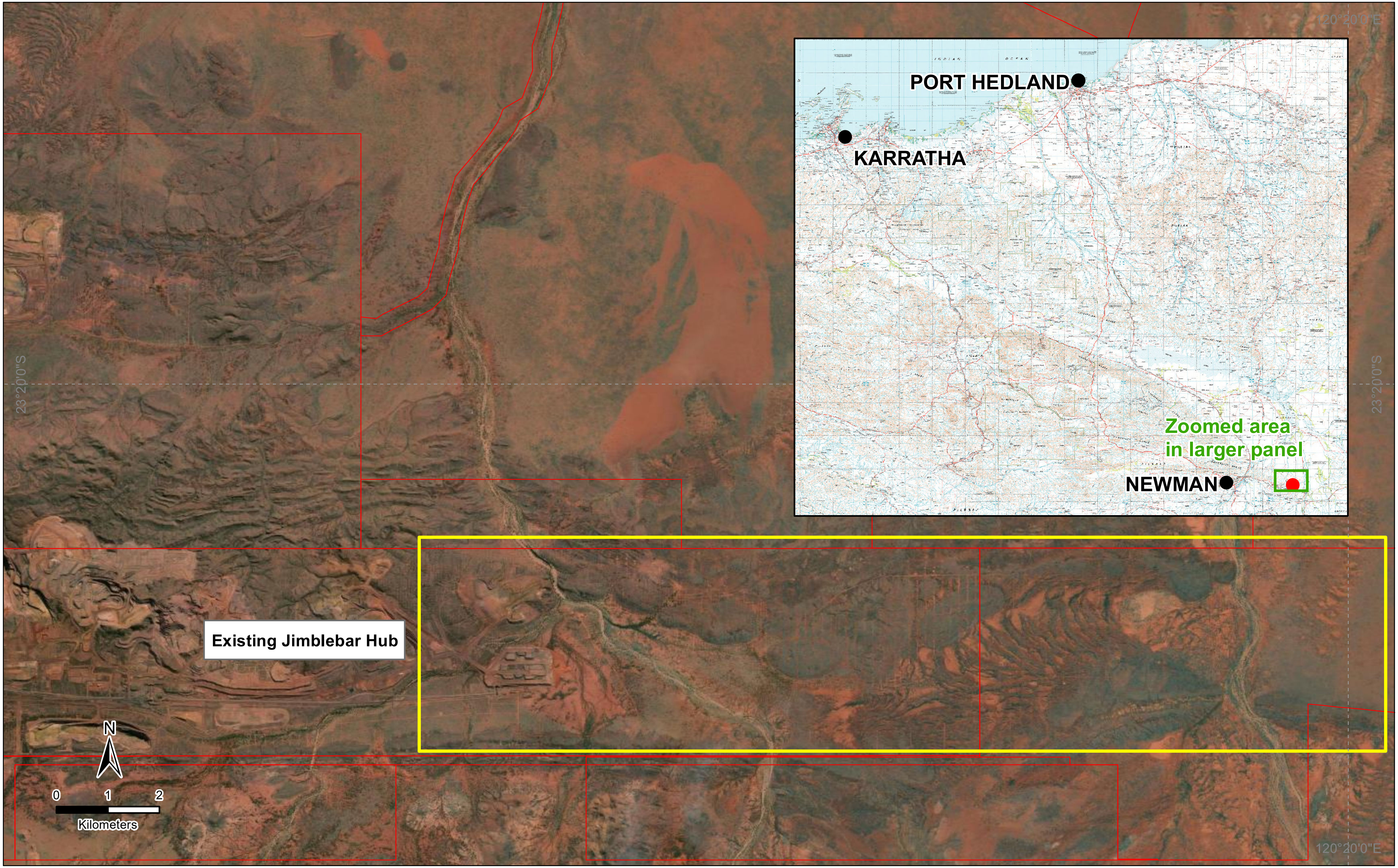
Native flora and fauna in Western Australia are protected at both State and Commonwealth levels. At the national level, the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) provides a legal framework to protect and manage nationally and internationally important flora, fauna and ecological communities. However, the threatened fauna lists of the EPBC Act currently place little emphasis on subterranean fauna. The legal framework for protection of flora and fauna at the state level in Western Australia is the *Biodiversity Conservation Act 2016* (BC Act). Most protection is provided for species listed under the BC Act as 'threatened' and this list includes subterranean species. In addition to the list of threatened species under the BC Act, the Department of Biodiversity, Conservation and Attractions (DBCA) maintains a list of priority species that are of conservation importance but, for various reasons, do not meet the criteria for listing as threatened.

Both the EPBC and BC Acts provide frameworks for the protection of threatened ecological communities (TECs). Within Western Australia, DBCA also informally recognises communities of potential conservation concern, but for which there is not enough information to support listing, as priority ecological communities (PECs). The list of TECs and PECs recognised under the BC Act and by DBCA is larger than the EPBC Act TEC list and has much greater focus on subterranean communities.

2. LOCAL HABITAT

2.1. Geology

A review of the local geology within the Jimblebar tenements and surrounds was undertaken by BHPWAIO to assist with the characterisation of subterranean fauna habitat during the Regional Subterranean Fauna Survey (Bennelongia 2009). This previous information, together with regional geological mapping from the Geological Survey of Australia, has been used to describe the geology of current Study Area with a focus on characteristics that are important for stygofauna.



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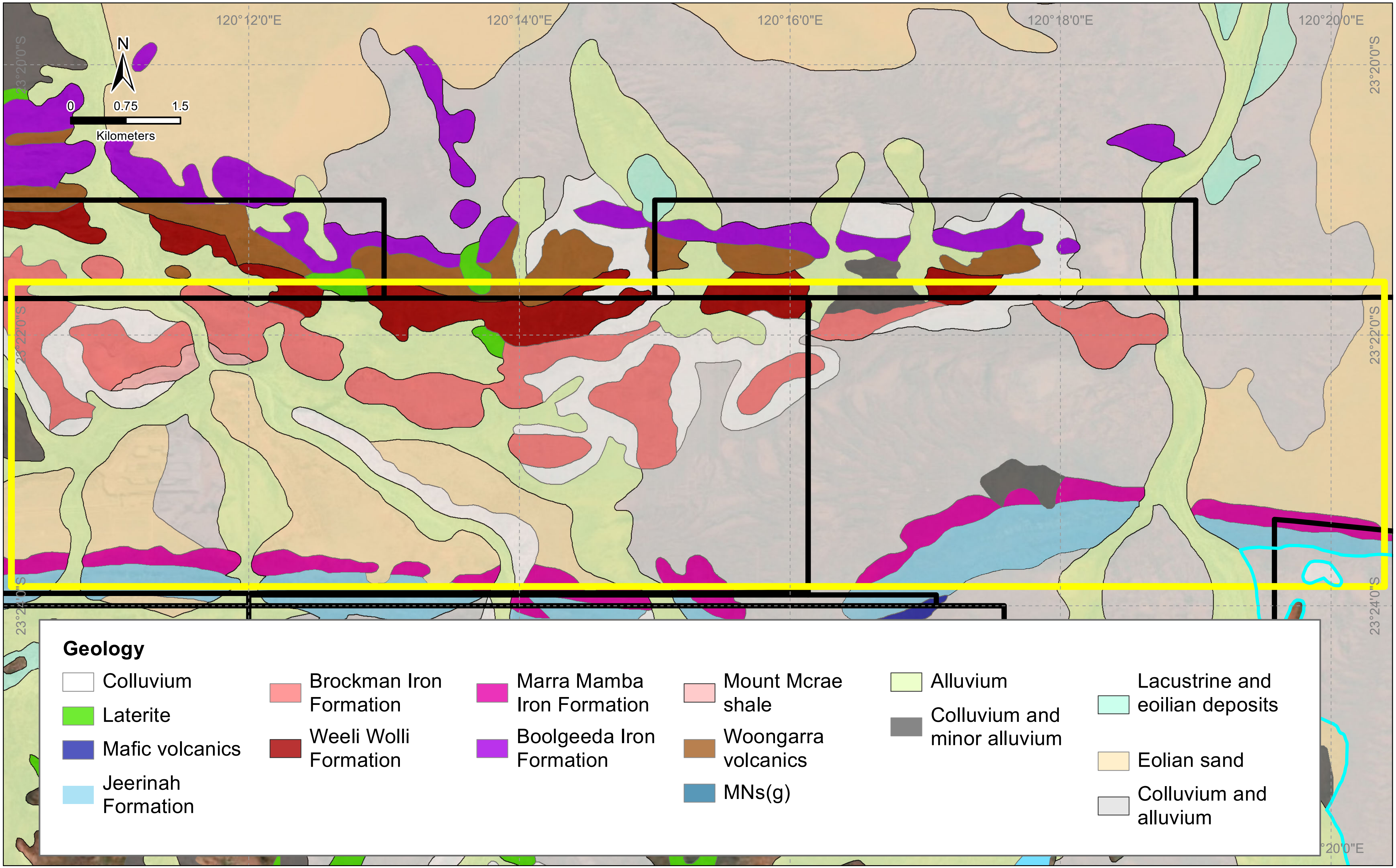
Legend

- Location of Study Area (inset maps)
- BHPWAIO tenements
- Study

Figure 1. Location of the Study Area deposits



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Legend

- Location of Study Area (bottom left map)
- BHPWAIO tenements
- Study Area

Figure 2. Geology of the Study Area, as per Geological Survey of Australia 1:250 000 mapping

The main iron-bearing formations of tenements in the Study Area are the Brockman Iron Formation, Weeli Wolli Formation, Marra Mamba Iron Formation, Boolgeeda Iron Formation, and Jeerinah Formations (Figure 2; Williams and Tyler 1991). Hashimoto and East Jimblebar deposits represent banded-iron of the Brockman Iron Formation (Figure 2). The other major banded-iron formation in the area is the Weeli Wolli Formation, which outcrops north of the target deposits, together with flaggy iron of the Boolgeeda Formation and some areas of Woongarra volcanic rocks. The Marra Mamba Iron and Jeerinah Formations, containing ferruginous chert, shale and sandstone, occur in the south of the Study Area (Figure 2). Weathering within the iron formations may provide highly prospective troglofauna habitat. Alluvial deposits of silt, sand and gravel are also present within the tenements along floodplains and drainage channels such as Jimblebar Creek and Copper Creek. Quaternary deposits of colluvium and minor alluvium are present on the scree slopes and talus slopes adjacent to and derived from the bedrock at the valley bottoms.

2.2. Hydrogeology

During the previous stygofauna assessment at Jimblebar, concurrent with the Regional Subterranean Fauna Survey Program, two main aquifer types were identified in the area (Aquaterra 2009): basement rock aquifers and valley fill sediment aquifers. Groundwater reservoirs in basement rocks are mainly associated with the Brockman Iron Formation (and to a much lesser extent the Marra Mamba Iron Formation) within the current Study Area. Aquifers in the bedrock are associated with fracturing and secondary permeability caused by mineralisation and weathering, with recharge occurring through direct infiltration where there is outcropping bedrock and by leakage from overlying geological units in other areas. The groundwater in valley-fill sediments is associated with primary permeability of the unconsolidated colluvial and alluvial deposits, with recharge through direct infiltration of rainfall and runoff. The depth to water table of the main regional aquifers is approximately 50 m below ground level, although some localised aquifers also occur in the shallower creek bed alluvium.

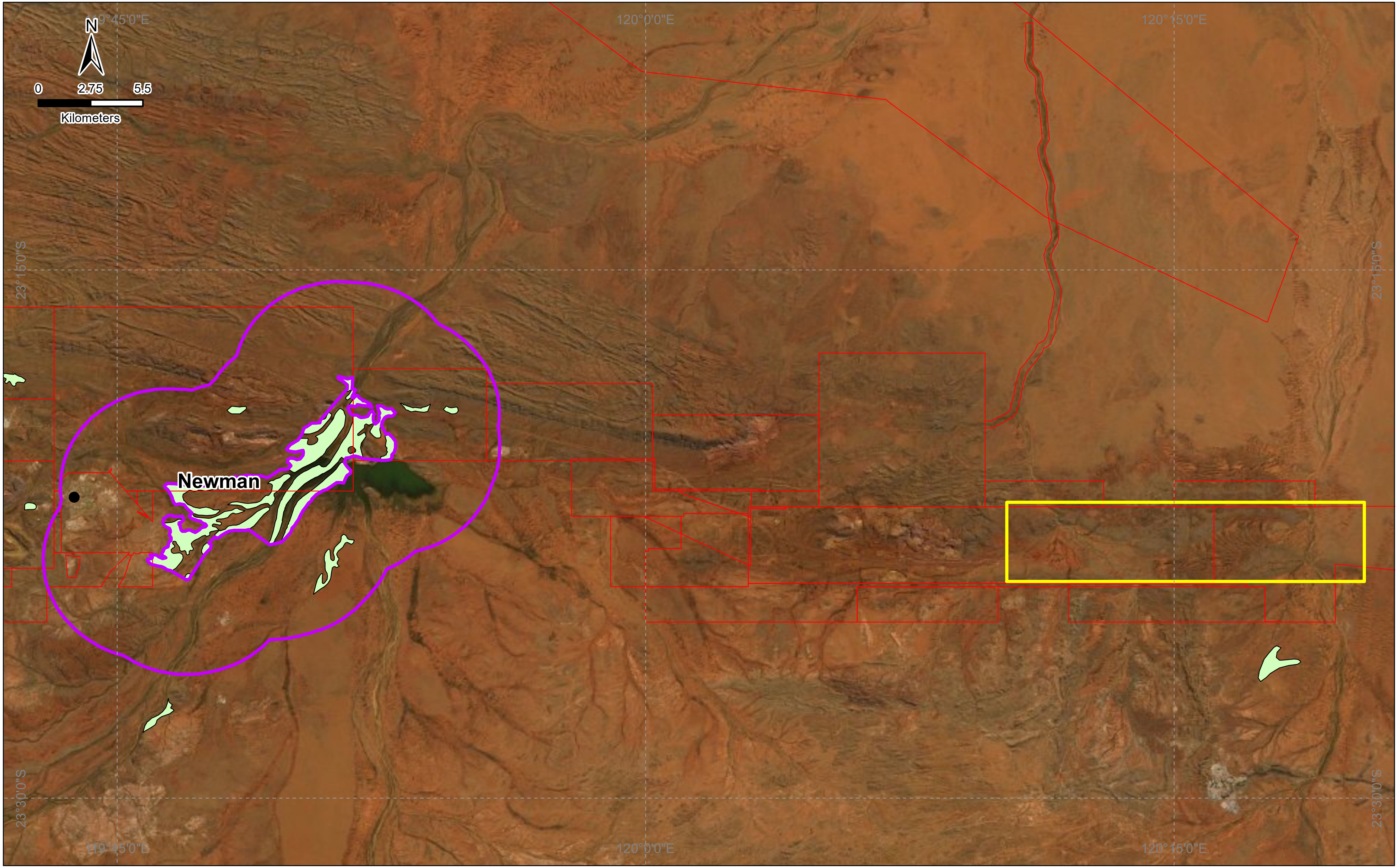
The most prospective stygofauna habitats are the aquifers associated with deep valley-fill alluvium and colluvium, although aquifers in weathered bedrock sometimes contain moderate stygofauna communities in the Pilbara (Halse 2018b). The localised aquifers in shallow, creek bed alluvium outside of the main palaeovalleys become largely unsaturated in the dry season and therefore are unlikely to represent permanent stygofauna habitat. There are no substantial deposits of calcrete in the immediate vicinity of the Study Area; the nearest extensive calcrete systems are associated with the Ethel Gorge Aquifer TEC, approximately 40 km west of the Study Area (Figure 3).

3. DESKTOP ASSESSMENT

3.1. Methods

A comprehensive review of previous subterranean fauna records was conducted for an area approximately 100 x 100 km around the Study Area (Figure 4; final decimal degrees search area, top left: -22.9°S:119.7°E, bottom right -23.9°S:120.7°E). This area serves to provide a list of the stygofauna and troglofauna that could possibly occur in the Study Area. The desktop review included a search of the Western Australian Museum (WAM) database and Bennelongia's own database, which has been compiled from over 13 years of subterranean fauna surveys in the Pilbara and includes historical samples at Hashimoto, East Jimblebar and surrounding BHP tenements. Additionally, lists of conservation-significant communities and species (BC Act and EPBC Act) and records in the Atlas of Living Australia were consulted for the desktop assessment.

Higher order identifications were not included in the final list of previous subterranean fauna records, unless they were unlikely to represent any other species present in the records. For example, higher order identifications were retained if there were no other representatives from that group in the records, or if other representatives from the group were collected from geographically distant locations.



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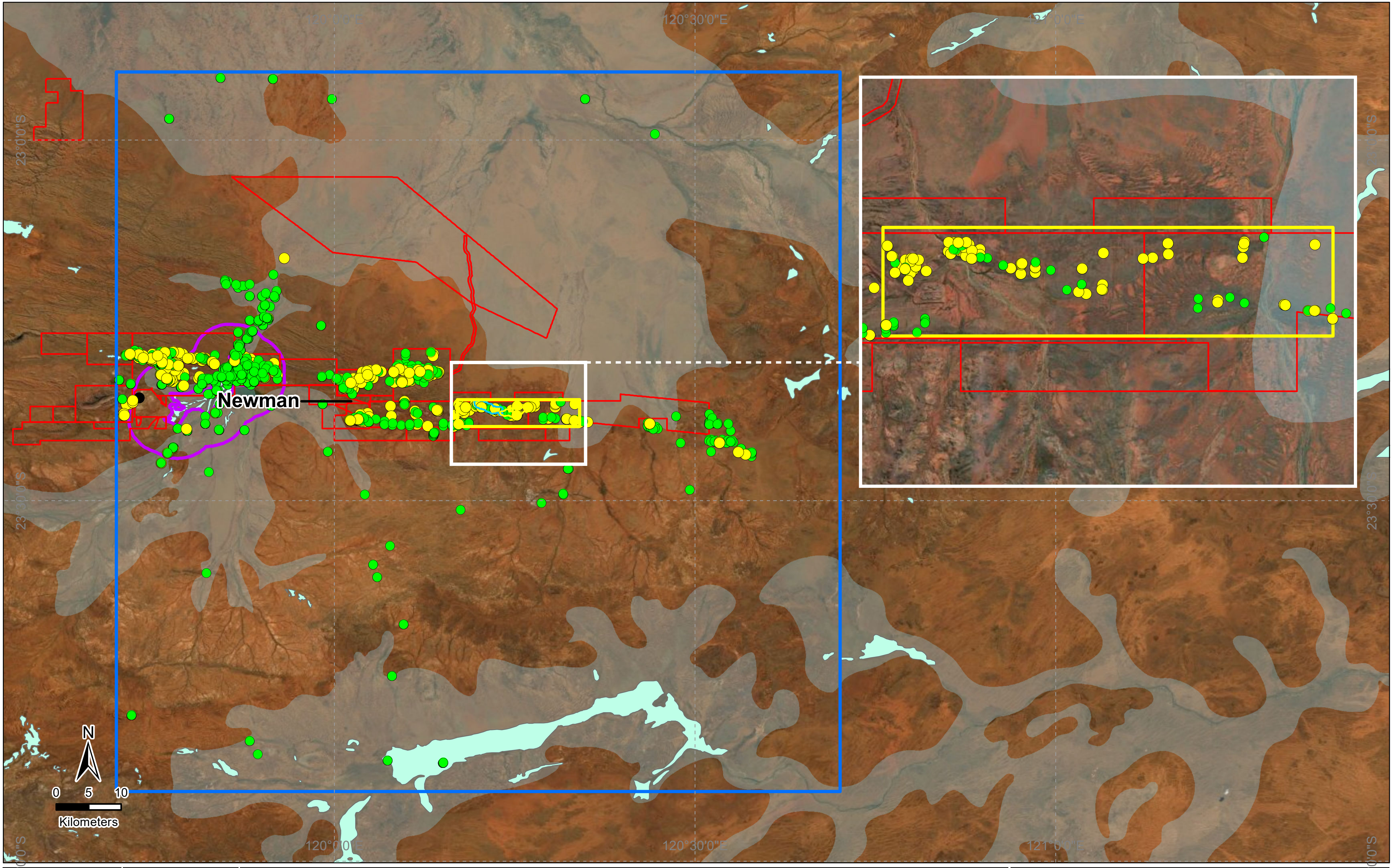
NEWMAN
PERTH

Legend

- Location of Study Area (bottom left map)
- BHPWAIO tenements
- Study
- Ethel Gorge TEC buffer
- Calcrete

Figure 3. Location of the Ethel Gorge TEC calcrete aquifer relative to the Study Area



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Location of Study Area (bottom left map)
BHP tenements
Desktop search area
Ethel Gorge TEC buffer
Calcrete
Palaeovalleys
Stygofauna
Troglofauna
Study

Figure 4. Location of the desktop survey area and previous subterranean records

3.2. Results

The desktop review identified occurrence of at least 109 troglofauna species and 149 stygofauna species in the search area around the Study Area (Figure 4; Appendices 1 and 2). Full lists of the troglofauna and stygofauna species recorded are provided in Appendices 1 and 2, respectively.

3.2.1. Stygofauna and the Ethel Gorge Aquifer Stygobiont Community

The existence of a significant stygofauna community within the Ethel Gorge aquifer first became apparent following survey work done in 1997 by Stefan Eberhard and Bill Humphreys in associated with the assessment process for below water table mining at Orebody 23. During the subsequent environmental impact assessment process, additional stygofauna survey was undertaken (Eberhard and Humphreys 1999), which led to the description of multiple species of the amphipod genus *Chydaekata* at Orebody 23 (Bradbury 2000). These descriptions led to the Threatened Ecological Communities Scientific Committee recommending that DBCA list Ethel Gorge as containing a TEC (DEC 2010). Survey to date has documented 82 stygofauna species in the Ethel Gorge aquifer and/or adjacent local groundwater in the Newman area, most of which occur in the TEC. About 40 species have been recorded only from the Ethel Gorge aquifer and/or adjacent local groundwater (Subterranean Ecology 2013). While this level of endemicity would be regarded as exceptionally high for surface fauna, it is not unusual for subterranean fauna (Halse *et al.* 2014).

3.2.2. Historical Subterranean Fauna Sampling in the Study Area

Prior to the 2020 survey, Bennelongia (2009) sampled troglofauna in the Study Area tenements at Hashimoto and East Jimblebar (see Table 1), along with deposits in surrounding tenements including Carramulla, Wheelarra Hill, Jimblebar South, Jimblebar West and Mesa Gap in 2008 and 2009, as part of BHP's Regional Subterranean Fauna Survey Program (Bennelongia 2009). Concurrently, stygofauna was surveyed through the same areas by Ecowise (2009). The previous troglofauna survey recorded a total of 30 species from 14 orders, while at least 27 species from five orders were recorded during the stygofauna survey. No stygofauna was recorded at Hashimoto and no stygofauna sampling occurred at East Jimblebar. Details are given in Bennelongia (2009) and Ecowise (2009).

In addition to the 2008-2009 survey of the Study Area and surrounds, the Regional Subterranean Fauna Survey Program included sampling of troglofauna and stygofauna at a number of other locations in the general Newman area. Bennelongia has also conducted more recent survey within BHP tenements in the close vicinity of the Study Area, such as Western Ridge, Mount Whaleback and Orebodies 19, 29, 30, 31 and 35 (e.g., Bennelongia 2013, 2014, 2021).

4. LEVEL 2 SURVEY

4.1. Methods

4.1.1. Troglofauna sampling

As far as possible, each troglofauna sample represented the combined results of two different, complementary sampling techniques: scraping and trapping.

Scraping is an active sampling technique that is used prior to setting traps. In each scraping event, a troglofauna net is prepared with a weighted ring net of 150 µm mesh, and a diameter closely matched to 60% of the bore diameter. This net is lowered to the bottom of a bore or to the water table, and subsequently scraped back to the surface at least four times. In each of these *scrapes* a different section of the wall of the hole is targeted (e.g., north, south) to maximize the organisms retrieved. The contents of each scrape are immediately transferred to 100% ethanol for preservation of the sample and its DNA.

Trapping is a passive sampling technique used after the drill hole is scraped. Traps of cylindrical PVC (270 x 70 mm) with holes drilled on the side and top to function as entrances were baited with microwaved leaf litter. Traps were lowered on nylon cord to the end of the bore, or to a few metres above the water table. An additional second trap was set (at half the depth of the first trap) in approximately every fourth hole (where possible), according to Halse *et al*. (2018). Traps were then left inside bores for nine weeks. During that period, the bores were sealed to minimise movement of surface animals into the troglofauna traps. When traps were retrieved, their contents were transferred to a zip-lock bag and transported alive to the laboratory in Perth.

Sampling effort for troglofauna was calculated on the basis that standard sampling comprised both scraping and trapping. Thus, the combined results scraping and setting one or two traps in a bore on the same date were treated as one sample. If only one trap or a single scrape was collected from the hole the sampling effort was deemed to be 0.5 of a sample.

4.1.2. Stygofauna sampling

Stygofauna were collected by lowering a small weighted plankton net to the bottom of the hole and then agitated vigorously to stir benthic and epibenthic fauna into the water column, where animals were then captured as the net was slowly retrieved. Six separate net hauls were made (three with 50 µm mesh net and three with 150 µm mesh net). The contents of the net were transferred to 100% ethanol for preservation after each haul. Contamination between sites was avoided by washing the nets between the sampling of different drill holes.

4.1.3. Sampling effort

Two rounds of sampling were conducted in 2020. The first round was conducted on 4-11 March (scrapes and net samples taken, traps set) and 11-13 May (traps collected); the second round was undertaken on 25 June – 2 July (scrapes and net samples taken, traps set) and 8-9 September (traps collected). A total of 90 stygofauna samples and 140 troglofauna samples were collected across the two rounds (Table 1; Figure 5).

Table 1: Historic and latest sampling effort at the East Jimblebar Study Area.

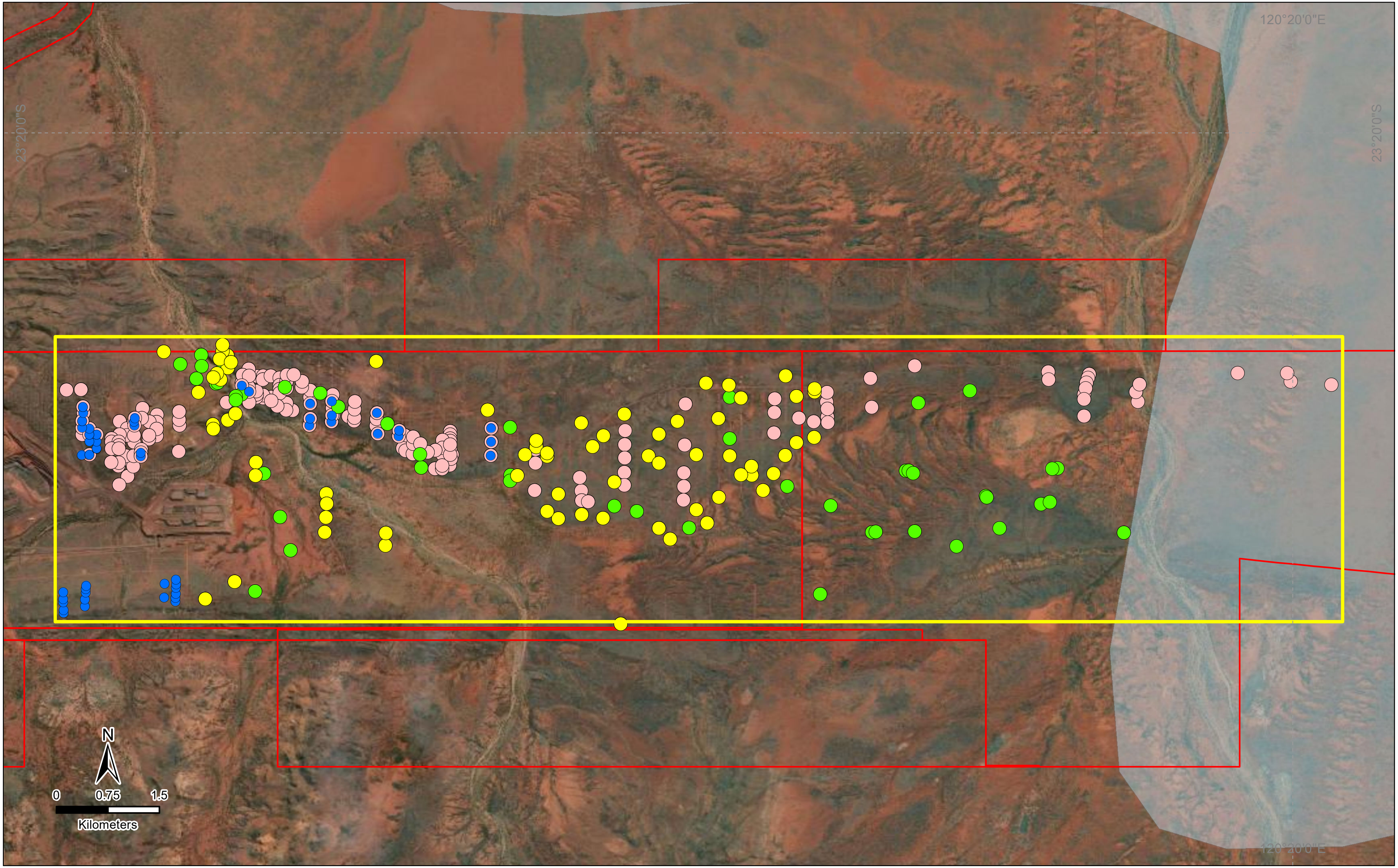
Sampling Round	Stygofauna	Troglofauna			
		Scrapes	Single traps	Double traps	No. of Samples
2008-2009	57	391	212	73	339
2020 (R1)	45	70	61	9	70
2020 (R2)	45	70	53	17	70

4.1.4. Laboratory processing

All samples were sorted in the laboratory. Leaf litter retrieved from traps was processed in Tullgren funnels under halogen lamps for 72 hours, during which time the light and heat drives animals downwards and towards a vial containing 100% ethanol as a preservative. Litter was checked after removal from the funnels to ensure no invertebrates remained.

Samples in ethanol from the Tullgren funnels were carefully screened under a dissecting microscope. Troglofauna scape samples and stygofauna net samples were elutriated to separate animals from sediment and put through sieves to fractionate the contents according to size (53, 90 and 250 µm) to improve searching efficiency before screening under a dissection microscope. All potential subterranean animals were removed from these samples for species or morpho-species level identification.

Troglofauna and stygofauna identifications were made using published, unpublished and informal taxonomic keys, as well as species descriptions in the scientific literature. Morphospecies identifications



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Location of Study Area (bottom left map)
BHP tenements
Palaeovalleys
Study
2020 Troglofauna samples
2020 Stygofauna samples
2008-2009 Troglofauna samples
Ecowise 2009 Stygofauna samples

Figure 5. Sampling effort for subterranean fauna in the 2008-2009 and 2020 surveys.

based on the characters of existing species keys were used for undescribed species, and the lowest level of identification possible was reached given the constraints of sex, maturity of the specimens (juveniles and females are often impossible to identity to species level) and possible damage to body parts. During the final phase of identification, dissecting and compound microscopes were used, with the process often requiring dissection of specimens. After the taxonomic assessment was completed, representative animals were lodged with the WAM.

DNA sequencing of nine animals from the Study Area (along with 10 reference animals from the surrounding area) was used to confirm morphological identifications or provide names for juvenile or damaged animals. Depending on the size of the specimens, legs or whole animals were used for DNA extractions using a Qiagen DNeasy Blood & Tissue kit (Qiagen 2006). Elute volumes varied from 40 µL to 200 µL depending on age, condition and quantity of material. Primers combinations used for PCR amplifications were: (1) LCO1490:HCO2198 and LCO1490:HCOoutout for the MT-CO1 gene (Folmer *et al.* 1994; Schwendinger and Giribet 2005); and (2) 12Sai:12RJ and 12Sai:12Sbi for the 12S gene (Kambhampati and Smith 1995; Simon *et al.* 1994). Next, dual-direction, sanger sequencing was undertaken for PCR products by the Australian Genome Research Facility (AGRF). The sequences returned were edited and aligned in Geneious (Kearse *et al.* 2012), where neighbour-joining phylogenetic trees were then calculated using the and 1000 bootstraps. Genetic distances (using the Tamura-Nei method) between unique sequences were measured as uncorrected p-distances (total percentage of nucleotide differences between sequences). Sequences on GenBank and in grey literature were included in phylogenetic analysis in order to provide a framework for assessing intra and interspecific variation, as well as to examine levels of differentiation among individuals within described species across their geographic ranges.

4.1.5. Personnel and limitations of the survey

The qualifications or relevant experience of Bennelongia staff involved in each component of the assessment are shown in Table 2. Limitations of the survey are presented in Table 3.

Table 2: Staff qualifications or experience.

Task	Year	Personnel	Qualifications/experience
Fieldwork	2020	Jim Cocking	B.Sc. Grad Dip
		Louis Masarei	B.Sc.
		Huon Clark	B.Sc. (Hons) PhD
		Mike Scanlon	B.Sc. (Hons)
Sample sorting	2020	Heather McLetchie	B.Sc. (Hons)
		Melanie Fulcher	B.Sc. (Hons)
		Melita Pennifold	B.Sc. (Hons)
Species identification	2020	Jane McRae (most invertebrates)	30 years of identification experience at Australian Museum, British Museum, DBCA, Bennelongia, author/co-author of 12 taxonomic papers and 9 papers on species inventory/ecology
		Stuart Halse (ostracods)	B.Sc. (Hons) Ph.D. Ostracods, 40 years experience, described numerous species, invited author of Thorp & Covich guide to Australian ostracod genera
DNA analysis	2020	Heather McLetchie	B.Sc. (Hons)
		Melanie Fulcher	B.Sc. (Hons)
		Rowan Lymbery	B.Sc. (Hons) PhD
Mapping	2020	Rowan Lymbery	B.Sc. (Hons) PhD
Reporting	2021	Rowan Lymbery	B.Sc. (Hons) PhD
		Bruno Buzatto	B.Sc. (Hons) PhD

Table 3: Limitations of the survey.

Limitation	Rationale	Mitigation	Severity
Weak taxonomic framework for some groups	There is a very weak taxonomic framework for certain groups collected, making it hard to identify some specimens to species level, or even to place some animals in the right genus.	Genetic analyses were used in nine cases to confirm IDs, align newly collected specimens with previously sequenced species, and/or narrow down the identification of poorly taxonomically defined genera.	Moderate limitation that, due to the genetic analyses used to mitigate it. does not significantly impact the results.
Difficulty in identifying females and juveniles	In most groups covered in this report, adult males are necessary for full identifications, and the majority of specimens collected are juveniles and females.	As above.	As above.

4.2. Results

4.2.1. Troglofauna survey results

Combining the 2008-2009 sampling results (Bennelongia 2009) with the 2020 survey results, 552 specimens belonging to at least 29 species have been collected from the Study Area (Table 4; Figure 6). This includes representatives of three orders of arachnids, four classes of myriapods, six orders of hexapods, and two species of crustacean. Arachnids were represented by two species of spider, at least two species of Palpigradi and two species of Pseudoscorpiones. Within myriapods, the classes Chilopoda (two species), Diplopoda (one species), Symphyla (at least five species) and Pauropoda (three species) were collected. Within hexapods, the orders Diplura (at least two species), Blattodea (one species), Coleoptera (one species), Diptera (one species), Hemiptera (two species) and Zygentoma (at least two species) were collected. The most widespread species were the palpigrade Palpigradi sp. B01, the polyxenid millipede *Lophoturus madecassus,* the beetle Pselaphinae sp. B01, the silverfish *Dodecastyla* sp. B02, the troglobitic planthoppers Cixiidae sp. B02 and *Phaconeura* sp. B04, and the subterranean fly *Allopnyxia* sp. B01. *Lophoturus madecassus* and *Allopnyxia* sp. B01 were found in large numbers (up to 147 individuals). All other species were recorded at low to moderate abundances (Table 4), with minimum linear ranges varying from 940 m to 76 km. Thirteen species are currently known only from the Study Area, and seven of these species are known from single specimens. Additionally, Pauropodidae sp. B01 s.l. and *Nocticola quartermainei* s.l. represent species complex that could be restricted to the Study Area as well.

4.2.2. Stygofauna survey results

The diversity of stygofauna collected in the Study Area is slightly lower than that of troglofauna, with 839 specimens from 15 species recorded (Table 5; Figure 7). This total includes an uncertain number of species of nematodes (here considered as one species because there is no taxonomic framework to formally assess the group), at least nine species of earthworms, one species of bathynellid crustacean from the superorder Syncarida, three species of copepod (one new) and at least one species of ostracod. While the nematodes and the earthworms (Enchytraeidae `2 bundle` s.l. (short sclero 4 per seg) and Enchytraeidae `3 bundle` s.l. (short sclero)) were collected in high abundance, all other species were collected in low to moderate abundances. With the exception of the copepod *Schizopera* `BHA285`, which was collected as a single animal representing a new species known only from the Study Area, all species are considered to be widespread. However, four of the earthworm and the ostracod species could represent species complexes, and higher-level identification hampers our ability to estimate the ranges of the syncarid, one copepod and two of the earthworms.

Table 4: Troglofauna collected at the East Jimblebar Study Area in the 2008-2009 and 2020 surveys.
Blue highlight represents potential species complexes. Grey highlight represents higher level identification likely to belong to another species listed.

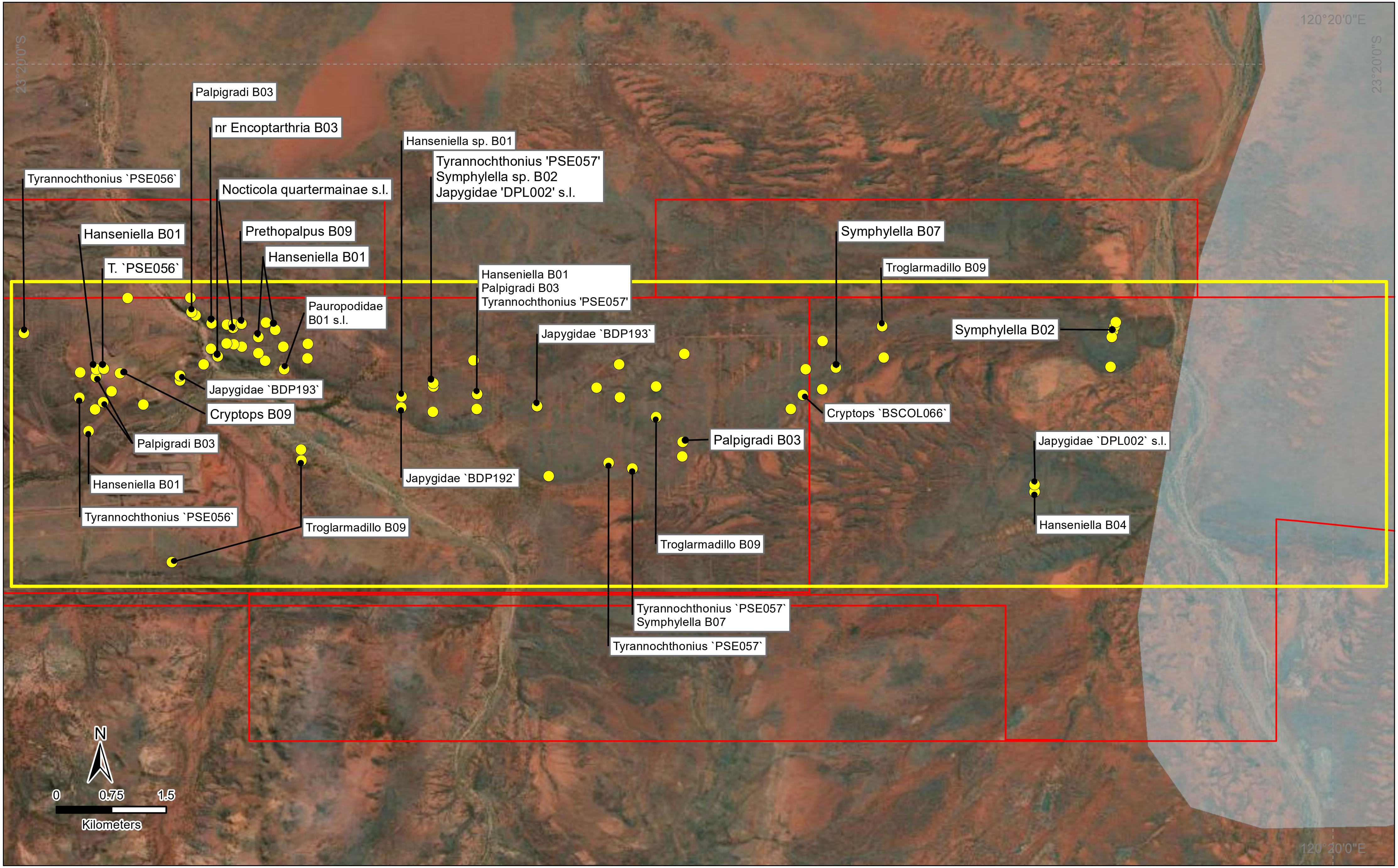
Higher groups	Lowest identification	Specimens (samples)	Bores	Years when recorded	Occurrences out of Study Area (linear range) previous names in Bennelongia (2009)
ARACHNIDA					
Araneae					
Gnaphosidae	nr *Encoptarthria* sp. B03#	2(2)	MCM0067, MCM0241	2009	Wheelarra Hill (10 km); 'Araneomorphae com. B1 sp. B3'
Oonopidae	*Prethopalpus* sp. B09	2(2)	MCM0120, HH0118R	2008, 2009	Wheelarra Hill (5.9 km); 'Oonopidae sp. B9'
Palpigradi					
Unknown family	Palpigradi sp. B01	8(2)	EXR0424, WRKRC148	2009	Widespread (> 470 km); 'Palpigradida sp. B1'
	Palpigradi sp. B03	6(6)	EJR0014, EJR0028, HH1525R, LB070, MCM1530, HH0110R	2008, 2009, 2020	Wheelarra Hill/Jimblebar West (23 km); 'Palpigradida sp. B3'
	Palpigradi sp.	2(2)	CM0089R, LB091	2008, 2020	Uncertain ID, possibly same species as above
Pseudoscorpiones					
Chthoniidae	*Tyrannochthonius* `PSE056`	3(3)	LB068, LB084, MCM0241	2008, 2009	**Study Area only** (1.12 km); '*Tyrannochthonius* sp. B5'
	Tyrannochthonius `PSE057`	5(4)	EJ0791R, EJ0833R, EJR0014, PI012	2008, 2020	**Study Area only** (2.76 km); '*Tyrannochthonius* sp. B6'
CHILOPODA					
Scolopendrida					
Cryptopidae	*Cryptops* `BSCOL066`	1(1)	EJ1211R	2020	**Study Area only (singleton)**
	Cryptops sp. B09	1(1)	LB035	2009	**Study Area only (singleton)**
DIPLOPODA					
Polyxenida					
Lophoproctidae	*Lophoturus madecassus*	147(36)	36 different bores in the study area	2008, 2009, 2020	Widespread in the Pilbara and WA; 'Polyxenida sp. B1'
	Lophoproctidae sp.	7(3)	EJR0013, EJR0027, HH013	2008, 2009	Uncertain ID, possibly same species as above

Higher groups	Lowest identification	Specimens (samples)	Bores	Years when recorded	Occurrences out of Study Area (linear range) previous names in Bennelongia (2009)
SYMPHYLA					
Cephalostigmata					
Scolopendrellidae	*Symphylella* sp. B02	2(2)	EXR0425, PI044	2008, 2009	Western Ridge, Orebody 35 (76 km) 'Symphyla GEN 1 sp. B2'
	Symphylella sp. B07*	2(2)	EJ0833R, EXR0388	2009, 2020	Orebody 35 (63.1 km) 'Symphyla GEN 1 sp. B2' (as above, split later)
	Symphylella sp.	1(1)	EJ1185R	2020	Uncertain ID, probably one of the species above
Scutigerellidae	*Hanseniella* sp. B01	9(7)	EJR0014, HH051, MCM0142, MCM1545, PI059, LB069	2008, 2009	**Study Area Only** (4.9 km)
	Hanseniella sp. B04	3(2)	EXP0012	2009	**Study Area Only (singleton)**
	Hanseniella sp. B24	1(1)	EXR1356	2009	**Study Area Only (singleton)**
	Hanseniella sp.	1(1)	LB084	2008	Uncertain ID, possibly same species as above.
PAUROPODA					
Tetramerocerata					
Pauropodidae	Pauropodidae sp. B01 s.l.	1(1)	HH0158R	2009	**Potentially only in Study Area** 'Pauropoda sp. B1', possible species complex
	Pauropodidae sp. B05.	3(1)	EXR1569R	2009	**Study Area Only (singleton)**
	Allopauropus sp. B02	1(1)	FG2234R	2009	**Study Area Only (singleton)**
ENTOGNATHA					
Diplura					
Japygidae	Japygidae \`BDP192\`*	1(1)	PI031	2020	**Study Area Only (singleton)**
	Japygidae \`BDP193\`*	3(3)	EJ0679R, HH2092R	2020	**Study Area only** (4.5 km)
	Japygidae \`DPL002\` s.l.	3(3)	HH0118T, EXP0013, PI012	2008, 2009	'Japygidae sp. B4', species complex containing the above species
	Japygidae sp.*	1(1)	HH2053R	2020	Uncertain ID, possibly one of the species above (failed to return sequences)
Uncertain family	Diplura sp.	1(1)	EJR0004	2009	Fragment only, uncertain ID

Higher groups	Lowest identification	Specimens (samples)	Bores	Years when recorded	Occurrences out of Study Area (linear range) previous names in Bennelongia (2009)
INSECTA					
Blattodea					
Nocticolidae	*Nocticola quartermainei* s.l.	3(2)	HH104, MCM0114	2009	**Potentially only in Study Area** '*Nocticola* sp. B1', likely species complex
Coleoptera					
Staphylinidae	Pselaphinae sp. B01	1(1)	MCM0120	2008	Widespread (> 350 km)
Diptera					
Sciaridae	*Allopnyxia* sp. B01	52(2)	HH2093R	2020	Widespread (> 470 km) 'Sciaridae sp. B1'
Hemiptera					
Cixiidae	Cixiidae sp. B02	6(3)	HH035, HH106, LB022	2008, 2009	Widespread (> 480 km) 'Hemiptera sp. B2'
Meenoplidae	*Phaconeura* sp. B04*	2(2)	EJ0679R	2020	Widespread in the Pilbara and WA 'Meenoplidae sp. B3'
	Phaconeura sp.	28(7)	EJR0004, EXP0038, EXR0426, HH004, HH035, LB040	2008, 2009	Uncertain ID, possibly same species as above.
Zygentoma					
Nicoletiidae	*Dodecastyla* sp. B02*	7(5)	EJ0679R, HH104, LB040, MCM0109	2008, 2009, 2020	Widespread (> 505 km); 'Atelurinae sp. B2'
	Trinemura sp.	1(1)	MCM0282	2009	Potentially female of *Trinemura* sp. B4 (45 km), but uncertain ID (female)
Uncertain family	Zygentoma sp.	1(1)	EJR0014	2009	Uncertain ID, probably one of the species above
MALACOSTRACA					
Isopoda					
Armadillidae	*Troglarmadillo* sp. B09	35(7)	EJ0886R, EJR0029, EXP0038, HH062, HH0857R, SJ2454RDG	2009, 2020	**Study Area only** (9.53 km)

Higher groups	Lowest identification	Specimens (samples)	Bores	Years when recorded	Occurrences out of Study Area (linear range) previous names in Bennelongia (2009)
Armadillidae	*Troglarmadillo* sp. B07	199(5)	EXP1356, EXR1568R	2009	**Study Area only** (940 m)
TOTAL		**552(126)**			

*Indicates species also analysed genetically; #'nr' means near *Encoptarthria*, but current taxonomic framework does not allow confident placement in that genus.



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Location of Study Area (bottom left map)

BHP tenements

Palaeovalleys

Troglofauna collected

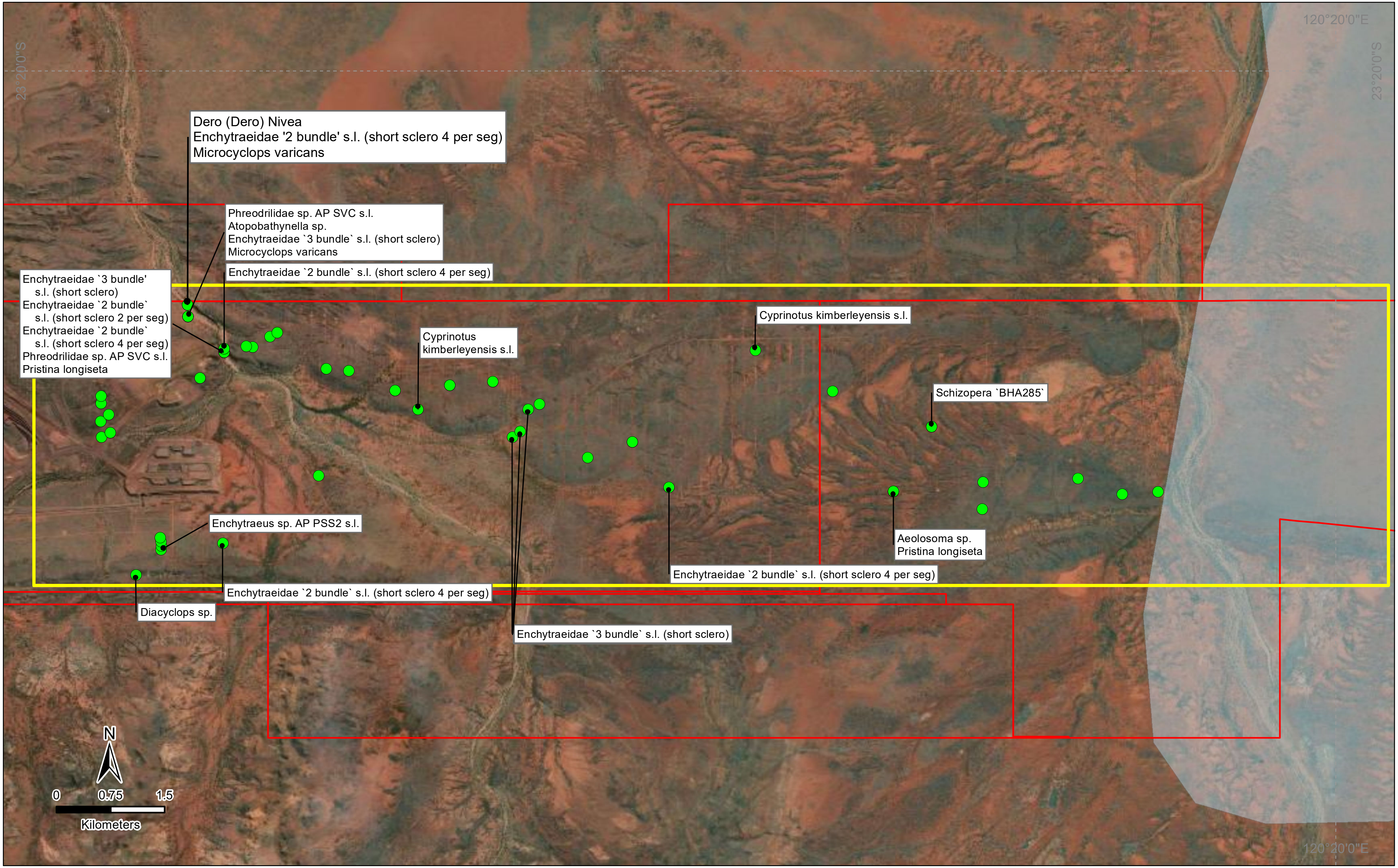
Study Area

Figure 6. Troglofauna collected in the 2008-2009 and 2020 surveys. Potentially restricted species are labelled.

Table 5: Stygofauna collected at the East Jimblebar Study Area.
Blue highlight represents potential species complexes. Grey highlight represents higher level identification likely to belong to another species listed.

Higher groups	Lowest identification	Specimens (samples)	Bores	Years when recorded	Occurrences outside Study Area (range)
NEMATODA					
	Nematoda spp.	499(25)	25 different bores in the Study Area	2008, 2009, 2020	Uncertain ID
ANNELIDA					
Aphanoneura					
Aeolosomatidae	*Aeolosoma* sp.	1(1)	HCM0021	2020	Uncertain ID
Clitellata					
Enchytraeida					
Enchytraeidae	Enchytraeidae `2 bundle` s.l. (short sclero 2 per seg)	6(1)	HH2120R	2020	Lake Way and Kutayi (> 400 km), but potentially a species complex
	Enchytraeidae `2 bundle` s.l. (short sclero 4 per seg)	32(6)	EJ0868R, HH1272R, HH2120R, HH2121R, SJ2634DG	2020	Lake Way (> 360 km), but potentially a species complex
	Enchytraeidae `3 bundle` s.l. (short sclero)	31(4)	EJ0618R, EJ0639R, HH1267R, HH2120R,	2020	Widespread in the Pilbara, but potentially a species complex
	Enchytraeus sp. AP PSS2 s.l.	26(4)	FG2340R, FG2341R, FG2219R, FG2188R	2008	Widespread in the Pilbara and WA
	Enchytraeidae sp.	1(1)	FG2187R	2008	Uncertain ID
Haplotaxida					
Naididae	*Dero* (*Dero*) *nivea*	1(1)	HH1272R	2020	Widespread in the Pilbara
	Pristina longiseta	3(2)	HCM0021, HH2120R	2020	Widespread in the Pilbara and WA
Phreodrilidae	Phreodrilidae sp. AP SVC s.l.	2(2)	HH1267R, HH2120R	2020	Widespread in the Pilbara, but potentially a species complex
Tubificidae	Tubificidae sp.	2(1)	HCM0021	2020	Uncertain ID

Higher groups	Lowest identification	Specimens (samples)	Bores	Years when recorded	Occurrences outside Study Area (range)
Uncertain class	Oligochaeta sp.	198(15)	EXR0800, EXR0801, FG2339R, HH0132R, MCM0168, PI012, SJ0500R	2008, 2009	Uncertain ID
ARTHROPODA					
Malacostraca					
Syncarida					
Parabathynellidae	*Atopobathynella* sp.	9(1)	HH1267R	2020	Uncertain ID
Maxillopoda					
Cyclopoida					
Cyclopidae	*Microcyclops varicans*	18(2)	HH1267R, HH1272R	2020	Widespread in the Pilbara and WA
	Diacyclops sp.	1(1)	SJ0330R		Uncertain ID
Harpacticoida					
Miraciidae	*Schizopera* `BHA285`	1(1)	HCM0007	2020	**Study Area only (singleton)**
Ostracoda					
Podocopida					
Cyprididae	*Cyprinotus kimberleyensis* s.l.	7(2)	EJ1124R, PI031	2020	Widespread in the Pilbara, but potentially a species complex
Uncertain order	Ostracoda sp.	1(1)	EJR0001	2009	Uncertain ID, possibly one of the species above
TOTAL		**839(71)**			



Bennelongia Environmental Consultants

GCS GDA 1994
Author: bbuzatto
Date: 27/05/2021

Location of Study Area (bottom left map)

BHP tenements

Palaeovalleys

Stygofauna collected

Study Area

Figure 7. Stygofauna collected in the Study Area. Only species identified at least to genus are labelled.

5. DISCUSSION

5.1. Molecular Analysis

Some of the morphological identifications were constrained by the individuals collected being juveniles or females, and in these cases molecular analyses were used to substantiate identifications. In other cases, molecular analyses were used to further identifications. A summary of the conclusions of combined molecular and morphological results is given below for the 2020 survey, as well as an assessment of each species' vulnerability to development in the area:

Japygidae sp. (Entognatha: Diplura)
Five individual of two-pronged bristletails from the family Japygidae were collected in the 2020 survey (coded 47_B6 to 47_B10), but the majority of individuals were juveniles, and one of them was a badly deteriorated specimen, so a molecular analysis was the only means to determine how many species were represented by the specimens. Unfortunately, the poor condition individual collected from bore HH2053R did not return a sequence. Three of the other individuals sequenced were nearly identical in the CO1 gene (only 0 – 0.2% divergence; Table 6), but they were all **at least 8.5% divergent to all the other species in the analysis**, and did not group with any other species (Figure 8), confirming that these individuals represent a new species of Japygidae, here treated as Japygidae `BDP193`. The remaining individual, collected from bore PI031 (coded 47_B10), **was at least 12.5% divergent** in the CO1 gene from its closest relative, and also represents a new species, here treated as Japygidae `BDP192`.

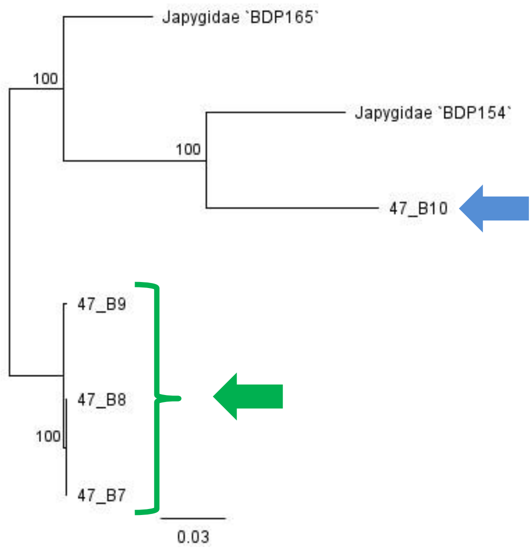


Figure 8: Neighbour-joining tree of Japygidae spp. based on MT-CO1.

Table 6: Intra (bold) and interspecific (not bold) divergences in MT-CO1 of species of subterranean diplurans from the family Japygidae.

	BDP165	EJ 47B9	EJ 47B8	EJ 47B7	BDP154
Japygidae `BDP165`					
East Jimblebar 47B9	8.5				
East Jimblebar 47B8	8.2	**0.2**			
East Jimblebar 47B7	8.2	**0.2**	**0**		
Japygidae `BDP154`	14.2	15.2	15.4	15.4	
East Jimblebar 47B10	16.1	16.5	16.7	16.7	12.5

***Phaconeura* sp. B04 (Hemiptera: Meenoplidae)**
Two individuals of the troglobitic planthopper genus *Phaconeura* were collected in the 2020 survey of the Study Area, but both of them were nymphs, so identification to the species level was not possible. The two juveniles were sequenced for the MT-CO1 gene and compared to 40 other sequences of the genus *Phaconeura*. The results of the molecular analyses confirmed that the new specimens are conspecifics (identical in their COI sequences) and that they belong to the widespread species *Phaconeura* sp. B04, with **only 0.2% - 0.4% divergence** (in the MT-CO1 gene) when compared to six individuals previously collected in Western Ridge and near Mount Sheila, more than 270 kms to the northwest of the Study Area.

***Dodecastyla* sp. (Zygentoma: Nicoletiidae)**

An adult female of the subterranean silverfish genus *Dodecastyla* was collected from bore EJ0679R, and given that males are necessary for a full identification in this genus (Smith and McRae 2014), the female was sequenced for the MT-CO1 gene. The female was compared to six other individuals, three of which were collected in Jimblebar previously. The analysis revealed two clades for the specimens (**Figure 9**), and the very low genetic divergences in MT-CO1 (Table 7) suggest that both clades represent the species *Dodecastyla* sp. B02, with a maximum divergence of 3.8%. Even if the different clades represent distinct species (i.e., if *Dodecastyla* sp. B02 was considered a species complex), the new specimen (coded 47_ B5 and highlighted in a red box in **Figure 9**) is conspecific with the individuals 47_B14 and 47_B16, previously collected 5 kms to the west of bore EJ0679R.

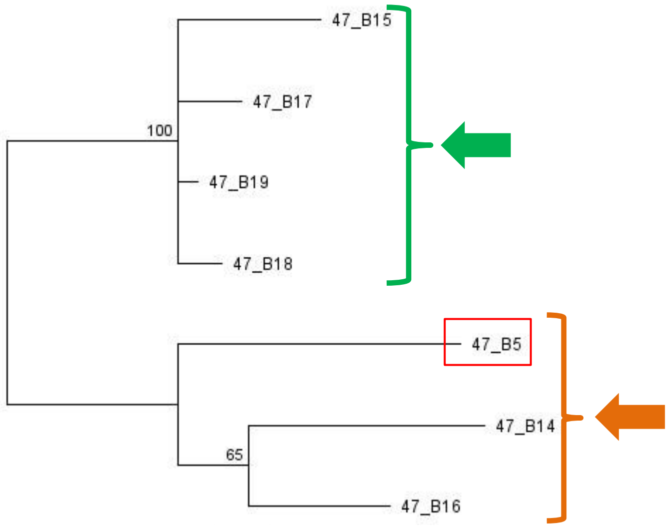


Figure 9: Neighbour-joining tree of *Dodecastyla* based on MT-CO1.

Table 7: Intra (bold) and interspecific (not bold) divergences in MT-CO1 of species of species of subterranean diplurans from the family Japygidae.

	47_B15	47_B17	47_B19	47_B18	47_B5	47_B14
47_B15: *Dodecastyla* sp. B02						
47_B17: *Dodecastyla* sp. B02	**1.2**					
47_B19: *Dodecastyla* sp. B02	**1.4**	**0.7**				
47_B18: *Dodecastyla* sp. B02	**1.4**	**1.2**	**0.5**			
East Jimblebar (47_B5)	4	3.8	3.6	3.6		
47_B14: *Dodecastyla* sp. B02	4	3.8	3.6	3.6	**2.9**	
47_B16: *Dodecastyla* sp. B02	3.6	3.3	3.1	3.1	**2.4**	**1.9**

***Symphylella* sp. B07 (Symphyla: Scolopendrellidae)**

Two individuals of the genus *Symphylella* were collected in the survey, and whereas one was too damaged to be used in molecular analyses, the other individual (morphologically identified to *Symphylella* sp. B07) was sent for sequencing, in order to confirm this identification. Unfortunately, that individual failed to return genetic sequences, so the morphological identification cannot be confirmed genetically. The morphological identification stands as *Symphylella* sp. B07.

5.2. Subterranean fauna at Hashimoto and Jimblebar East

The Study Area contains subterranean fauna communities of moderate diversity, with 29 troglofauna and 15 stygofauna species. The presence of spiders, pseudoscorpions and cockroaches suggests the troglofauna community has stronger subterranean affinity than the stygofauna community. The collection of 13 troglofauna species (45% of the community) known only from the Study Area reinforces this message.

The survey results for 2008-2009 and 2020 are in line with expectation based on the large number (109) of troglofauna species in the search area and the occurrence of banded iron in the Study Area. Hashimoto and East Jimblebar deposits contain weathered and mineralised Brockman Iron Formation, which is highly prospective for troglofauna. Not as many species have been collected as in central Pilbara deposits of comparable size but species richness declines for troglofaunal in the eastern Pilbara (Mokany *et al*. (2018).

With two-thirds of the stygofauna community comprised of worms of various kinds, and some worm and crustacean species with strong surface connections *(Dero nive*a, *Pristina longiseta*, *Microcyclops varicans*, *Cyprinotus kimberleyensis*), the community appears not to have strong stygofauna conservation values. Most rich stygofauna communities are dominated by crustaceans (Halse 2018b). Just one stygofauna species is known only from the Study area (the copepod *Schizopera* 'BHA285'), although some species of worm belong to species complexes. These complexes are treated as widespread species, but further taxonomic work may show one of more of the Study Area representatives in the complexes have restricted distributions.

The most likely reason for the somewhat unusual composition and only moderate richness of the stygofauna community is the large depth to watertable in the Study Area. The shallowest depth to watertable was 43 m and most holes had standing water levels of 50-90 m below ground level (bgl). Halse *et al*. (2014) found that rich stygofauna communities were rarely collected in the Pilbara where the watertable is much greater than 30 m bgl. For this and other geological reasons, the richness and endemism that characterises the stygofauna community Ethel Gorge TEC (less than 50 km to the west) and many parts of the central Pilbara is almost absent from the Study Area.

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Appendix 1 – Previous troglofauna records in the 100 x 100 km search area

Higher Order Identification	Lowest Identification
ARTHROPODA	
Chelicerata	
Arachnida	
Araneae	Araneomorphae sp. Jim 1
Gnaphosidae	nr *Encoptarthria* sp. B02
	nr *Encoptarthria* sp. B03
Oonopidae	*Prethopalpus* sp. B05
	Prethopalpus sp. B09
	Prethopalpus sp. B10
	Prethopalpus sp. B22
	Prethopalpus sp. B29
	Prethopalpus sp. B30
Opiliones	Opiliones sp. B05
Assamiidae	*Dampetrus* sp. B03 (nr *isolatus*)
Palpigradi	Palpigradi sp. B01
	Palpigradi sp. B03
	Palpigradi sp. B16
	Palpigradi sp. B17
	Palpigradi sp. indet. OB
Eukoeneniidae	*Eukoenenia* sp.
Pseudoscorpiones	
Chthoniidae	*Lagynochthonius* `PSE040`
	Lagynochthonius PSE097
	Tyrannochthonius `PSE052`
	Tyrannochthonius `PSE056`
	Tyrannochthonius `PSE057`
	Tyrannochthonius `PSE059`
	Tyrannochthonius aridus
	Tyrannochthonius sp. B11
	Tyrannochthonius sp. B28
	Tyrannochthonius sp. OP
Lechytiidae	*Lechytia* `PSE019`
Olpiidae	Olpiidae sp.
Schizomida	
Hubbardiidae	*Draculoides* SCH034
	Draculoides SCH055
	Draculoides SCH067
	Draculoides neoanthropus
Crustacea	
Malacostraca	
Isopoda	
?Stenoniscidae	?Stenoniscidae sp. OB
Armadillidae	?*Buddelundia* sp. B01
	Troglarmadillo sp. B
	Troglarmadillo sp. B07
	Troglarmadillo sp. B09
	Troglarmadillo sp. B34
	Troglarmadillo sp. B38
	Troglarmadillo sp. B39
	Troglarmadillo sp. B42
	Troglarmadillo sp. B48
	Troglarmadillo sp. B49
	Armadillidae sp. B12
Philosciidae	nr *Andricophiloscia* sp. B17

Higher Order Identification	Lowest Identification
Stenoniscidae	Stenoniscidae gen. nov. sp. B01
	Stenoniscidae gen. nov. sp. B06
Hexapoda	
Entognatha	
Diplura	
Japygidae	Japygidae `BDP154` (DPL002)
	Japygidae `DPL002` s.l.
	Japygidae sp. B09
Parajapygidae	Parajapygidae `BDP189`
	Parajapygidae sp. B05 (*Parajapyx swani* group)
	Parajapygidae sp. B26
Insecta	
Blattodea	
Blattidae	Blattidae sp.
Nocticolidae	*Nocticola quartermainei* s.l.
Coleoptera	
Curculionidae	Curculionidae Genus 1 sp. B01
Ptiliidae	*Ptinella* sp. B01 (=MC)
	Rodwayia sp. B01
Staphylinidae	Pselaphinae sp. B01
	Staphylinidae sp.
Diptera	
Sciaridae	Sciaridae sp. B01
Hemiptera	
Cixiidae	Cixiidae sp. B02
Meenoplidae	*Phaconeura* sp. B03
	Phaconeura sp. B04
Zygentoma	
Nicoletiidae	Atelurinae sp. (=?*Atelurodes* sp.)
	Atelurinae sp. B09
	Dodecastyla sp. B02 (=*Atelurodes* sp. S02)
	Trinemura sp. B04
	Trinemura sp. B13
	Trinemura sp. B24
	Trinemura sp. B26
Myriapoda	
Chilopoda	
Geophilida	
Chilenophilidae	Chilenophilidae sp. B08
Schendylidae	nr *Australoschendyla* sp. B02
Scolopendrida	
Cryptopidae	*Cryptops* sp. B09
	Cryptops sp. B10 (= Scolopendrida sp. S05)
	Cryptops sp. B43
Diplopoda	
Polydesmida	
Dalodesmidae	Dalodesmidae sp. B06
Polyxenida	
Lophoproctidae	*Lophoturus madecassus*
Polyxenidae	Polyxenidae sp.
Spirobolida	
Trigoniulidae	?*Speleostrophus* `DIP051`
Pauropoda	
Tetramerocerata	
Pauropodidae	*Allopauropus* sp. B02
	Decapauropus sp. B04
	Decapauropus sp. B05
	Pauropodidae `BPU097`

Higher Order Identification	Lowest Identification
	Pauropodidae sp. B01 s.l.
	Pauropodidae sp. B04 (*Decapauropus tenuis*?)
	Pauropodidae sp. B05
	Pauropodidae sp. B07
	Pauropodidae sp. B09
	Pauropodidae sp. B28 (B04 group)
	Pauropodidae sp. B32
Symphyla	
Cephalostigmata	
Scolopendrellidae	*Symphylella* sp. B02 (BHP)
	Symphylella sp. B07
Scutigerellidae	*Hanseniella* sp. B01
	Hanseniella sp. B04
	Hanseniella sp. B19
	Hanseniella sp. B20
	Hanseniella sp. B24
	Hanseniella sp. B25
	Hanseniella sp. B26
	Hanseniella sp. B27
	Scutigerella sp. B06

Appendix 2 – Previous stygofauna records in the 100 x 100 km search area

Higher Order Identification	Lowest Identification
ANNELIDA	
Aphanoneura	
Aeolosomatidae	*Aeolosoma* sp. 1 (PSS)
	Aeolosoma sp. 2 (PSS)
	Aeolosoma sp. OB
Clitellata	
Enchytraeida	
Enchytraeidae	*Achaeta* sp.
	Enchytraeidae \`Biota1\`
	Enchytraeidae \`PST1\` s.l. (E06)
	Enchytraeidae sp. E06-B05
	Enchytraeidae sp. E08
	Enchytraeidae sp. E12
	Enchytraeidae sp. E12-02
	Enchytraeidae sp. OB2
	Enchytraeidae sp. OB3
	Enchytraeidae sp. OB4
	Enchytraeus sp. AP PSS1 s.l.
	Enchytraeus sp. AP PSS2 s.l.
Haplotaxida	
Naididae	*Allonais pectinata*
	Dero (*Dero*) *nivea*
	Naididae sp. N03
	Pristina aequiseta
	Pristina longiseta
Phreodrilidae	*Antarctodrilus* sp. OB4
	Insulodrilus \`WA31\`
	Phreodrilidae sp. ?P11
	Phreodrilidae sp. AP DVC s.l.
	Phreodrilidae sp. AP SVC s.l.
	Phreodrilidae sp. B05
	Phreodrilidae sp. OB3
	Phreodrilidae sp. P10
	Phreodrilidae sp. P11
	Phreodrilidae sp. P15
	Phreodrilidae sp. WAM indet. 1
	Phreodrilus peniculus
Tubificidae	*Ainudrilus* sp. WA27 (PSS)
	Tubificidae \`stygo type 1A\`
	Tubificidae \`stygo type 4\`
	Tubificidae \`stygo type 5\`
	Tubificidae sp.
ARTHROPODA	
Arachnida	Trombidiformes
Mideopsidae	*Guineaxonopsis* sp. S01 group (PSS)
Pezidae	*Peza* \`ACA001\`
Insecta	
Coleoptera	
Dytiscidae	*Limbodessus* sp.
Malacostraca	
Amphipoda	
Melitidae	Melitidae sp.
Paramelitidae	*Chydaekata* \`AMP005\`
	Chydaekata \`E\`

Higher Order Identification	Lowest Identification
	Chydaekata acuminata
	Chydaekata sp. OB1
	Chydaekata simulata
	Kruptus `AMP004`
	Maarrka etheli
	Paramelitidae gen. nov. 1 `AMP001`
	Paramelitidae gen. nov. 1 `AMP001`/`AMP002`
	Paramelitidae gen. nov. 1 `AMP002`
	Paramelitidae gen. nov. 1 `AMP003`
	Paramelitidae sp. 2 s.l. (PSS)
	Paramelitidae sp. B34
	Paramelitidae sp. OB1 (B33)
	Paramelitidae sp. OB2
	Paramelitidae sp. OB3_AMP003
	Pilbarus millsi s.l.
	Pilbarus sp. S01 (PSS)
Isopoda	
Microcerberidae	*Coxicerberus* `ISO019`
	Coxicerberus sp. OB2
	Microceberidae sp. OB
Tainisopidae	*Pygolabis humphreysi*
Spelaeogriphacea	
Spelaeogriphidae	*Mangkurtu kutjarra*
Syncarida	
Bathynellidae	*Bathynella* sp. B11
	Bathynellidae `sp. OB1`
	Pilbaranella `A`
	Pilbaranella `B`
	Pilbaranella `C`
	Pilbaranella ethelensis
	Pilbaranella sp. B12 (=`poss sp. D`)
Parabathynellidae	*Atopobathynella* sp. B18
	Atopobathynella `sp. B04`
	Atopobathynella `sp. DNA02`
	Billibathynella `SYN001`
	Billibathynella cassidis
	Billibathynella `sp. OB1`
	Brevisomabathynella pilbaraensis
	Notobathynella sp.
Maxillopoda	
Calanoida	Calanoida sp.
Cyclopoida	Cyclopoida sp.
Cyclopidae	*Anzcyclops* sp. B06
	Anzcyclops sp. OB
	Diacyclops cockingi
	Diacyclops humphreysi s.l.
	Diacyclops sobeprolatus
	Dussartcyclops uniarticulatus s.l.
	Halicyclops calm
	Mesocyclops brooksi
	Mesocyclops notius
	Microcyclops varicans
	nr *Pilbaracyclops* sp. OB
	Orbuscyclops westaustraliensis
	Pescecyclops pilbaricus
	Pilbaracyclops supersensus
	Thermocyclops aberrans
	Thermocyclops decipiens

Higher Order Identification	Lowest Identification
	Tropocyclops prasinus
Harpacticoida	
Ameiridae	*Archinitocrella newmanensis*
	Megastygonitocrella bispinosa
	Nitocrella `ophthalmia`
	Nitocrella karanovici
	Nitocrella sp. 1 (PSS)
Canthocamptidae	*Australocamptus* sp. B10
	Elaphoidella sp.
Parastenocarididae	*Parastenocaris* `COP001`
	Parastenocaris `COP002`
	Parastenocaris jane
	Parastenocaris sp. OB1 (= P. sp. B02)
Ostracoda	
Podocopida	
Candonidae	*Areacandona* `7` (PSS)
	Areacandona mulgae
	Areacandona newmani
	Areacandona nr *iuno*
	Areacandona scanloni
	Candonopsis tenuis
	Meridiescandona `3` (PSS)
	Meridiescandona lucerna
	Meridiescandona nr *facies* (PSS)
	Notacandona `BOS119` (sp. nov.)
	Notacandona gratia
	Origocandona `BOS099`
	Origocandona gratia
	Origocandona grommike
	Origocandona inanitas
	Pilbaracandona `OST001`
	Pilbaracandona `OST002`
	Pilbaracandona colonia
	Pilbaracandona eberhardi
	Pilbaracandona kosmos
	Pilbaracandona rhabdote
	Pilbaracandona temporaria
Cyprididae	*Cypretta seurati*
	Cypridopsis vidua
	Cyprinopsinae sp.
	Cyprinotus kimberleyensis s.l.
	Ilyodromus sp.
	Riocypris fitzroyi
	Sarscypridopsis ochracea
	Stenocypris bolieki
	Stenocypris malcolmsoni
	Strandesia sp.
Darwinulidae	*Vestalenula marmonieri*
Limnocytheridae	*Gomphodella hirsuta*
	Limnocythere stationis
NEMATODA	Nematoda sp. 01 (rat-tailed gp) (PSS)
	Nematoda spp.
PLATYHELMINTHES	
Turbellaria	Turbellaria sp.
ROTIFERA	
Bdelloidea	Bdelloidea sp. 2:2

Appendix 3 – Drill holes sampled in the Study Area.

Field Code	Latitude	Longitude	Visit Date	Sample Name	Depth to water (m)	Conductivity (µS/cm)	pH
70R	-23.38771666	120.2891732	30/06/2020	Net	41	1089	6.25
CM0038R	-23.3940265	120.2712492	7/03/2020	Net	68	1315	7
CM0038R	-23.3940265	120.2712492	1/07/2020	Net	68	1315	7
CM0077R	-23.37337869	120.2704911	6/03/2020	Scrape	59		
CM0077R	-23.37337869	120.2704911	28/06/2020	Scrape	59		
CM0077R	-23.37337869	120.2704911	6/03/2020	Trap 1	59		
CM0077R	-23.37337869	120.2704911	28/06/2020	Trap 1	59		
CM0089R	-23.36743181	120.2705391	6/03/2020	Scrape	65		
CM0089R	-23.36743181	120.2705391	6/03/2020	Trap 1	65		
CM0089R	-23.36700716	120.2705267	28/06/2020	Scrape	65		
CM0089R	-23.36700716	120.2705267	28/06/2020	Trap 1	65		
EJ0523R	-23.37151306	120.2398574	5/03/2020	Scrape			
EJ0523R	-23.37151306	120.2398574	28/06/2020	Scrape			
EJ0523R	-23.37151306	120.2398574	5/03/2020	Trap 1			
EJ0523R	-23.37151306	120.2398574	28/06/2020	Trap 1			
EJ0524R	-23.38352973	120.2399456	5/03/2020	Scrape			
EJ0524R	-23.38352973	120.2399456	29/06/2020	Scrape			
EJ0524R	-23.38352973	120.2399456	5/03/2020	Trap 1			
EJ0524R	-23.38352973	120.2399456	29/06/2020	Trap 1			
EJ0530RE	-23.37315527	120.242764	6/03/2020	Scrape			
EJ0530RE	-23.37315527	120.242764	28/06/2020	Scrape			
EJ0530RE	-23.37315527	120.242764	6/03/2020	Trap 1			
EJ0530RE	-23.37315527	120.242764	28/06/2020	Trap 1			
EJ0546R	-23.37583165	120.2486922	5/03/2020	Scrape			
EJ0546R	-23.37583165	120.2486922	28/06/2020	Scrape			
EJ0546R	-23.37583165	120.2486922	5/03/2020	Trap 1			
EJ0546R	-23.37583165	120.2486922	28/06/2020	Trap 1			
EJ0573R	-23.36624136	120.256252	5/03/2020	Scrape	62		
EJ0573R	-23.36624136	120.256252	28/06/2020	Scrape	62		
EJ0573R	-23.36624136	120.256252	5/03/2020	Trap 1	62		
EJ0573R	-23.36624136	120.256252	28/06/2020	Trap 1	62		
EJ0573R	-23.36624136	120.256252	5/03/2020	Trap 2	62		
EJ0578R	-23.37356248	120.2593658	8/03/2020	Net	65	1585	7
EJ0578R	-23.37356248	120.2593658	1/07/2020	Net	65	1585	7
EJ0581RE	-23.3681224	120.2593672	8/03/2020	Net	65	1669	7
EJ0581RE	-23.3681224	120.2593672	30/06/2020	Net	65	1669	7
EJ0584R	-23.36650218	120.2592714	5/03/2020	Scrape			
EJ0584R	-23.36650218	120.2592714	28/06/2020	Scrape			
EJ0584R	-23.36650218	120.2592714	5/03/2020	Trap 1			
EJ0584R	-23.36650218	120.2592714	28/06/2020	Trap 1			
EJ0585R	-23.37717406	120.2622078	6/03/2020	Scrape			

Field Code	Latitude	Longitude	Visit Date	Sample Name	Depth to water (m)	Conductivity (µS/cm)	pH
EJ0585R	-23.37717406	120.2622078	28/06/2020	Scrape			
EJ0585R	-23.37717406	120.2622078	6/03/2020	Trap 1			
EJ0585R	-23.37717406	120.2622078	28/06/2020	Trap 1			
EJ0606R	-23.3680105	120.2681654	6/03/2020	Scrape			
EJ0606R	-23.3680105	120.2681654	28/06/2020	Scrape			
EJ0606R	-23.3680105	120.2681654	6/03/2020	Trap 1			
EJ0606R	-23.3680105	120.2681654	28/06/2020	Trap 1			
EJ0606R	-23.3680105	120.2681654	6/03/2020	Trap 2			
EJ0606R	-23.3680105	120.2681654	28/06/2020	Trap 2			
EJ0609R	-23.37030485	120.2455107	5/03/2020	Scrape			
EJ0609R	-23.37030485	120.2455107	28/06/2020	Scrape			
EJ0609R	-23.37030485	120.2455107	5/03/2020	Trap 1			
EJ0609R	-23.37030485	120.2455107	28/06/2020	Trap 1			
EJ0609R	-23.37030485	120.2455107	5/03/2020	Trap 2			
EJ0618R	-23.37838913	120.2314743	5/03/2020	Scrape	60		
EJ0618R	-23.37838913	120.2314743	27/06/2020	Scrape	60		
EJ0618R	-23.37838913	120.2314743	5/03/2020	Trap 1	60		
EJ0618R	-23.37838913	120.2314743	27/06/2020	Trap 1	60		
EJ0639R	-23.37564366	120.2324852	5/03/2020	Scrape			
EJ0639R	-23.37564366	120.2324852	27/06/2020	Scrape			
EJ0639R	-23.37564366	120.2324852	5/03/2020	Trap 1			
EJ0639R	-23.37564366	120.2324852	27/06/2020	Trap 1			
EJ0658R	-23.374657	120.2339477	27/06/2020	Scrape	59		
EJ0658R	-23.374657	120.2339477	27/06/2020	Trap 1	59		
EJ0659R	-23.37429095	120.2339504	7/03/2020	Scrape	69		
EJ0659R	-23.37429095	120.2339504	7/03/2020	Trap 1	69		
EJ0660R	-23.37383951	120.2339499	7/03/2020	Scrape	69		
EJ0660R	-23.37383951	120.2339499	27/06/2020	Scrape	69		
EJ0660R	-23.37383951	120.2339499	7/03/2020	Trap 1	69		
EJ0660R	-23.37383951	120.2339499	27/06/2020	Trap 1	69		
EJ0662R	-23.38309627	120.2354093	6/03/2020	Scrape			
EJ0662R	-23.38309627	120.2354093	29/06/2020	Scrape			
EJ0662R	-23.38309627	120.2354093	6/03/2020	Trap 1			
EJ0662R	-23.38309627	120.2354093	29/06/2020	Trap 1			
EJ0678R	-23.37588599	120.2353826	5/03/2020	Scrape	89		
EJ0678R	-23.37588599	120.2353826	27/06/2020	Scrape	89		
EJ0678R	-23.37588599	120.2353826	5/03/2020	Trap 1	89		
EJ0678R	-23.37588599	120.2353826	27/06/2020	Trap 1	89		
EJ0678R	-23.37588599	120.2353826	27/06/2020	Trap 2	89		
EJ0679R	-23.3754313	120.2354043	6/03/2020	Scrape			
EJ0679R	-23.3754313	120.2354043	27/06/2020	Scrape			
EJ0679R	-23.3754313	120.2354043	6/03/2020	Trap 1			
EJ0679R	-23.3754313	120.2354043	27/06/2020	Trap 1			

Field Code	Latitude	Longitude	Visit Date	Sample Name	Depth to water (m)	Conductivity (µS/cm)	pH
EJ0679R	-23.3754313	120.2354043	6/03/2020	Trap 2			
EJ0683R	-23.38404155	120.2368809	5/03/2020	Scrape			
EJ0683R	-23.38404155	120.2368809	29/06/2020	Scrape			
EJ0683R	-23.38404155	120.2368809	5/03/2020	Trap 1			
EJ0683R	-23.38404155	120.2368809	29/06/2020	Trap 1			
EJ0688R	-23.38086145	120.2368928	5/03/2020	Scrape			
EJ0688R	-23.38086145	120.2368928	29/06/2020	Scrape			
EJ0688R	-23.38086145	120.2368928	5/03/2020	Trap 1			
EJ0688R	-23.38086145	120.2368928	29/06/2020	Trap 1			
EJ0688R	-23.38086145	120.2368928	5/03/2020	Trap 2			
EJ0688R	-23.38086145	120.2368928	29/06/2020	Trap 2			
EJ0768R	-23.37459501	120.2413356	5/03/2020	Scrape			
EJ0768R	-23.37459501	120.2413356	28/06/2020	Scrape			
EJ0768R	-23.37459501	120.2413356	5/03/2020	Trap 1			
EJ0768R	-23.37459501	120.2413356	28/06/2020	Trap 1			
EJ0768R	-23.37459501	120.2413356	28/06/2020	Trap 2			
EJ0771R	-23.38401338	120.2427582	5/03/2020	Scrape			
EJ0771R	-23.38401338	120.2427582	29/06/2020	Scrape			
EJ0771R	-23.38401338	120.2427582	5/03/2020	Trap 1			
EJ0771R	-23.38401338	120.2427582	29/06/2020	Trap 1			
EJ0791R	-23.38243063	120.2442052	8/03/2020	Net			
EJ0791R	-23.38243063	120.2442052	1/07/2020	Net			
EJ0798R	-23.37928191	120.2442184	5/03/2020	Scrape	62		
EJ0798R	-23.37928191	120.2442184	29/06/2020	Scrape	62		
EJ0798R	-23.37928191	120.2442184	5/03/2020	Trap 1	62		
EJ0798R	-23.37928191	120.2442184	29/06/2020	Trap 1	62		
EJ0798R	-23.37928191	120.2442184	5/03/2020	Trap 2	62		
EJ0833R	-23.38311521	120.2471456	8/03/2020	Net			
EJ0833R	-23.38311521	120.2471456	1/07/2020	Net			
EJ0868R	-23.38534323	120.2500718	6/03/2020	Scrape			
EJ0868R	-23.38534323	120.2500718	28/06/2020	Scrape			
EJ0868R	-23.38534323	120.2500718	6/03/2020	Trap 1			
EJ0868R	-23.38534323	120.2500718	28/06/2020	Trap 1			
EJ0868R	-23.38534323	120.2500718	28/06/2020	Trap 2			
EJ0886R	-23.37675519	120.2500819	6/03/2020	Scrape			
EJ0886R	-23.37675519	120.2500819	28/06/2020	Scrape			
EJ0886R	-23.37675519	120.2500819	6/03/2020	Trap 1			
EJ0886R	-23.37675519	120.2500819	28/06/2020	Trap 1			
EJ0889R	-23.37299426	120.2500733	5/03/2020	Scrape			
EJ0889R	-23.37299426	120.2500733	28/06/2020	Scrape			
EJ0889R	-23.37299426	120.2500733	5/03/2020	Trap 1			
EJ0889R	-23.37299426	120.2500733	28/06/2020	Trap 1			
EJ0889R	-23.37299426	120.2500733	28/06/2020	Trap 2			

Field Code	Latitude	Longitude	Visit Date	Sample Name	Depth to water (m)	Conductivity (µS/cm)	pH
EJ0890R	-23.38674922	120.2515534	6/03/2020	Scrape			
EJ0890R	-23.38674922	120.2515534	28/06/2020	Scrape			
EJ0890R	-23.38674922	120.2515534	6/03/2020	Trap 1			
EJ0890R	-23.38674922	120.2515534	28/06/2020	Trap 1			
EJ0948R	-23.371269	120.252534	5/03/2020	Scrape			
EJ0948R	-23.371269	120.252534	28/06/2020	Scrape			
EJ0948R	-23.371269	120.252534	5/03/2020	Trap 1			
EJ0948R	-23.371269	120.252534	28/06/2020	Trap 1			
EJ0956R	-23.38526203	120.2540285	8/03/2020	Net			
EJ0956R	-23.38526203	120.2540285	1/07/2020	Net			
EJ0997R	-23.38290096	120.2550182	6/03/2020	Scrape			
EJ0997R	-23.38290096	120.2550182	28/06/2020	Scrape			
EJ0997R	-23.38290096	120.2550182	6/03/2020	Trap 1			
EJ0997R	-23.38290096	120.2550182	28/06/2020	Trap 1			
EJ1011R	-23.37564323	120.2549811	6/03/2020	Scrape			
EJ1011R	-23.37564323	120.2549811	28/06/2020	Scrape			
EJ1011R	-23.37564323	120.2549811	6/03/2020	Trap 1			
EJ1011R	-23.37564323	120.2549811	28/06/2020	Trap 1			
EJ1011R	-23.37564323	120.2549811	28/06/2020	Trap 2			
EJ1052R	-23.38129077	120.2579409	6/03/2020	Scrape			
EJ1052R	-23.38129077	120.2579409	28/06/2020	Scrape			
EJ1052R	-23.38129077	120.2579409	6/03/2020	Trap 1			
EJ1052R	-23.38129077	120.2579409	28/06/2020	Trap 1			
EJ1073R	-23.370902	120.257906	5/03/2020	Scrape	64		
EJ1073R	-23.370902	120.257906	28/06/2020	Scrape	64		
EJ1073R	-23.370902	120.257906	5/03/2020	Trap 1	64		
EJ1073R	-23.370902	120.257906	28/06/2020	Trap 1	64		
EJ1073R	-23.370902	120.257906	28/06/2020	Trap 2	64		
EJ1088R	-23.37583911	120.2593746	5/03/2020	Scrape	69		
EJ1088R	-23.37583911	120.2593746	28/06/2020	Scrape	69		
EJ1088R	-23.37583911	120.2593746	5/03/2020	Trap 1	69		
EJ1088R	-23.37583911	120.2593746	28/06/2020	Trap 1	69		
EJ1088R	-23.37583911	120.2593746	5/03/2020	Trap 2	69		
EJ1124R	-23.36822555	120.2608529	5/03/2020	Scrape	67		
EJ1124R	-23.36822555	120.2608529	28/06/2020	Scrape	67		
EJ1124R	-23.36822555	120.2608529	5/03/2020	Trap 1	67		
EJ1124R	-23.36822555	120.2608529	28/06/2020	Trap 1	67		
EJ1185R	-23.37576983	120.2666607	6/03/2020	Scrape	60		
EJ1185R	-23.37576983	120.2666607	28/06/2020	Scrape	60		
EJ1185R	-23.37576983	120.2666607	6/03/2020	Trap 1	60		
EJ1185R	-23.37576983	120.2666607	28/06/2020	Trap 1	60		
EJ1185R	-23.37576983	120.2666607	6/03/2020	Trap 2	60		
EJ1185R	-23.37576983	120.2666607	28/06/2020	Trap 2	60		

Field Code	Latitude	Longitude	Visit Date	Sample Name	Depth to water (m)	Conductivity (µS/cm)	pH
EJ1208R	-23.36531461	120.2667025	6/03/2020	Scrape	70		
EJ1208R	-23.36531461	120.2667025	28/06/2020	Scrape	70		
EJ1208R	-23.36531461	120.2667025	6/03/2020	Trap 1	70		
EJ1208R	-23.36531461	120.2667025	28/06/2020	Trap 1	70		
EJ1211R	-23.37406112	120.2681434	6/03/2020	Scrape			
EJ1211R	-23.37406112	120.2681434	28/06/2020	Scrape			
EJ1211R	-23.37406112	120.2681434	6/03/2020	Trap 1			
EJ1211R	-23.37406112	120.2681434	28/06/2020	Trap 1			
EJ1241R	-23.38465602	120.2564009	6/03/2020	Scrape			
EJ1241R	-23.38465602	120.2564009	28/06/2020	Scrape			
EJ1241R	-23.38465602	120.2564009	6/03/2020	Trap 1			
EJ1241R	-23.38465602	120.2564009	28/06/2020	Trap 1			
EJ1246R	-23.37832942	120.2608357	6/03/2020	Scrape			
EJ1246R	-23.37832942	120.2608357	28/06/2020	Scrape			
EJ1246R	-23.37832942	120.2608357	6/03/2020	Trap 1			
EJ1246R	-23.37832942	120.2608357	28/06/2020	Trap 1			
EJ1249R	-23.3803495	120.2637827	6/03/2020	Scrape			
EJ1249R	-23.3803495	120.2637827	28/06/2020	Scrape			
EJ1249R	-23.3803495	120.2637827	6/03/2020	Trap 1			
EJ1249R	-23.3803495	120.2637827	28/06/2020	Trap 1			
EJ1250R	-23.37816896	120.2651552	6/03/2020	Scrape			
EJ1250R	-23.37816896	120.2651552	28/06/2020	Scrape			
EJ1250R	-23.37816896	120.2651552	6/03/2020	Trap 1			
EJ1250R	-23.37816896	120.2651552	28/06/2020	Trap 1			
EJ1252R	-23.37835606	120.2622928	6/03/2020	Scrape			
EJ1252R	-23.37835606	120.2622928	28/06/2020	Scrape			
EJ1252R	-23.37835606	120.2622928	6/03/2020	Trap 1			
EJ1252R	-23.37835606	120.2622928	28/06/2020	Trap 1			
EJ1252R	-23.37835606	120.2622928	6/03/2020	Trap 2			
EJ1252R	-23.37835606	120.2622928	28/06/2020	Trap 2			
HCM0005	-23.38235552	120.2726485	7/03/2020	Net			
HCM0005	-23.38235552	120.2726485	1/07/2020	Net			
HCM0007	-23.37776818	120.2828985	7/03/2020	Net			
HCM0007	-23.37776818	120.2828985	30/06/2020	Net			
HCM0008	-23.37779081	120.2825077	7/03/2020	Net			
HCM0008	-23.37779081	120.2825077	30/06/2020	Net			
HCM0009	-23.37809403	120.2834758	7/03/2020	Net			
HCM0009	-23.37809403	120.2834758	30/06/2020	Net			
HCM0010	-23.36883443	120.2841688	8/03/2020	Net	58.2	1452	7
HCM0011	-23.38216833	120.3002638	30/06/2020	Net			
HCM0012	-23.3818851	120.3014451	1/07/2020	Net			
HCM0016	-23.37752566	120.3017608	30/06/2020	Net			
HCM0017	-23.37746563	120.3024431	8/03/2020	Net			

Field Code	Latitude	Longitude	Visit Date	Sample Name	Depth to water (m)	Conductivity (µS/cm)	pH
HCM0018	-23.38577849	120.2836626	8/03/2020	Net			
HCM0018	-23.38577849	120.2836626	30/06/2020	Net			
HCM0021	-23.38584359	120.2780949	7/03/2020	Net			
HCM0021	-23.38584359	120.2780949	30/06/2020	Net			
HCM0022	-23.38581374	120.2785591	7/03/2020	Net			
HCM0022	-23.38581374	120.2785591	30/06/2020	Net			
HCM0025	-23.38592266	120.311178	8/03/2020	Net			
HCM0025	-23.38592266	120.311178	30/06/2020	Net			
HCM0027	-23.38129046	120.2931489	8/03/2020	Net			
HCM0027	-23.38129046	120.2931489	30/06/2020	Net			
HCM0029	-23.37982752	120.2669194	8/03/2020	Net			
HCM0029	-23.37982752	120.2669194	1/07/2020	Net			
HCM0034	-23.36724648	120.2909192	8/03/2020	Net	59.9		
HCM0037	-23.38535983	120.294812	30/06/2020	Net			
HCM0040	-23.38111492	120.2930511	8/03/2020	Net			
HCM0040	-23.38111492	120.2930511	30/06/2020	Net			
HH0478R	-23.36377419	120.1872128	10/03/2020	Net	53.6		
HH0478R	-23.36377419	120.1872128	29/06/2020	Net	53.6		
HH0520R	-23.36745771	120.1895713	7/03/2020	Scrape			
HH0520R	-23.36745771	120.1895713	29/06/2020	Scrape			
HH0520R	-23.36745771	120.1895713	7/03/2020	Trap 1			
HH0520R	-23.36745771	120.1895713	29/06/2020	Trap 1			
HH0719R	-23.36565004	120.1892821	10/03/2020	Net	53.81	187	6.49
HH0719R	-23.36565004	120.1892821	29/06/2020	Net	53.81	187	6.49
HH0854R	-23.37666115	120.1971081	7/03/2020	Scrape			
HH0854R	-23.37666115	120.1971081	25/06/2020	Scrape			
HH0854R	-23.37666115	120.1971081	7/03/2020	Trap 1			
HH0854R	-23.37666115	120.1971081	25/06/2020	Trap 1			
HH0855R	-23.37843324	120.1970769	7/03/2020	Scrape			
HH0855R	-23.37843324	120.1970769	25/06/2020	Scrape			
HH0855R	-23.37843324	120.1970769	7/03/2020	Trap 1			
HH0855R	-23.37843324	120.1970769	25/06/2020	Trap 1			
HH0856R	-23.38389957	120.2062999	7/03/2020	Scrape			
HH0856R	-23.38389957	120.2062999	25/06/2020	Scrape			
HH0856R	-23.38389957	120.2062999	7/03/2020	Trap 1			
HH0856R	-23.38389957	120.2062999	25/06/2020	Trap 1			
HH0857R	-23.38212003	120.2064075	7/03/2020	Scrape			
HH0857R	-23.38212003	120.2064075	25/06/2020	Scrape			
HH0857R	-23.38212003	120.2064075	7/03/2020	Trap 1			
HH0857R	-23.38212003	120.2064075	25/06/2020	Trap 1			
HH0857R	-23.38212003	120.2064075	25/06/2020	Trap 2			
HH0858R	-23.38076735	120.2063701	7/03/2020	Scrape			
HH0858R	-23.38076735	120.2063701	25/06/2020	Scrape			

Field Code	Latitude	Longitude	Visit Date	Sample Name	Depth to water (m)	Conductivity (µS/cm)	pH
HH0858R	-23.38076735	120.2063701	7/03/2020	Trap 1			
HH0858R	-23.38076735	120.2063701	25/06/2020	Trap 1			
HH0859R	-23.38584807	120.2061607	6/03/2020	Scrape			
HH0859R	-23.38584807	120.2061607	25/06/2020	Scrape			
HH0859R	-23.38584807	120.2061607	6/03/2020	Trap 1			
HH0859R	-23.38584807	120.2061607	25/06/2020	Trap 1			
HH0880R	-23.38596477	120.2141959	6/03/2020	Scrape			
HH0880R	-23.38596477	120.2141959	25/06/2020	Scrape			
HH0880R	-23.38596477	120.2141959	6/03/2020	Trap 1			
HH0880R	-23.38596477	120.2141959	25/06/2020	Trap 1			
HH0881R	-23.38758855	120.2141679	6/03/2020	Scrape			
HH0881R	-23.38758855	120.2141679	25/06/2020	Scrape			
HH0881R	-23.38758855	120.2141679	6/03/2020	Trap 1			
HH0881R	-23.38758855	120.2141679	25/06/2020	Trap 1			
HH1250R	-23.36496318	120.1920197	7/03/2020	Scrape	52		
HH1250R	-23.36496318	120.1920197	29/06/2020	Scrape	52		
HH1250R	-23.36496318	120.1920197	7/03/2020	Trap 1	52		
HH1250R	-23.36496318	120.1920197	29/06/2020	Trap 1	52		
HH1261R	-23.36579268	120.1924627	7/03/2020	Scrape			
HH1261R	-23.36579268	120.1924627	29/06/2020	Scrape			
HH1261R	-23.36579268	120.1924627	7/03/2020	Trap 1			
HH1261R	-23.36579268	120.1924627	29/06/2020	Trap 1			
HH1264R	-23.36549321	120.1915216	7/03/2020	Scrape			
HH1264R	-23.36549321	120.1915216	29/06/2020	Scrape			
HH1264R	-23.36549321	120.1915216	7/03/2020	Trap 1			
HH1264R	-23.36549321	120.1915216	29/06/2020	Trap 1			
HH1264R	-23.36549321	120.1915216	29/06/2020	Trap 2			
HH1267R	-23.36401525	120.1899967	9/03/2020	Net	53.68	913	7
HH1267R	-23.36401525	120.1899967	29/06/2020	Net	53.68	913	7
HH1272R	-23.36255991	120.1899359	9/03/2020	Net	50.18	409	7
HH1272R	-23.36255991	120.1899359	29/06/2020	Net	50.18	409	7
HH1519R	-23.36632012	120.191891	10/03/2020	Net	54.42	115.1	6.45
HH1519R	-23.36632012	120.191891	29/06/2020	Net	54.42	115.1	6.45
HH1522R	-23.36427029	120.1934149	6/03/2020	Scrape	52		
HH1522R	-23.36427029	120.1934149	26/06/2020	Scrape	52		
HH1522R	-23.36427029	120.1934149	6/03/2020	Trap 1	52		
HH1522R	-23.36427029	120.1934149	26/06/2020	Trap 1	52		
HH1524R	-23.36259663	120.1933658	6/03/2020	Scrape			
HH1524R	-23.36259663	120.1933658	26/06/2020	Scrape			
HH1524R	-23.36259663	120.1933658	6/03/2020	Trap 1			
HH1524R	-23.36259663	120.1933658	26/06/2020	Trap 1			
HH1525R	-23.36385963	120.1929006	10/03/2020	Net	53	440	6.6
HH1525R	-23.36385963	120.1929006	27/06/2020	Net	53	440	6.6

Field Code	Latitude	Longitude	Visit Date	Sample Name	Depth to water (m)	Conductivity (µS/cm)	pH
HH1545R	-23.363527	120.1938379	6/03/2020	Scrape			
HH1545R	-23.363527	120.1938379	26/06/2020	Scrape			
HH1545R	-23.363527	120.1938379	6/03/2020	Trap 1			
HH1545R	-23.363527	120.1938379	26/06/2020	Trap 1			
HH1545R	-23.363527	120.1938379	26/06/2020	Trap 2			
HH1650R	-23.36306965	120.1923652	6/03/2020	Scrape			
HH1650R	-23.36306965	120.1923652	26/06/2020	Scrape			
HH1650R	-23.36306965	120.1923652	6/03/2020	Trap 1			
HH1650R	-23.36306965	120.1923652	26/06/2020	Trap 1			
HH1654R	-23.36772604	120.1952153	9/03/2020	Net	55.02		
HH1654R	-23.36772604	120.1952153	27/06/2020	Net	55.02		
HH1769R	-23.36342818	120.2129232	6/03/2020	Scrape	59		
HH1769R	-23.36342818	120.2129232	26/06/2020	Scrape	59		
HH1769R	-23.36342818	120.2129232	6/03/2020	Trap 1	59		
HH1769R	-23.36342818	120.2129232	26/06/2020	Trap 1	59		
HH1908R	-23.37157948	120.214393	9/03/2020	Net			
HH1908R	-23.37157948	120.214393	27/06/2020	Net			
HH1965R	-23.37733963	120.2188557	9/03/2020	Net			
HH1965R	-23.37733963	120.2188557	27/06/2020	Net			
HH2053R	-23.36977458	120.2275896	6/03/2020	Scrape			
HH2053R	-23.36977458	120.2275896	26/06/2020	Scrape			
HH2053R	-23.36977458	120.2275896	6/03/2020	Trap 1			
HH2053R	-23.36977458	120.2275896	26/06/2020	Trap 1			
HH2053R	-23.36977458	120.2275896	26/06/2020	Trap 2			
HH2059R	-23.37834568	120.2305766	9/03/2020	Net			
HH2059R	-23.37834568	120.2305766	1/07/2020	Net			
HH2073R	-23.37209121	120.2305362	9/03/2020	Net			
HH2073R	-23.37209121	120.2305362	1/07/2020	Net			
HH2092R	-23.3716829	120.1914843	7/03/2020	Scrape			
HH2092R	-23.3716829	120.1914843	29/06/2020	Scrape			
HH2092R	-23.3716829	120.1914843	7/03/2020	Trap 1			
HH2092R	-23.3716829	120.1914843	29/06/2020	Trap 1			
HH2093R	-23.37229716	120.1915114	7/03/2020	Scrape			
HH2093R	-23.37229716	120.1915114	29/06/2020	Scrape			
HH2093R	-23.37229716	120.1915114	7/03/2020	Trap 1			
HH2093R	-23.37229716	120.1915114	29/06/2020	Trap 1			
HH2095R	-23.37111876	120.1934149	7/03/2020	Scrape			
HH2095R	-23.37111876	120.1934149	29/06/2020	Scrape			
HH2095R	-23.37111876	120.1934149	7/03/2020	Trap 1			
HH2095R	-23.37111876	120.1934149	29/06/2020	Trap 1			
HH2096R	-23.37029575	120.1944176	7/03/2020	Scrape			
HH2096R	-23.37029575	120.1944176	29/06/2020	Scrape			
HH2096R	-23.37029575	120.1944176	7/03/2020	Trap 1			

Field Code	Latitude	Longitude	Visit Date	Sample Name	Depth to water (m)	Conductivity (µS/cm)	pH
HH2096R	-23.37029575	120.1944176	29/06/2020	Trap 1			
HH2096R	-23.37029575	120.1944176	29/06/2020	Trap 2			
HH2120R	-23.36848271	120.1944901	10/03/2020	Net			
HH2120R	-23.36848271	120.1944901	27/06/2020	Net			
HH2121R	-23.36802176	120.1945105	10/03/2020	Net			
HH2121R	-23.36802176	120.1945105	27/06/2020	Net			
HH2458R	-23.36935045	120.2079728	9/03/2020	Net			
HH2458R	-23.36935045	120.2079728	27/06/2020	Net			
HH2781R	-23.37910991	120.2305035	9/03/2020	Net			
HH2781R	-23.37910991	120.2305035	1/07/2020	Net			
HH3270R	-23.36215119	120.1850491	6/03/2020	Scrape			
HH3270R	-23.36215119	120.1850491	26/06/2020	Scrape			
HH3270R	-23.36215119	120.1850491	6/03/2020	Trap 1			
HH3270R	-23.36215119	120.1850491	26/06/2020	Trap 1			
HH3278R	-23.3620567	120.1927651	6/03/2020	Scrape			
HH3278R	-23.3620567	120.1927651	26/06/2020	Scrape			
HH3278R	-23.3620567	120.1927651	6/03/2020	Trap 1			
HH3278R	-23.3620567	120.1927651	26/06/2020	Trap 1			
HH3279R	-23.36126305	120.1927475	6/03/2020	Scrape			
HH3279R	-23.36126305	120.1927475	26/06/2020	Scrape			
HH3279R	-23.36126305	120.1927475	6/03/2020	Trap 1			
HH3279R	-23.36126305	120.1927475	26/06/2020	Trap 1			
HH3279R	-23.36126305	120.1927475	26/06/2020	Trap 2			
HHH0009	-23.36620853	120.1921107	10/03/2020	Net			
HHH0009	-23.36620853	120.1921107	29/06/2020	Net			
HHH0026	-23.37812217	120.1981736	10/03/2020	Net			
HHH0026	-23.37812217	120.1981736	26/06/2020	Net			
HHH0027	-23.38385429	120.2003142	10/03/2020	Net			
HHH0027	-23.38385429	120.2003142	26/06/2020	Net			
HHH0028	-23.3882279	120.201682	10/03/2020	Net			
HHH0028	-23.3882279	120.201682	26/06/2020	Net			
HHH0054	-23.36756258	120.2055654	9/03/2020	Net			
HHH0054	-23.36756258	120.2055654	27/06/2020	Net			
HHH0064	-23.36679888	120.2009074	9/03/2020	Net			
HHH0064	-23.36679888	120.2009074	27/06/2020	Net			
HSJ0117	-23.39362938	120.1970473	10/03/2020	Net			
HSJ0117	-23.39362938	120.1970473	26/06/2020	Net			
PI031	-23.37560481	120.2187095	9/03/2020	Net			
PI031	-23.37560481	120.2187095	27/06/2020	Net			
SJ1529R	-23.39790037	120.2450491	5/03/2020	Net			
SJ1529R	-23.39790037	120.2450491	7/03/2020	Scrape			
SJ1529R	-23.39790037	120.2450491	26/06/2020	Scrape			
SJ1529R	-23.39790037	120.2450491	7/03/2020	Trap 1			

Field Code	Latitude	Longitude	Visit Date	Sample Name	Depth to water (m)	Conductivity (µS/cm)	pH
SJ1529R	-23.39790037	120.2450491	26/06/2020	Trap 1			
SJ2454RDG	-23.3946137	120.190479	5/03/2020	Scrape			
SJ2454RDG	-23.3946137	120.190479	26/06/2020	Scrape			
SJ2454RDG	-23.3946137	120.190479	5/03/2020	Trap 1			
SJ2454RDG	-23.3946137	120.190479	26/06/2020	Trap 1			
SJ2454RDG	-23.3946137	120.190479	26/06/2020	Trap 2			
SJ2634DG	-23.3923591	120.1943361	5/03/2020	Net			
SJ2634DG	-23.3923591	120.1943361	7/03/2020	Scrape			
SJ2634DG	-23.3923591	120.1943361	26/06/2020	Scrape			
SJ2634DG	-23.3923591	120.1943361	7/03/2020	Trap 1			
SJ2634DG	-23.3923591	120.1943361	26/06/2020	Trap 1			