Bennelongia Environmental Consultants

Targeted Survey for Extent of Occurrence (EOO) and Area of Occupancy (AOO) Expansion of the Lake Goorly Shield-Backed Trapdoor Spider (*Idiosoma kopejtkaorum*)

Prepared for:

Tetris Environmental on behalf of Crimson Metals

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Final Report

Short-Range Endemics I Subterranean Fauna

Waterbirds I Wetlands

Targeted Survey for Extent of Occurrence (EOO) and Area of Occupancy (AOO) Expansion of the Lake Goorly Shield-Backed Trapdoor Spider (*Idiosoma kopejtkaorum*)

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EXECUTIVE SUMMARY

Previous surveys within and around the Mount Gibson Gold Project (MGGP) identified potential impacts on 6.15% of *Idiosoma kopejtkaorum*'s known Area of Occupancy (AOO), based on a then 1,562 ha Development Footprint (DF), of which 1,174 ha was native vegetation. Of this, 1,402 ha overlapped with the species' AOO, with 1,058 ha being native vegetation.

Following comments from DCCEEW (2025), a targeted survey was undertaken from 28 April to 2 May 2025 to refine the species' Extent of Occurrence (EOO) and AOO and provide habitat preference data. The survey covered 39 unpopulated 2 x 2 km grids, with 194 km of transects, representing ~50 ha of survey effort.

The species was confirmed in 32 of 39 grids, including areas beyond the previously known EOO. This expanded the known distribution to 75 occupied grids, increasing the EOO from 4,444 km² to 4,930 km² and the AOO from 172 km² to 300 km² — a 74.42% increase.

The updated impact estimate suggests the MGGP is likely to affect **3.65%** of the species' AOO, down from 6.15%, with 1,094 ha of native vegetation within the DF subject to clearing. Additional impacts outside the current DF would require reassessment.

Habitat assessments of 158 confirmed burrows showed 82% occur in eucalypt woodlands, 66% at the base of trees, and 54% in sandy soils. Preferred habitats are eucalypt woodlands with acacia shrubland understory on red sandy to clayey soils, especially within loamy plains and calcareous alluvial plains near salt-lake systems.

A habitat rating tool was developed based on nine key habitat, microhabitat, and soil variables, producing a suitability index (max score 18) classified into four categories: unsuitable, marginal, suitable, and optimal.

Genetic analysis incorporating eight new *COI* sequences (totalling 21 haplotypes) and 14 *16S* sequences confirmed high genetic diversity, but also indicated some geographic genetic clustering, likely due to limited dispersal. Further sampling is required to fully understand population structure.

While the updated data reduced the predicted impact, the MGGP's effect remains **Moderate** according to Bennelongia's (2025) criteria. The Project proposes progressive rehabilitation, though recolonisation by *I. kopejtkaorum* is unlikely in the short to medium term, as mygalomorph spiders are slow to recolonise and sensitive to habitat conditions such as leaf litter and ground cover. Despite the species' current genetic resilience, continued fragmentation and habitat loss may lead to isolated sub-populations with reduced gene flow, increasing the risk of localised extinctions.

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1. INTRODUCTION

The Lake Goorly shield-backed trapdoor spider (*Idiosoma kopejtkaorum*; hereafter "the target species") is a member of the northern *clypeatum*-clade within the *nigrum*-group (Rix *et al.* 2018). It has a restricted distribution in the north-eastern Wheatbelt bioregion, a region rich in mygalomorph spiders (Rix *et al.* 2018). The target species was assessed as Endangered by Rix *et al.* (2018), who suggested it has a known Extent of Occurrence (EOO) of 3,571 km^2 and an Area of Occupancy (AOO) of <500 km^2. *Idiosoma kopejtkaorum* is listed as Endangered under the *Biodiversity Conservation Act 2016* and Vulnerable under the *Environment Protection and Biodiversity Conservation Act 1999* (as part of the *Idiosoma nigrum* complex). Crimson Metals is planning to recommence gold mining at the Mt Gibson Mine in a program of operations called the Mt Gibson Gold Project (MGGP, hereafter "the Project"). The Project involves the expansion of historical mine pits as well as creation of additional surface infrastructure bounded by a Development Envelope (DE) of approximately 3,823 ha and a Disturbance Footprint (DF) of 1,612 ha (of which ~399 ha is previously disturbed land) which intersect the target species' distribution (DE and DF areas provided by Tetris on 9/05/2025).

Recognising the potential impacts the Project development could have on some of the target species' populations, Tetris Environmental (Tetris), on behalf of Crimson Metals, engaged Bennelongia Environmental Consultants (Bennelongia) to conduct an impact assessment. The assessment was based on targeted surveys conducted within and around the Project's Development Envelope to determine the presence, distribution, habitat preferences, and potential impacts of the MGGP on the target species (Bennelongia 2025).

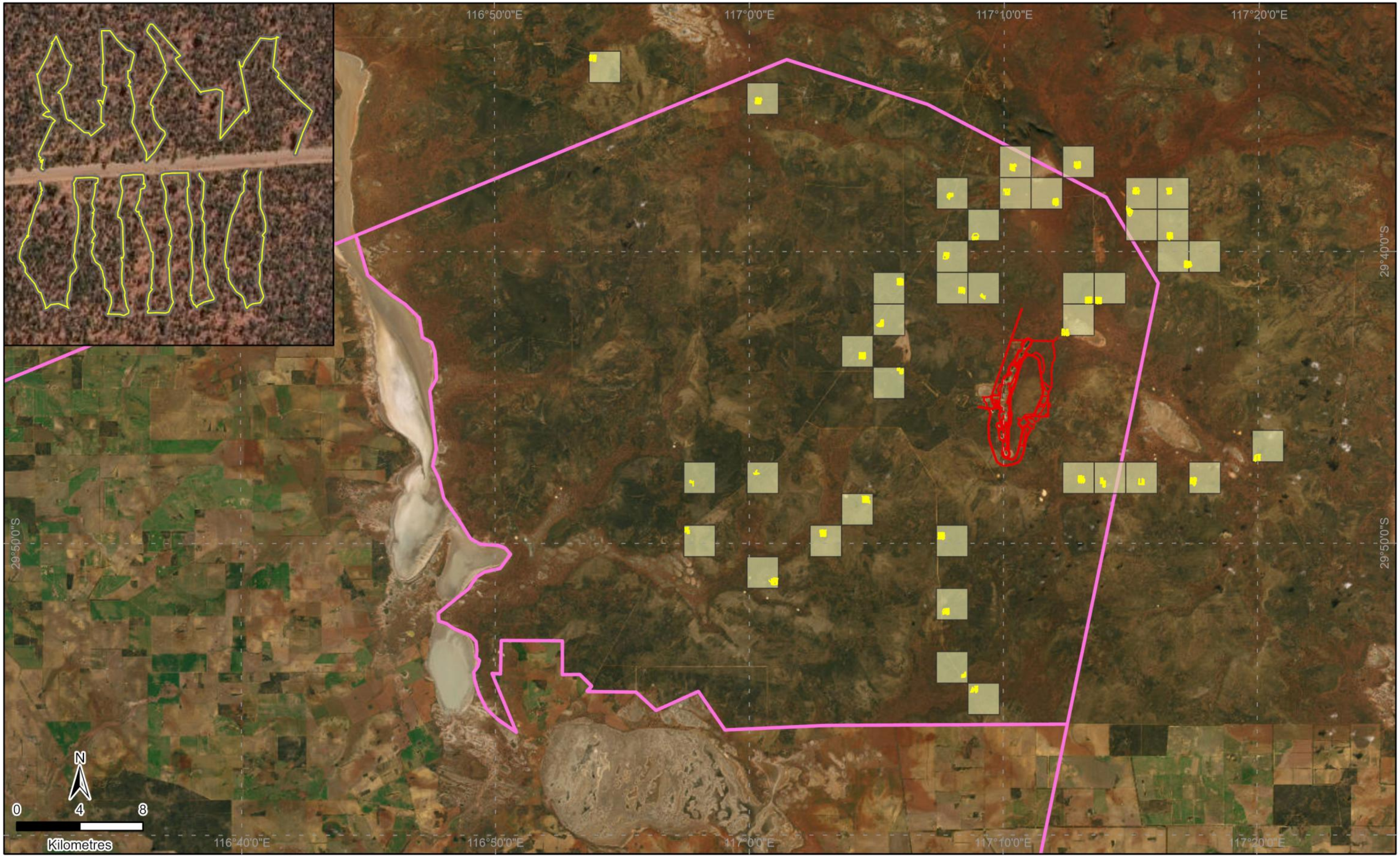
The Project had a then defined DF area of 1,562 ha, of which 1,174 ha comprised native vegetation. However, only 1,402 ha of the DF fall inside of the target species' AOO, with 1,058 ha corresponding to native vegetation. Based on these figures, the impact assessment initially concluded that the Project could potentially affect 6.15% of the species' known AOO (reported as 6.48% by Bennelongia 2025).

In response to the follow-up comments from DCCEEW (2025), a single round of targeted survey was conducted to expand the species' known EOO and AOO and to provide relevant information about habitat preference.

2. METHODS

The targeted survey was conducted between 28 April to 2 May 2025 with the aim to expand the species' known EOO and AOO. Additionally, habitat data was collected to provide context on habitat preference and suitability. The survey focused on visiting 2 x 2 km grids within and outside the species' EOO that lacked previous records of the target species ("*unpopulated grids*") but contained suitable habitat. The objective was to identify any new occurrences that could be incorporated into the AOO area calculations (see section 2.5 in Bennelongia 2025 for further details).

A total of 39 unpopulated grids were surveyed (Figure 1). Within each grid, a 400 x 400 m quadrat was placed in areas of suitable habitat - typically eucalyptus woodlands over acacia shrublands- and surveyed along linear transects oriented north to south (Figure 1). Spider burrows were uncovered with the aid of leaf blowers, and burrows likely to belong to the target species were inspected via an endoscope to confirm species identity. Additionally, non-lethal DNA samples were taken from representative localities to compare with previous samples from near the Project area. The survey followed IUCN Standards and Petitions Committee (2024) recommendation of adequate survey effort when estimating a species' AOO which resulted in approximately 194 km of transects equivalent to approximately 50 ha (considering transect overlaps) being surveyed (Figure 1).



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GDA2020 MGA Zone 50
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Legend

- MGGP Disturbance Footprint
- AOO Expansion Survey Grids
- Survey tracks
- Idiosoma_kopejtkaorum EOO (previous to survey)

Figure 1. Idiosoma kopejtkaorum EOO and AOO survey localities.

Inset shows indicative layout of survey transects at each grid.

3. RESULTS

3.1. Updated EOO and AOO

Out of the 39 surveyed (unpopulated) grids, 32 were confirmed to have representatives of the target species, including grids outside of the species EOO (Figure 2). The addition of these grids to the previously known (n=43) grids resulted in a total of 75 (2 km x 2 km) grids within the species EOO having confirmed presence of the target species. As a result, the species EOO and AOO have been increased as follows: EOO increased from 4,444 km^2 (Bennelongia 2025) to **4,930 km^2**, and AOO increased from 172 km^2 (Bennelongia 2025) to **300 km^2** (Table 1; Figure 3). This represents an increase of 74.42% in the species' AOO, equivalent to 128 km^2. Following the IUCN Standards and Petitions Committee (2024) guidelines for estimating AOO, the minimum AOO area was calculated by considering the survey grids which have records only half or less of the grid (valued at *0.5*), or in more than half (valued at *1*). This results in a minimum AOO of 172 km^2 (previously calculated at 108 km^2 in Bennelongia 2025).

3.2. Updated impact estimates

Approximately 90% of the Project's DF, equivalent to 1,452 ha, overlaps with the species' current AOO. However, only 1,094 ha of the overlap DF area corresponds to native vegetation and will be subject to clearing (the remaining 358 ha corresponds to cleared or recently rehabbed areas). Therefore, updated estimates based on these figures suggest the MGGP is likely to impact **3.65%** of the species' known AOO. Any additional impact outside of the proposed DF will increase the percentage estimates.

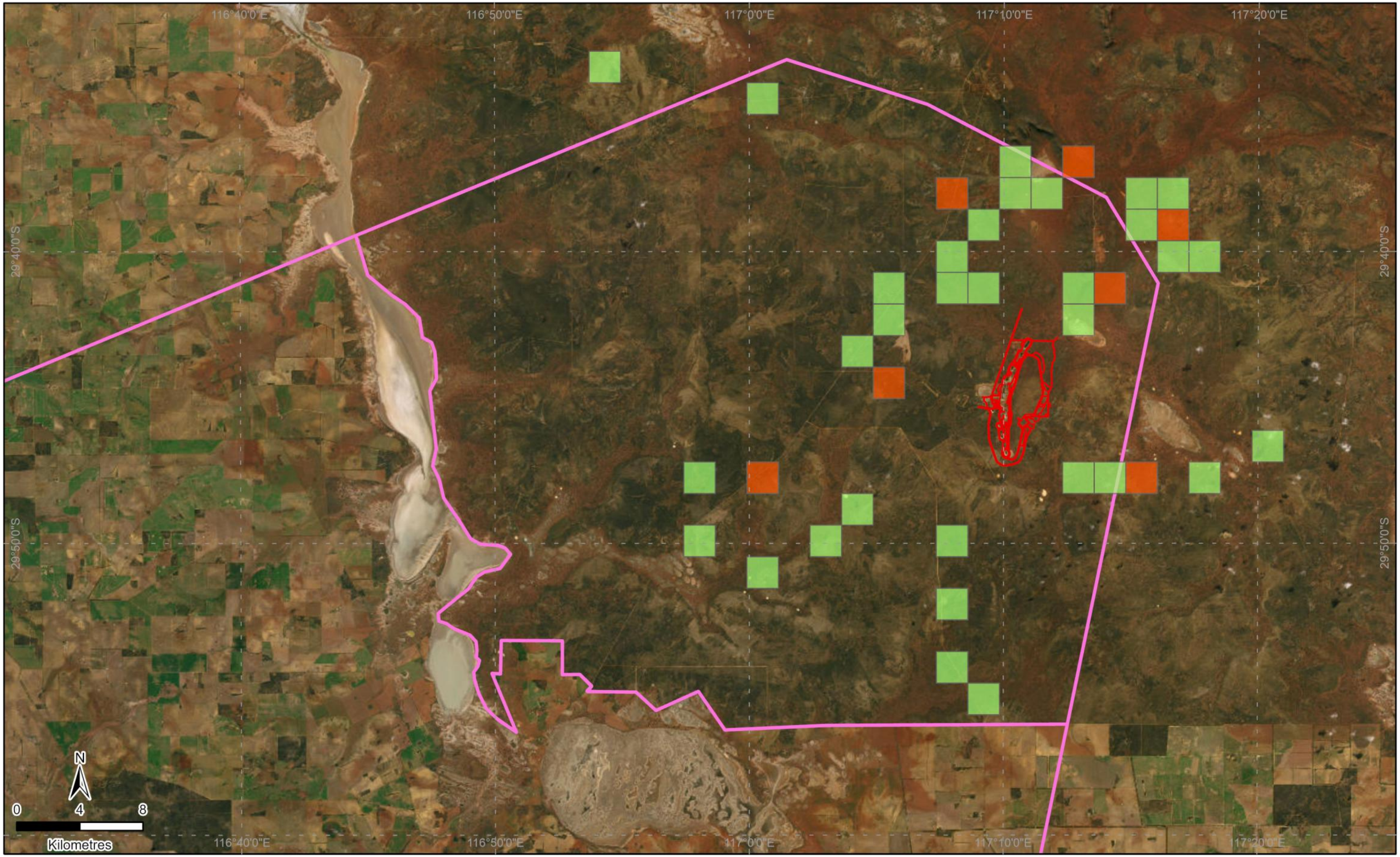
Table 1**.** Updates to the target species EOO and AOO after targeted survey.

Measurement	Previous	Updated	Increase (%)
EOO	4,444 km^2	4,930 km^2	10.93%
Populated grids	43 grids	75 grids	32 grids
AOO	172 km^2	300 km^2	74.42% (128 km^2)
DF impact over AOO	6.15% (previously reported as 6.48%)	3.65%	2.5 (reduction)

3.3. Habitat preferences

After the numerous rounds of survey conducted by Bennelongia and Tetris Environmental, habitat preference was deduced via direct observations during the initial field surveys (Bennelongia 2025). Bennelongia was able to record habitat, microhabitat, and soil term data for 158 confirmed *Idiosoma kopejtkaorum* burrows. From these, 82% (n = 130) were recorded from eucalyptus woodlands, 66% (n = 105) were recorded from the base of trees, and 54% (n =86) were recorded from sandy soils (Table 2).

It is important to note that habitat and soil types mentioned in Table 2 refer to broad characteristics and there is noticeable variation within categories. For example, *eucalypt woodlands* include multiple species such as York gum (*Eucalyptus loxophleba*), Salmon gum (*E. salmonophloia*), Wandoo (*E. capillosa*), mallee (*E. kochii*) and gimlet (*E. salubris*) (Bamford 2024). However, field observations recorded the presence of the target spider species in those eucalypt woodlands dominated by York and/or Salmon gum. No records of the species were found in eucalypt woodlands dominated by gimlet. Similarly, although most of the records of the target species were found on *sand* or *clay* soil type (Table 2), field observations suggest the species is mainly associated with red soils ranging in consistency between sandy-clay to clayey-sandy soils.



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GDA2020 MGA Zone 50
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PAYNES FIND
PERTH

Legend

MGGP Disturbance Footprint

Idiosoma_kopejtkaorum EOO (previous to survey)

AOO Expansion Survey Grids

Idiosoma kopetjkaorum

Absent

Present

Figure 2. Idiosoma kopejtkaorum AOO survey grids results.

Green grids represent positive grids (i.e., target species was found).

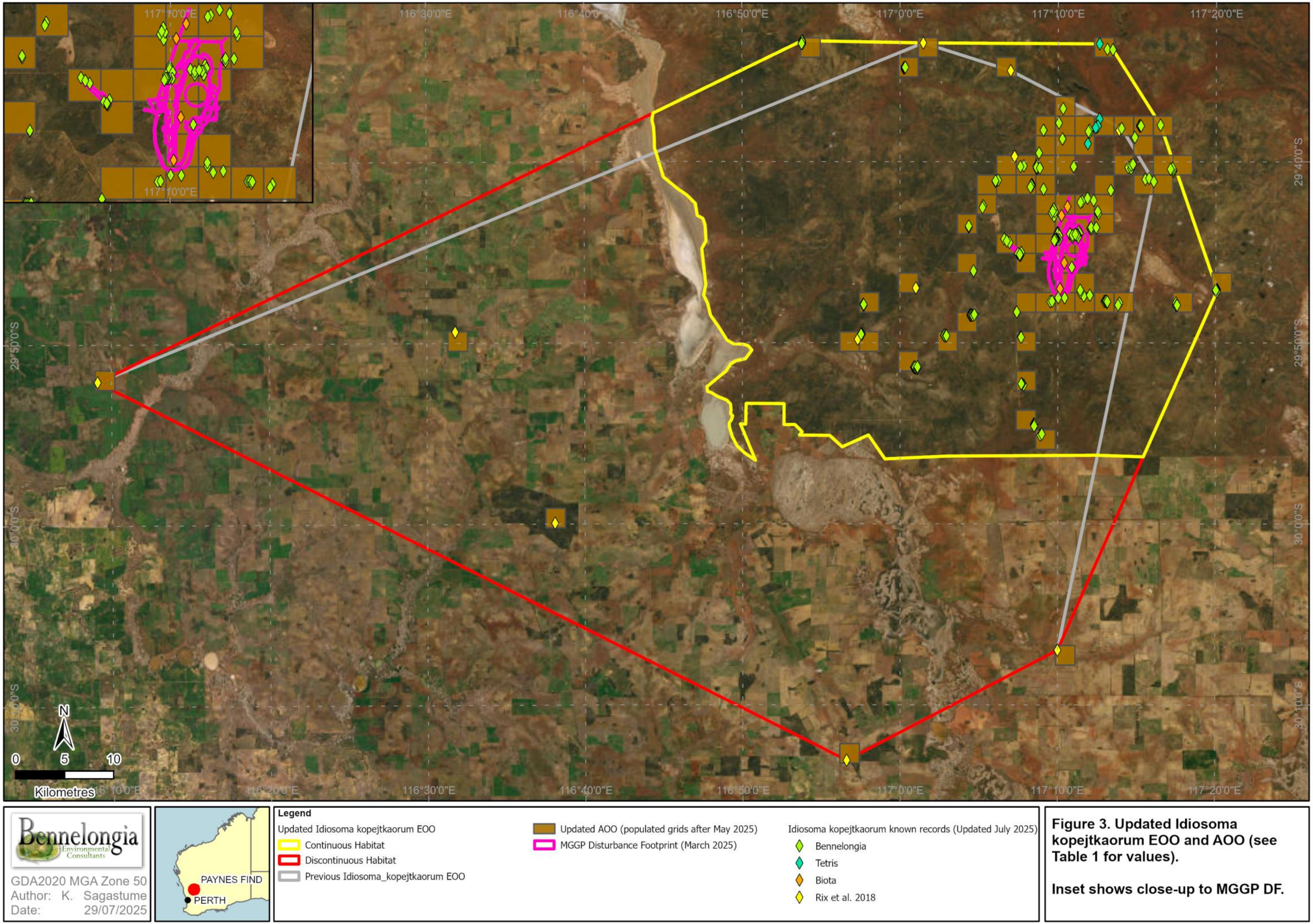

Figure 3. Updated Idiosoma kopejtkaorum EOO and AOO (see Table 1 for values).

Inset shows close-up to MGGP DF.

Table 2. Lake Goorly Shield-Backed Trapdoor Spider Habitat Preference

Habitat	Count_R3	R4_Target	R3+R4	**%**	**Microhabitat**	Count_R3	R4_Target	R3+R4	**%**	**SoilTerm**	Count_R3	R4_Target	R3+R4	**%**
Acacia shrub	4	4	8	5	**Base of tree**	38	67	105	**66**	**Clay**	26	42	68	43
Eucalypt woodland	39	91	130	**82**	**Leaf litter**	20	33	53	34	**Loam**	2	2	4	3
Mixed shrubland	2	5	7	4						**Sand**	30	56	86	**54**
Mallee woodland	8	0	8	5										
Allocasuarina shrub	2	0	2	1										
Callitris woodland	3	0	3	2										
Total	58	100	**158**	100		58	100	**158**	100		58	94	**158**	100

3.4. Habitat rating tool

To provide a better understanding of the species' habitat preferences, the species' known records were mapped over broad landscape mapping (DPIRD 2022) and preferred habitat was estimated based on the number of records (Figure 4). Of all the *Idiosoma kopejtkaorum* records within the species' EOO, 45% (n= 114) were found over *loamy plains surrounded by sandplains supporting **York gum woodlands and acacia shrublands***, with the second highest habitat type being *calcareous alluvial plains with **eucalypt woodland** adjacent to salt-lake systems* with 18% (n = 46) records of the target species. Our field observations agree with the habitat mapping in the sense that what seems to be the ideal habitat for the species is a combination of eucalypt woodland with patches of acacia shrubland understory over red sandy to clayey soils.

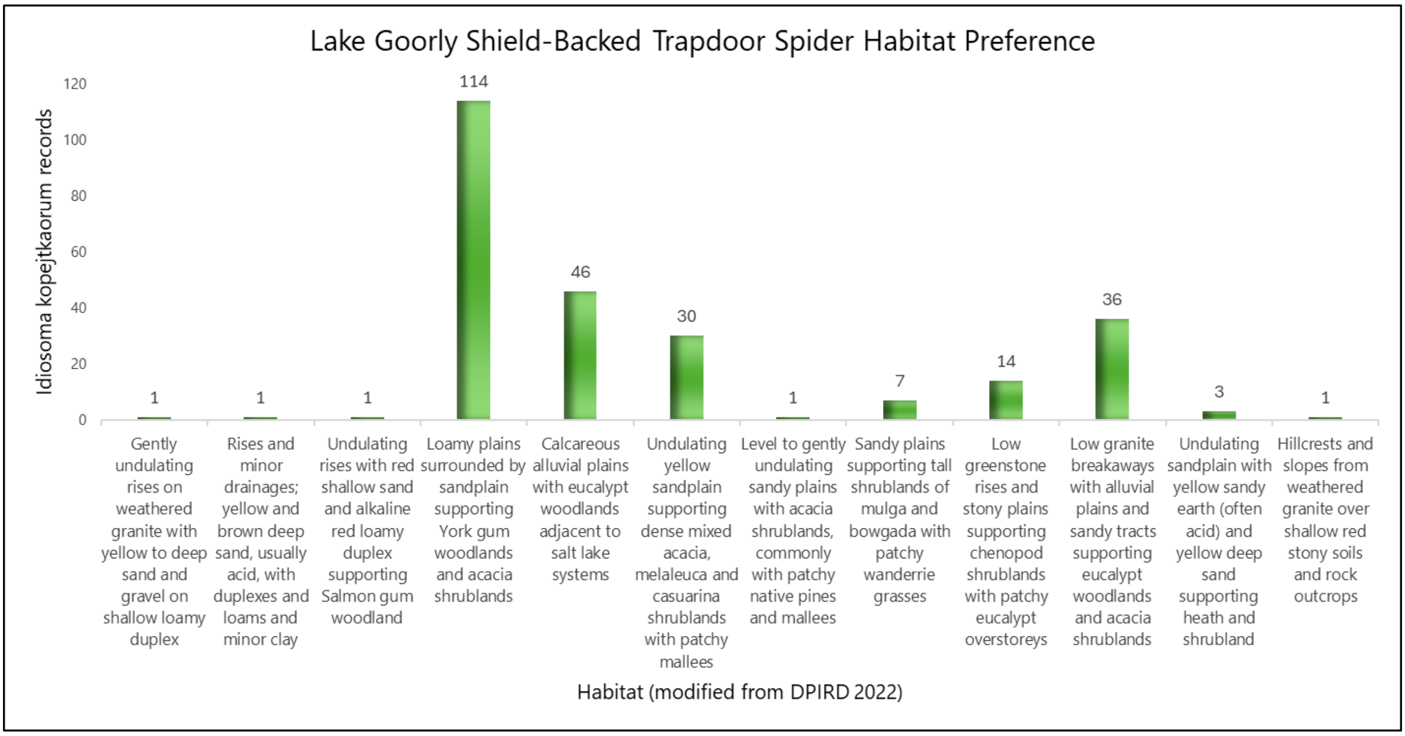

Figure 4. *Idiosoma kopejtkaorum* habitat preference (based on number of records).

Following the above habitat preference, a habitat rating tool was developed to provide more granular information and better habitat preference context elsewhere in the target species' AOO. This habitat rating tool outlines the preferred criteria used to assess habitat suitability for *Idiosoma kopejtkaorum* across survey sites. Nine key variables across three categories have been identified (Table 3). Each variable is scored from 0 (unsuitable) to 2 (optimal). The sum of all scores provides a habitat suitability index (max score = 18), which is then classified into one of four habitat suitability categories (Table 4).

Table 3. Habitat rating tool for the Lake Goorly Shield-Backed Trapdoor Spider.

Category	**Habitat Variable**	**Scoring Criteria**	**Score Range**
1. Broad Environmental Features	Soil Type	0 = Gravel, heavy clay, or shallow soils 1 = Loamy yellow sands or sandy earths 2 = Deep, red sandy to clayey soils	0–2
	Vegetation Type	0 = Cleared or non-native vegetation 1 = Sparse native mixed (*Allocasuarina* or *Callitris*) shrublands 2 = Eucalypt woodlands with Acacia shrubland understory	0–2
	Topography	0 = Major drainage lines, wet depressions, rocky slopes or outcrops 1 = Gently undulating to undulating rises 2 = Broad floodplains or lower slopes	0–2
	Disturbance Level	0 = Heavily disturbed (e.g. grazing, clearing, mining) 1 = Moderately disturbed (young secondary growth woodlands) 2 = Minimal or no disturbance (pristine or old secondary growth woodlands)	0–2
2. Microhabitat Features	Ground Cover	0 = Bare or compacted surface 1 = Patchy logs, leaf litter, or grass covered floors 2 = Dense litter and abundant logs, minor to no grass coverage	0–2
	Surface Condition	0 = Waterlogged, compacted, or crusted soil 1 = Neutral or variable 2 = Friable or minimally cracked soils (suitable for burrows construction)	0–2
	Burrow Presence	0 = No burrows observed 1 = Possible burrows (uncertain ID) 2 = Confirmed target species trapdoor-style burrows	0–2
3. Spatial Context	Proximity to Known Records	0 = >5 km from any known locality 1 = 2–5 km from known records 2 = <2 km or within same grid cell	0–2
	Habitat Connectivity	0 = Isolated or fragmented unsuitable habitat patch 1 = Moderately connected corridor 2 = Large, continuous tract of suitable habitat	0–2

Table 4. Habitat suitability categories for the Lake Goorly Shield-Backed Trapdoor Spider.

Total Score (Max 18)	**Habitat Class**	**Comments**
0–5	Unsuitable	Highly disturbed; no native vegetation remains; compacted, weedy ground with no surface structure.
6–10	Marginal	Some native vegetation persists, soils too shallow or disturbed; non-suitable habitats present; leaf litter sparse; minor surface cracking observed.
11–15	Suitable	Soil, vegetation, and habitat structure are suitable; burrows are likely but not detected yet despite appropriate conditions.
16–18	Optimal	Excellent structural integrity, ideal habitat type (eucalypt woodland with acacia understory) with dense litter and stable soils; confirmed *I. kopejtkaorum* burrows at site or in near vicinity.

3.5. Updated haplotype analysis

Haplotypes analysis followed the methods detailed in Bennelongia (2025) with the addition of eight newly collected mitochondrial *COI* sequence data as part of this survey which resulted in a total *COI* dataset of twenty-one haplotype networks. Additionally, fourteen *16S* sequences were used to calculate mitochondrial and nucleotide diversities and following Rozas *et al.* (2017).

High genetic diversity (based on mitochondrial markers) can be seen in the haplotype analysis (Figure 5) and diversity measurements. Haplotype diversity for both mitochondrial sequence sets was 0.981 (SD ± 0.023), and 0.0978 (SD ± 0.035) with *COI* and *16S*, respectively. Nucleotide diversity was 0.04 for *COI*, and 0.017 (SD ± 0.0013) for *16S*.

Within mtDNA *COI* haplotype analysis, multiple mutations between sequences can be noted, with only two *COI* haplotypes shared; one with two AOO Expansion samples and the other between one Mt Gibson and two Mummaloo individuals. Some genetic clustering can be seen, with haplotype network branches consistent with geographic sampling areas (Figure 5). This can possibly be linked to sex-based dispersal, and a true understanding of the structure and/or boundaries of any possible sub-populations would require more sampling.

4. DISCUSSION

This survey substantially expanded the target species' AOO and resulted in a minor increase to the EOO. Most importantly, the survey was able to reduce the MGGP expected impact to the species AOO from 6.15% to 3.65%. Nevertheless, this level of impact is still considered as *Moderate* based on Bennelongia's (2025) assessment criteria, which is not only based on the percentage of impact to the species' AOO but also considers the duration of time over which populations will be impacted and recovery plans after the end of the project (rehabilitation, species monitoring, etc).

It is planned that disturbed areas will be progressively rehabilitated during operations, and areas subject to active operations will be rehabilitated at the end of mine life (Tetris Environmental 2024). However, rehabilitation does not guarantee recolonisation by the target species. Although only a handful of studies have investigated spiders recolonising rehabilitated areas, some authors have suggested that it may take decades—if at all—for these areas to be recolonised. Main (1987) reported that certain areas in the Wheatbelt region that were cleared and cropped only once, and subsequently left to regenerate naturally, show almost no recolonisation by mygalomorph spiders from adjacent bushland even after 20 years. Yen (1995) echoed Main's (1987) remarks, noting that the persistence long-lived adult individuals can often be misinterpreted as evidence of population survival in disturbed areas. In reality, adults, particularly females, may outlive the viability of their habitats and fail to breed. Similarly, the presence of wandering adult males in disturbed areas should be interpreted as a sign of biological activity rather than an indicator of a thriving population. Finally, Simmonds *et al.* (1994) discussed how specific features of rehabilitated sites—such as leaf litter depth and ground cover—have a stronger influence on spider species recolonisation than others, as they provide prey availability, regulate temperature and moisture, and offer refuge and structural retreats. That study also noted that an unidentified *Idiosoma* species was only recorded at rehabilitated sites that were at least 18 years old.

Results from the haplotype analysis suggest that genetic diversity of *I. kopejtkaorum* mtDNA is high, nonetheless, haplotype structuring can be seen within the mtDNA *COI* sequence set. We hypothesise that although the overall diversity is high, if habitat fragmentation and destruction continue to limit connection and gene flow between microhabitats, it could lead to small sub-populations with reduced genetic diversity and high levels of genetic structure. This has been noted in previous mygalomorph population studies, where high genetic structure has been linked to habitat fragmentation and/or limited dispersal (Marsh *et al.* 2023; Monjaraz-Ruedas *et al.* 2024; Pedersden and Loeschcke 2001). The fragmentation and limited gene flow could lead to local extinctions rates that exceed the recovery rates of vulnerable populations (Lambeck 1997).

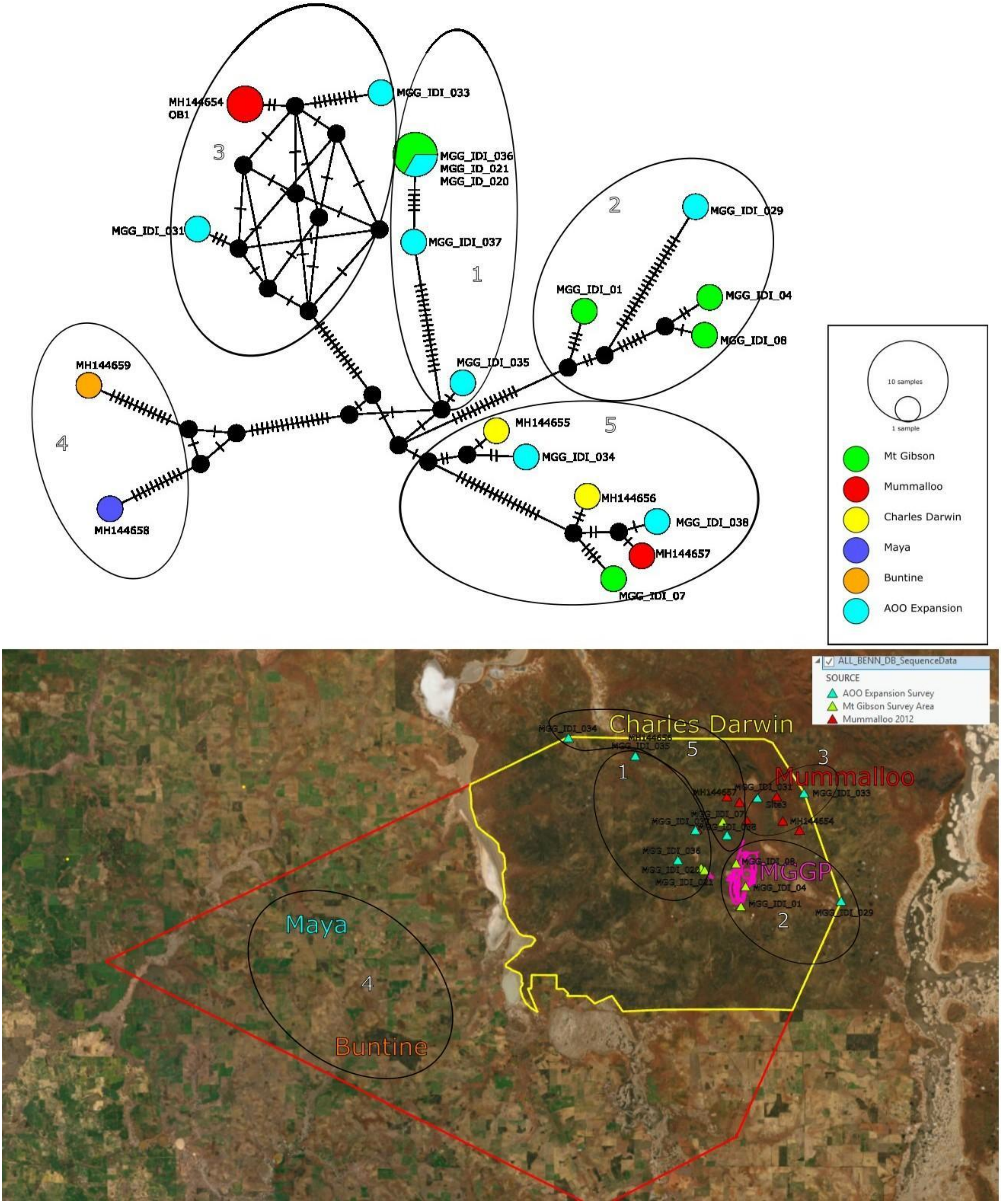

Figure 5. Updated *Idiosoma kopejtkaorum* haplotype analysis results.

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