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# Five new species of mouse spiders in the genus *Missulena* (Mygalomorphae: Actinopodidae) from national parks and conservation reserves in Western Australia

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# Abstract

We describe five new species of mouse spiders, genus *Missulena* Walckenaer, 1805 (family Actinopodidae Simon, 1892), from national parks and / or conservation reserves in Western Australia, based on somatic and genitalic characteristics, and molecular data where these were available: *Missulena durokoppin* sp. nov., *M. gelasinos* sp. nov., *M. ignea* sp. nov., *M. minima* sp. nov., and *M. terra* sp. nov. Three of these species, *M. ignea* sp. nov., *M. durokoppin* sp. nov., and *M. minima* sp. nov have very limited known distributions, being known only from a single park or reserve.

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# Introduction

Mouse spiders of the genus *Missulena* Walckenaer, 1805 (family Actinopodidae Simon, 1892) are medium-sized trapdoor spiders. The males of some species are brightly coloured and distinct, often with a bright red cephalothorax and / or chelicerae, contrasting with a blue abdomen; the females and juveniles are typically less colourful, being largely brown to black (e.g. Frame-

nau & Harms 2017; Greenberg *et al.* 2021; Harms & Framenau 2013; Miglio *et al.* 2014).

Actinopodidae have a southern Gondwanan distribution, with species reported from South and Central America and Australia (Miglio *et al.* 2014). The genus *Missulena* is known from Chile (1 species) and Australia (20 species) (World Spider Catalog 2023), although molecular studies indicate that there are a large number of undescribed species in Australia (e.g., Castalanelli *et al.* 

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2014). The highest diversity of named species is concentrated in Western Australia (WA), where 18 of the 20 described species occur; 14 of these are apparently endemic to WA (Miglio et al. 2014; Framenau & Harms 2017; Greenberg et al. 2021). Recent taxonomic treatments and molecular studies suggest that the ranges of most described species are small (Castalanelli et al. 2014; Framenau & Harms 2017; Greenberg et al. 2021; Harms & Framenau 2013; Miglio et al. 2014), with some notable exceptions. For example, M. dipsaca Faulder, 1995 is known from five states and the type species of the genus, M. occatoria Walckenaer, 1805, has been reported from seven states and territories (Miglio et al. 2014). However, these two species have not been treated with modern taxonomic methods and may represent species complexes, and the holotype of *M. occatoria* is lost, so designation of a neotype is needed to fix its taxonomic concept and allow for accurate identification.

Previous taxonomic work on Australian *Missulena* conducted by Womersley (1943), Main (1985), and Faulder (1995) resulted in the description or redescription of 10 species and the synonymisation of some. More recently, Harms and Framenau (2013), Miglio *et al.* (2014), Framenau and Harms (2017) and Greenberg *et al.* (2021) added an additional 10 species and provided an updated taxonomic protocol for the description of species.

In this paper, we use a combination of morphological and molecular techniques to describe five species of *Missulena* from national parks and conservation reserves in WA, and examine variation in key characters for these species.

# Methods

# Morphological analyses

Descriptions of external morphological features, macrosetae notation and imaging methods follow Greenberg et al. (2021). Morphological examination of specimens was conducted using a Nikon SMZ18 and a Zeiss Stemi 305 stereomicroscope. Images in different focal planes (10-20) were taken using a Leica MZ16A microscope and Leica DFC 500 camera, AutoMontage Pro Version 5.2 was used to combine them to a single image. Line drawings were made using Vectornator version 14.3.4, tracing over photographic images, using a stylus and an Apple iPad Air 5th Generation. Measurements were taken digitally using AutoMontage Pro Version 5.2 and are given in millimeters. Measurements are taken in dorsal view, total length is given from the anterior apex of the carapace, excluding the chelicerae, to the posterior apex of the abdomen, excluding the spinnerets. Carapace length is given from the anterior apex of the carapace, excluding the chelicerae. Pars cephalica height is measured along its posterior edge, taken from the base of pars cephalica, at the point it rises from the rest of the carapace adjacent to the fovea, to the highest point of apex. The proportion of the carapace that is the pars cephalica is measured dorsally. The taxonomic section lists species in alphabetical order. All specimens examined in this study were from museum collections.

# Molecular analyses

DNA extraction and PCR amplification of the 'DNA barcode' mitochondrial (mt) cytochrome *c* oxidase subunit I (COI) gene were completed at the South Australian Regional Facility for Molecular Ecology and Evolution (SARFMEE) from a single leg from each specimen following the same protocols detailed in Moore *et al.* (2021).

In addition to the five new sequences here, we included 164 other Missulena and four outgroup sequences from GenBank (https://www.ncbi.nlm.nih.gov/, accessed on 22/04/2023; Table S1). The resulting 173 sequences were aligned Sequencher v5.1 in (http://www.genecodes.com) to produce a 611 bp (COI) alignment. Substitution models (1st codon - TN+F+I+G4, 2nd - TN+F+I+G4, 3rd - GTR+F+G4) and maximum likelihood (ML) trees were generated using the IQ-TREE web server using default settings (Trifinopoulos et al. 2016), with 1,000 ML (ultrafast) bootstrap replicates. The resulting trees were visualised and modified using (https://beast.community/figtree, FigTree v1.4.4 accessed on 22/04/2023) and Adobe Illustrator (Adobe Systems, Inc., San Jose, CA, USA). We use mitochondrial (mt) DNA to explore species boundaries within the genus Missulena, which has been successfully used for this purpose in numerous invertebrate groups, including mouse spiders (Greenberg et al. 2021) (Fig. 1). All sequences in Fig. 1 and in Table S1 without a species identification were identified as "Missulena sp." either by us or is as it appears in GenBank.

# Abbreviations

ALE, anterior lateral eyes; AME, anterior median eyes; BEI, basal embolar intumesence; PLE, posterior lateral eyes; PME, posterior median eyes; OQ, ocular quadrangle; d, dorsal; p, prolateral; r, retrolateral; v, ventral; pv, proventral; rv, retroventral; WA, Western Australia; WAM, Western Australian Museum.

# Discussion

We here describe five new and distinct species of Missulena from conservation reserves or national parks in WA. All species are only known from males, as we could not match females from collections unequivocally to these males. Our molecular analyses show many undescribed Missulena species in WA, with only ten described Missulena species, supporting the findings of other studies (Castalanelli et al. 2014; Greenberg et al. 2021). This diversity pattern, including a high number of species in semi-arid environments, mirrors that of other mygalomorph spider groups in Australia such as Anamidae Simon, 1889 and Idiopidae Simon, 1889. The origin of this diversity is probably related to similar mechanisms previously suggested in these groups, namely a radiation in the Miocene and Pliocene due to an aridification of the continent (e.g., Rix et al. 2017; Rix et al. 2021).



Figure 1. Maximum likelihood tree of the mitochondrial DNA COI gene of 170 *Missulena* sequences used and four outgroup taxa. Sequences with only GenBank numbers were identified in the genus *Missulena*. All sequences here without a species identification were identified as "*Missulena* sp." either by us or is as it appears in GenBank. Species clades with three or more sequences are collapsed, see Figure S1 for the full analysis. Bootstrap support values are shown at each node, those with no values are 100%. New sequences indicated by a \*. Details for all new sequences and those obtained from GenBank are available in Table S1.

However, we lack dated, multigene hypotheses of *Missulena*, or interpretation of lineages and distribution patterns within the genus to support this biogeographic scenario.

The divergence between the two *M. terra* sp. nov. specimens identified in this study is well within the divergence identified among other species such as *M. davidi*, *M. langlandsi*, and *M. granulosa*. Despite remarkable molecular divergence within *M. davidi* yet little morphological differences (see Greenberg *et al.* 2021), the potential for cryptic species within the *M. granulosa* and *M. langlandsi* clades will need further examination.

Three of the *Missulena* species described here, *M. durokoppin* sp. nov., *M. ignea* sp. nov., and *M. minima* sp. nov., are currently known only from single reserves or parks, potentially providing further evidence for shortor narrow-range endemism in the genus and thus elevated conservation significance (Harvey *et al.* 2012). However, comprehensive and targeted sampling, plus taxonomic and molecular examination of a greater range of material is required to more comprehensively



Figure 2. Somatic, dorsal view, a, *Missulena durokoppin* sp. nov.; b, *M. gelasinos* sp. nov.; c, *M. ignea* sp. nov.; d, *M. minima* sp. nov.; e, *M. terra* sp. nov.

delineate species' ranges. The taxonomic history of *Missulena*, specifically in the last decade and including this publication, is characterised by opportunistic studies of few species when limited resources were available. A comprehensive study of Australian material, including the use of modern molecular methods such as museomics (i.e. Jin *et al.* 2000), would allow a complete species inventory (including matching males and females) and finally the opportunity to identify the most

likely candidate for *M. occatoria*, the type species of the genus, followed by the designation of a neotype.

# Taxonomy

# Missulena durokoppin sp. nov.

Figs 2a, 3a-n, 4a-d, 5

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#### **Type material**

*Holotype ∂*. AUSTRALIA: *Western Australia*: Durokoppin Nature Reserve, 31.5°S, 117.73°E, 13–23 March 1992, G. Friend *et al.*, wet pitfall traps, DKR E3 (WAM T44137)

#### Diagnosis

Males of *M. durokoppin* sp. nov. are similar to seven other species, which share a brown carapace and che-

licerae: *Missulena faulderi* Harms & Framenau, 2013, *M. harewoodi* Framenau & Harms, 2017, *M. leniae* Miglio, Harms, Framenau & Harvey, 2014, *M. melissae* Miglio, Harms, Framenau & Harvey, 2014, *M. pinguipes* Miglio, Harms, Framenau & Harvey, 2014, *M. rutraspina* Faulder, 1995, and *M. terra* sp. nov. Of these, they differ from *M. terra* sp. nov., *M. harewoodi, M. melissae* & *M. pinguipes*, and by having a slender pedipalp tibia as



Figure 3. *Missulena durokoppin* sp. nov.  $\Im$  holotype (WAM T44137) from Durokoppin Nature Reserve, WA; a, carapace, dorsal view; b, same, ventral view; c, abdomen, dorsal view; d, same, ventral view; e, eyes; f, mouthparts, ventral view; g, rastellum; h, cheliceral teeth, line drawing; i, carapace, lateral view; j, leg IV retrolateral view; k, left patella I, dorsal view; I, same patella II; m, same patella III; n, same patella IV. Scale bars a–d, f, i = 1 mm; e, j–n = 0.5 mm.



Figure 4. *Missulena durokoppin* sp. nov. ♂ holotype (WAM T44137) from Durokoppin Nature Reserve, WA; a, left pedipalp, prolateral view; b, same, ventral view; c, same, retrolateral view d, embolar tip, prolateral view. Scale bars a-c = 1 mm, d = 0.1 mm.

opposed to it being distinctly swollen in these other species (Fig. 4a–c vs Fig. 14a–c; fig. 2f, 5f Miglio *et al.* 2014; fig. 2b, c Framenau & Harms 2017). Males of *M. durokoppin* sp. nov. differ from males of other species

by the number of spinules in patella III, with 70–100 covering the dorsal, prolateral and retrolateral surface in *M. durokoppin* sp. nov., 40 in *M. harewoodi*, 59 in *M. melissae*, 42 in *M. rutraspina*, 41 in *M. terra* sp. nov. and 31



Figure 5. Distributional records for *M. durokoppin* sp. nov. and *M. gelasinos* sp. nov.

or fewer in *M. faulderi*, *M. leniae*, and *M. pinguipes* (Fig. 3m vs Fig. 13m; fig. 4e Harms & Framenau 2013; figs 3b, 6b, 8b, Miglio *et al.* 2014; Faulder 1995; Framenau & Harms 2017). They are further differentiated from *M. leniae* and *M. rutraspina* by faving a smooth carapace, which is coarsely granulated in males of these other species (Fig. 3a, e, i vs fig. 4 Faulder 1995; fig. 7a–c Miglio *et al.* 2014). They are further separated from males of *M. faulderi* by the curvature of the embolus, which is straighter and less curved in *M. durkoppin* sp. nov. (Fig. 4a–d vs figs 7f–h Harms & Framenau 2013). Males of *M. durokoppin* sp. nov. further differ from males of *M. pinguipes*, by the number of spines in the rastellum, with five strong spines in *M. durokoppin* sp. nov., as opposed nine in *M. pinguipes* (Fig. 3g vs fig. 5e Miglio *et al.* 2014).

#### Description

Male (based on holotype; WAM T44137). Total length 8.32.

*Colour in ethanol:* Pars cephalica and chelicerae dark brown, pars thoracica lighter brown (Fig. 2a, 3a). Mottled dark brown pigmentation around AME, PLE, and ALE (Fig. 3e). Sternum pale orange-brown, with eight sigilla of darker orange-brown; maxillae dark orange-brown, darker mottled patches basally; labium dark orangebrown with two distinct darker patches on the basal lateral edges (Fig. 3f). Abdomen dorsally and ventrally pale grey; ventrally with pale yellow book lungs. Spinnerets pale cream, with white interconnecting segments (Fig. 3c, d). Legs bright orange-brown, more or less uniform in colour.

Carapace: 3.37 long and 3.89 wide; pars cephalica height 1.53; pars cephalica covers 0.62 of carapace length. Pars cephalica smooth with few granulations; with two distinct, rounded indentations posterior to AME (Fig. 3e). Pars thoracica with slight granulation, deep trench running longitudinally from fovea to posterior edge; two lateral indentations posteriorly, and a moderately shallow central posterior notch; lateral edges strongly recurved and undulating (Fig. 3a). Pars cephalica strongly elevated, highest point anteriorly (Fig. 3i). Chelicerae: 2.32 long; elongate, and broadly cylindrical; dorsally with fine granulations, and with strong, distinct, and regular dorsal-prolateral transverse ridges, beginning at the midpoint and extending to the apex (Fig. 3a). Sternum: ovoid, with sparse setae. Four pairs of sigilla, all lightly depressed, anterior pair small, and oval; second pair consisting of either a cluster of three small depressions and a larger one (left), or two small adjacent depressions (right); third pair around the same size as the cluster of the second pair and oval; fourth pair largest, ca. twice the size of the third pair, oval (Fig. 3b). Labiosternal junction fused (Fig. 3b). Eyes: OQ four times wider than long; anterior eyes slightly procurved; posterior

eyes strongly recurved (Fig. 3e). Cheliceral furrow with row of nine strong pyramidal teeth prolaterally the apical teeth connected in a ridge; retrolateral edge of furrow with two small teeth basally, and with a cluster of five small teeth in the inter-furrow region (Fig. 3h). Maxillae: anteriorly with ca. 80–100 weakly developed cuspules (Fig. 3f). Labium: conical; anteriorly with ca. 25 weakly developed cuspules (Fig. 3f), with labio-sternal sigillae basally (Fig. 3b). Rastellum well pronounced, with five strong, conical spines (Fig. 3g). Around 15 setae forming a fringe over the base the fang of each chelicera and the rastellum.

*Abdomen:* 3.42 long and 3.47 wide; rounded oval; four spinnerets (Fig. 3c, d).

Legs: sparse, scattered brown-black setae on all surfaces. Leg spination: leg I: tibia rv11, v4, pl7 (spinules), d2; metatarsus rv6, v6, pl6, d2; tarsus rv5, v2, pl5, d2; leg II: tibia rv6, v6, pl5 (spinules), d0; metatarsus rv5, v10, pl5, d0; tarsus rv9, v5, pl8, d0; leg III: tibia rv4, v2, pl6, d7 (spinules); metatarsus rv3, v0, pl6, d10; tarsus rv5, v0, pl7, d5; leg IV: tibia r2, v9, pl6, d0; metatarsus rv3, v0, pl13, d3; tarsus rv11, v3, pl16, d4; patella I 16 spinules prolaterally (Fig. 3k); patella II with ca. 10 spines prolaterally (Fig. 3I); patella III with dense covering of c. 90–100 spinules on the dorsal, prolateral and retrolateral surfaces (Fig. 3m); patella IV eight small spinules retrolaterally, four prolaterally (Fig. 3n). Scopulose setae on tarsus I and II. Tarsi and metatarsi III, IV with scopulae along ventral surfaces (leg IV imaged, Fig. 3j). Leg measurements: Leg I: femur 2.61, patella 1.18, tibia 2.21, metatarsus 1.71, tarsus 1.28, total 8.99. Leg II: femur 2.73, patella 1.28, tibia 1.61, metatarsus 1.43, tarsus 1.10, total 8.15. Leg III: femur 3.05, patella 1.29, tibia 1.64, metatarsus 1.93, tarsus 1.80, total 9.71. Leg IV: femur 3.56, patella 1.23, tibia 2.32, metatarsus 2.05, tarsus 1.69, total 10.85. Formula: 4>3>1>2.

*Pedipalp:* length of femur 2.28, patella 1.17, tibia 2.14, tarsus 0.76; all segments with scattered setae, sparse dorsally and those of the tibia thickest and longest ventrally (Fig. 4a–c). Tibia not inflated, broader basally, 0.83 wide on the widest point from dorsal and prolateral view, 2.6 times the length than the width (Fig. 4a). Bulb roughly pyriform (Fig. 4a–c). Embolus elongate, curved and slightly sinuous apically, with an apical lamella (Fig. 4d).

**Variation** (n = 10). All material examined had pars cephalica and chelicerae dark brown, pars thoracica lighter brown. Colour of the dorsal surface of the abdomen varied from pale-grey to slate-grey. Total length: 6.31–8.50, mean 7.32. Number of maxillary cuspules: 45–65, mean 51.8; number of labial cuspules: 21–29, mean 23.8; number of spines on the rastellum: left and right 4–6, left mean 4.5, right mean 4.63. All material examined had a distinct medial groove in the pars thoracica. Number of spinules on the left patella (n

= 7): Leg I 11–19, mean 14.86; Leg II 7–11, mean 9; Leg III ca. 70–100; Leg IV 12–22, mean 15.86.

## Other material examined

AUSTRALIA: Western Australia: 🖒 Durokoppin Nature Reserve, 31.5°S, 117.73°E,13-23 May 1992, G. Friend et al., DKRG2 (WAM T157067); 👌 Durokoppin Nature Reserve, 31.5°S, 117.73°E, 13-23, May 1992, G. Friend et al. DKRB4 (WAM T44140); 👌 Durokoppin Nature Reserve, 31.5°S, 117.73°E, 13–23 May 1992, G. Friend et al., wet pitfall traps DKRB4 (WAM T44134); ♂ Durokoppin Nature Reserve, 31.5°S, 117.73°E, 13–23 May 1992, G. Friend et al., wet pitfall traps DKRE4 (WAM T44138); 2 ∂, Durokoppin Nature Reserve, 31.5°S, 117.73°E, 13–23 May 1992, G. Friend et al., wet pitfall traps, DKRG2 (WAM T44139); 2 👌 Durokoppin Nature Reserve, 31.5°S, 117.73°E, 13–23 May 1992, G. Friend et al., wet pitfall traps, DKRE1 (WAM T44135); 👌 Durokoppin Nature Reserve, DKRG4, 31.5°S, 117.73°E, 13-23 May 1992, G. Friend *et al.*, wet pitfall traps (WAM T44141); *C* Durokoppin Nature Reserve, 31.5°S, 117.73°E, 13-23 May 1992, G. Friend et al., wet pitfall traps, DKRE2 (WAM T44136); ♂ Durokoppin Nature Reserve, 31.4°S, 117.76°E, 26 February-7 March 1989, G. Friend et al. wet pitfall traps, DKRB3 (WAM T56010); ♂ Durokoppin Nature Reserve, 31.4°S, 117.76°E, 26 February-7 March 1989, G. Friend et al., wet pitfall traps, DKRA4 (WAM T56009).

# Etymology

The specific epithet is chosen to reflect the collecting locality for this species, Durokoppin Nature Reserve. The word Durokoppin comes from the Njakinjaki group of the Noongar peoples, traditional owners of the land in which this species is known and means "the tea tree sits around here and takes possession of this site" (www.boodjar.org.au/boodjar-placenames/durokoppin).

#### Distribution

Only known from Durokoppin Nature Reserve, south-western WA (Fig. 5).

# Missulena gelasinos sp. nov.

Figs 2b, 5, 6a-n, 7a-d

urn:lsid:zoobank.org:act:8B65341A-AF59-4C7A-A17E-933F055AD888

#### **Type material**

Holotype 3. AUSTRALIA: Western Australia: Charles Gardner Reserve, North, site Qu 93, 01, 03, 05, 07, 09, 31.77916°S, 117.47277°E, 27 May–5 October 1998, Paul Van Heurck, Wheatbelt Survey, wet pitfall trap (WAM T148354).

# Diagnosis

The combination of a red chelicerae and brown carapace of males of *M. gelasinos* sp. nov. are not shared by other described species of *Missulena*. Males can be fur-



Figure 6. *Missulena gelasinos* sp. nov.  $\Im$  holotype (WAM T148354) from Charles Gardner Reserve, WA; a, carapace, dorsal view; b, same, ventral view; c, abdomen, dorsal view; d, same, ventral view; e, eyes; f, mouthparts, ventral view; g, rastellum; h, cheliceral teeth, line drawing; i, carapace, lateral view; j, leg IV retrolateral view; k, left patella I, dorsal view; l, same patella II; m, same patella III; n, same patella IV. Scale bars a–d, f, g, i = 1 mm; k–n = 0.5 mm.

ther differentiated from other species of *Missulena* that have a brown carapace by the presence of an indentation on the retrolateral surface of the chelicerae (Fig. 6a), and by a lack of transverse striations on the dorsal and retrolateral surface of the chelicerae (except *M. harewoodi*, which also lacks striations), striations weak in *M. leniae* and *M. pinguipes* (Fig. 6a, i vs Fig. 3a; Fig. 12a; fig. 6 Faulder 1995; fig. 5b, e Harms & Framenau 2013; figs 2c, 6i, 8i Miglio *et al.* 2014). They further differ from *M. durokoppin* sp. nov., *M. faulderi, M. harewoodi, M. melissae*, and *M. terra* sp. nov. by having coarse granulations on the carapace, which is smooth in these other species (Fig. 6a vs Fig. 3a; Fig. 13a; fig. 4b, c Harms & Framenau 2013; fig. 2a, c Miglio *et al.* 2014; fig. 1a, d Framenau & Harms 2017). Of the species in which males have red chelicerae and a brown or black pars thoraci-



Figure 7. *Missulena gelasinos* sp. nov.  $3^{\circ}$  holotype (WAM T148354) from Charles Gardner Reserve, WA; a, left pedipalp, prolateral view; b, same, ventral view; c, same, retrolateral view; d, embolar tip, prolateral view. Scale bars a–c = 1 mm, d = 0.1 mm.

ca males of *M. gelasinos* sp. nov. differ by having 12 spines in the rastellum, in which there are less than nine in *M. insignis* (O. Pickard-Cambridge, 1877), *M. manningensis* Greenberg, Huey, Framenau & Harms, 2021, *M.* 

*iugum* Greenberg, Huey, Framenau & Harms, 2021, and *M. langlandsi* Harms & Framenau, 2013, and 16–20 in *M. reflexa* Rainbow & Pulleine, 1918 (Fig. 6f, g vs fig. 10c Harms & Framenau 2013; fig. 8f, h, 11i Greenberg*et al.* 

2021; Womersley 1943). They differ from *M. occatoria* Walckenaer, 1805 and *M. reflexa* by the lack of transverse striations on the chelicerae and from *M. iugum* by the lack of a ridge on the cheliceral groove (Fig. 6a, f, h vs fig. 9g Greenberg *et al.* 2021; Womersley 1943); from *M. occatoria* and *M. insignis* by the lack of spines or a rasp on patella II and from *M. davidi* Greenberg, Huey, Framenau & Harms, 2021 by the shorter and broader pedipalp tibia (Fig. 6l, 7a–c vs fig. 4g–i Greenberg *et al.* 2021; Womersley 1943).

# Descriptions

Male (based on holotype; WAM T148354). Total length 8.87.

*Colour in ethanol:* Pars cephalica, pars thoracica brown, chelicerae red (Fig. 6a). Sternum dull orange-brown, with eight sigilla, dark orange-brown in colour (Fig. 6b); maxillae and labium orange-brown (Fig. b, f). Abdomen dorsally cream-brown; ventrally mid-brown, with lighter yellow-brown over the book lungs; spinnerets mid-brown (Fig. 6c, d). Legs olive-brown with a faint blue metallic sheen.

Carapace: 4.75 long and 5.56 wide; pars cephalica height 1.93; pars cephalica covers 0.63 of carapace length. Pars cephalica strongly granulated. Pars thoracica moderately granulated; posterior and lateral edges recurved, lateral edges undulating; two depressions posteriorly either side of mid-point; posterior edge with a shallow medial notch (Fig. 6a). Pars cephalica strongly elevated (Fig. 6i). Chelicerae: 2.50 long; inflated and broadly cylindrical; coarsely granulated dorsally with two dorsoretrolateral indentations at around three quarters the length of the chelicerae, measured base to apex (Fig. 6a). Sternum: ovoid with sparse, scattered setae; four pairs of sigilla, all strongly depressed and distinct; anterior pair elongate oval; second pair small, around half the size of the first, rounded oval; third pair rounded oval, around twice the size of the first pair; fourth pair largest, rounded oval, ca. three times the size of the third pair (Fig. 6b). Labiosternal junction indistinct (Fig. 6b). Eyes: OQ 3.88 times wider than long; anterior eyes slightly procurved; posterior eyes strongly recurved (Fig. 6e). Around 20 setae forming a fringe over the base the fang of each chelicera. Cheliceral furrow with row of nine teeth prolaterally, five small and widely separated teeth retrolaterally; around 14 small teeth in the midfurrow region (Fig. 6h). Maxillae: with covering of setae, anteriorly with ca. 74 small and very weakly developed cuspules (Fig. 6f). Labium: squat pyramidal, with covering of setae; anteriorly with ca. 19 small and very weakly developed cuspules (Fig. 6f). Rastellum moderately pronounced, with 12 (10 right) strong, conical spines (Fig. 6f, g).

*Abdomen:* 4.79 long and 4.58 wide; rounded trapezoid; four spinnerets (Fig. 6c, d).

Legs: sparse, scattered brown-black setae on all surfaces. Leg spination: leg I: tibia rv2, v11, pl2, d0; metatarsus rv2, v15, pl2, d0; tarsus rv2, v9, pl1 d2; leg II: tibia rv2, v7, p3, d0; metatarsus rv5, v7, pl3, d0; tarsus rv2, v14, pl3, d2; leg III: tibia rv3, v6, pl5, d11; metatarsus rv6, v2, pl9, d10; tarsus rv6, v4, pl5, d5; leg IV: tibia rv1, v7, pl5, d0; metatarsus rv3, v0, pl9, d1; tarsus rv4, v0, pl4, d3. Patella I ca. 20 well developed, stout spines clustered prolaterally (Fig. 6k), nine ventrally; patella II with five spines ventrally; patella III with dense covering of ca. 50 well developed, stout spines on the dorsal and retrolateral surfaces (Fig. 6m); patella IV with cluster of ca. 15 spinules on prolateral sand retrolateral surfaces (Fig. 6n). Tarsus I with sparse scopulae apically; metatarsus and tarsus III, IV with scopulae along ventral surface (Fig. 6j, leg IV imaged). Leg measurements: Leg I: femur 4.76, patella 1.89, tibia 2.83, metatarsus 2.47, tarsus 1.78, total 13.73. Leg II: femur 4.07, patella 2.21, tibia 2.40, metatarsus 2.14, tarsus 1.81, total 12.60. Leg III: femur 3.76, patella 2.37, tibia 2.30, metatarsus 2.30, tarsus 1.54, total 12.8. Leg IV: femur 3.67, patella 2.38, tibia 2.21, metatarsus 3.02, tarsus 1.88, total 12.16. Formula: 1>2>3>4.

*Pedipalp:* femur 4.37, patella 2.23, tibia 3.40, tarsus 1.25; all segments with scattered setae, sparse dorsally and those of the tibia thickest and longest ventrally (Fig. 7a–c). Tibia slender, mildly inflated ventrally, 1.19 wide on the widest point from dorsal and prolateral view, 2.9 longer than wide (Fig. 7a–c). Bulb roughly pyriform (Fig. 7a, b). Embolus moderately short, thin, curved, embolar tip with a lamella (Fig. 7d).

**Variation** (n = 10). Most material examined had red chelicerae, with brown pars cephalica and brown pars thoracica, however the pars cephalica of one specimen was a more red-brown. The colour of the abdomen dorsally varied from slate-grey to cream-grey. Total length: 8.34–12.51, mean 9.84. Number of maxillary cuspules: 70–108, mean 76.7; number of labial cuspules: 17–26, mean 19.5; number of spines on the rastellum: left 7–10, mean 8.5, right 7–11, mean 8.12. All specimens examined had lateral indentations retrolaterally on the chelicerae. Number of spinules on the left patella (n = 8): Leg I 32–43, mean 35.38; Leg II 6–16, mean 11.29; Leg III 48–59, mean 53.38; Leg IV 20–36, mean 30.71.

# Other material examined

AUSTRALIA: *Western Australia*: ♂ Howatharra Nature Reserve, South West, No. 02, 01-05x2, 28.5475°S, 114.6613°E, 15 September–30 March 1999–18 October 1999, Paul Van Heurck, Wheatbelt survey, wet pitfall trap (WAM T148351); ♂ Kulunilup Nature Reserve, West, site UN07, 34.34888°S, 116.7725°E, closed 1 November 2000, N. Guthrie, CALM Wheatbelt Survey, wet pitfall trap (WAM T148359); ♂ N of Edwards Rd, SE of Lake King, site GP2, 33.36694°S, 120.99527°E, 15 October 1999-1 November 2000, Paul Van Heurck *et al.*, CALM Survey, wet pitfall trap (WAM T148348); ♂ Koorda Road,

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22363 Nature Reserve, Site WH 06, 33.36694°S, 120.99527°E, 15 September 1998-29 April 1999-25 October 1999, B. Durrant, CALM-WAM Survey, wet pitfall trap (WAM T148356); 👌 Tutanning Nature Reserve, site 8-2, ca. 32.53°S, 117.3°E, 16 June 1987, G.R. Friend, pitfall trap (WAM T59382); 👌 Tutanning Nature Reserve, WW End, Site WK07, 01, 04, 05, 06, 32.545°S, 117.275°E, closed 16 September 1998, L. King, CALM Wheatbelt Survey, wet pitfall trap (WAM T148357); ♂ Durokoppin Nature Reserve, central sites, KL 11, 01, 02, 05, 07, 08, 31.4044444°S, 117.75888°E, closed 22 September 1998, N. Guthrie, CALM Wheatbelt Survey, wet pitfall trap (WAM T148349); 👌 West Perenjori Nature Reserve, North, MO01, 01-05x2, 29.46444°S, 116.21000°E, 15 September 1998-2 April 1999-18 October 1999, Paul Van Heurck, CALM-WAM Wheatbelt, wet pitfall trap (WAM T148350); ∂ Perengillup Nature Reserve, site ST 12, 33.94361°S, 117.64472°E, 15 October 1999-1 November 2000, Paul Van Heurck et al., CALM Survey, wet pitfall trap (WAM T148355).

## Etymology

The specific epithet is a Greek noun meaning 'dimple' and refers to the lateral indentations on the chelicerae of this species.

## Distribution

Known from south-western to mid-western WA (Fig. 5).

# *Missulena ignea* sp. nov.

Figs 2c, 8a-n, 9a-d, 10

urn:lsid:zoobank.org:act:7159FE9D-1451-4C1E-8122-AB843BED833D

# Type material

Holotype 3. AUSTRALIA: Western Australia: Cape Range National Park, ca. 6 km NE of Milyering Visitor Centre, site TZ17C, 21.99285°S, 113.97426°E, 24 June 2019, walking, day, 2019-048, M.S. Harvey, N. Tatarnic, A.L. McMah (WAM T148118).

#### Diagnosis

Males of *Missulena ignea* sp. nov. are morphologically closest to *M. mainae* Miglio Harms, Framenau & Harvey, 2014 and *M. minima* sp. nov., which also have a bright red pars cephalica, pars thoracica, and chelicerae. They differ from these species by the presence of a rasp on patella I–IV in *M. ignea* sp. nov., whilst only III and IV have a rasp in the other species (Fig. 8k–n vs Fig. 11k–n, fig. 10a, b Miglio *et al.* 2014). They further differ by the presence of scopulae on tarsus III, IV and metatarsus III, IV in *M. ignea* sp. nov., which are only on metatarsus IV in these other species, and by by the absence of a swollen metatarsus IV in *M. ignea* sp. nov. (Fig. 8j vs Fig. 11j, fig. 10k Miglio *et al.* 2014).

#### Description

Male (based on holotype; WAM T148118). Total length 8.15.

*Colour in ethanol:* Pars cephalica, pars thoracica, and chelicerae reddish-orange (Fig. 8a); black pigmentation around AME, PLE, and ALE; PME pale (Fig. 8a, e). Sternum pale orange, with eight sigilla of similar colour (Fig. 8b); labium and maxillae darker orange with faint brown latitudinal striations on the base of labium (Fig. 8b, f). Abdomen with a strong, metallic blue-grey sheen dorsally, ventrally black; spinnerets pale violet grey, with white interconnecting segments (Fig. 8c, d). Legs dark olive-brown, femur dorsal surfaces with a faint blue metallic sheen, more prominent on legs I, II; tarsi of all segments paler brown, blending to pale cream apically.

Carapace: 3.91 long and 4.57 wide; pars cephalica height 1.62; pars cephalica covers 0.58 of carapace length. Pars cephalica with moderate granulation and with scattered setae. Pars thoracica granulation less coarse than that of pars cephalica, with two lateral indentations posteriorly, and a deep central posterior notch; lateral edges strongly recurved and undulating (Fig. 8a, i). Pars cephalica moderately elevated (Fig. 8i). Eyes: OQ 3.52 times wider than long; anterior eyes straight; posterior eyes strongly recurved (Fig. 8e). Chelicerae: 2.72 long; edges rounded and broadly cylindrical; dorsal surface smooth, granulations and regular longitudinal ridges on prolateral surfaces; faint ridges on retrolateral surfaces (Fig. 8a). Sternum: ovoid; with unevenly scattered setae, denser along margins and anterior. Four pairs of sigilla, all lightly depressed, anterior pair very small, indistinct and oval; second pair small, circular; third pair ca. three times larger than the second pair and oval; fourth pair largest, ca. three times larger than the third pair, oval (Fig. 8a). Labiosternal junction defined, fused (Fig. 8a). Cheliceral furrow with row of eight teeth prolaterally (seven right), five teeth retrolaterally (seven right) and with a cluster of five small teeth in the inter-furrow region (Fig. 8h). Maxillae: with covering of setae, denser anteriorly, and with ca. 50 cuspules on anterior and prolateral margins (Fig. 8f). Labium: squat pyramidal, with sparse long setae and with ca. 17 cuspules anteriorly (Fig. 8f). Rastellum present, not well pronounced, with five (right six) strong, conical spines (Fig. 8g). With ca. 20 setae forming a fringe over the base the fang of each chelicera - the setae being thicker retrolaterally.

*Abdomen:* 4.02 long and 3.37 wide; oval; four spinnerets (Fig. 8c, d).

*Legs:* scattered brown-black setae on all surfaces. Leg spination: leg I: tibia rv3, v9, pl0, d0; metatarsus rv6, v5, pl0, d0; tarsus rv2, v0, pl0, d0; leg II: tibia rv6, v6, pl0, d0; metatarsus rv7, v2, pl4, d0; tarsus rv2, v0, pl0, d0; leg III: tibia rv1, v3, pl3, d4; metatarsus rv6, v0, pl3, d7; tarsus rv5, v3, pl4, d2; leg IV: tibia rv2, v5, pl0, d0; metatarsus rv8, v0, pl4, d2; tarsus rv8, v3, pl9, d4. Patella I with six spines prolaterally, four ventral spines, one spine retro-laterally (Fig. 8k); patella II with two prolateral spines apically, two ventral spines apically, and one retrolateral spine apically (Fig. 8l); patella III with 18 spines on the prolateral and dorsal surfaces (Fig. 8m); patella IV with



Figure 8. *Missulena ignea* sp. nov.  $\bigcirc$  holotype (WAM T148118) from Cape Range National Park, WA; a, carapace, dorsal view; b, same, ventral view; c, abdomen, dorsal view; d, same, ventral view; e, eyes; f, mouthparts, ventral view; g, rastellum; h, cheliceral teeth, line drawing; i, carapace, lateral view; j, leg IV retrolateral view; k, left patella I, dorsal view; I, same patella II; m, same patella III; n, same patella IV. Scale bars a-g, i, j = 1 mm; k-n = 0.5 mm.

ca. six spinules dorsally interspersed amongst elongate setae (Fig. 8n). Scopulae on ventral surfaces of tarsi and metatarsi III and IV (Fig. 8j, leg IV imaged). Claws long. Leg measurements: Leg I: femur 3.05, patella 1.90, tibia 2.26, metatarsus 1.97, tarsus 1.42, total 10.06. Leg II: femur 2.37, patella 1.74, tibia 1.86, metatarsus 1.92, tarsus 1.24, total 9.13. Leg III: femur 1.95, patella 1.52, tibia 1.40, metatarsus 1.99, tarsus 1.49, total 8.35. Leg IV:

femur 2.75, patella 1.97, tibia 2.41, metatarsus 2.04, tarsus 1.62, total 10.79. Formula: 4>1>3>2.

*Pedipalp:* femur 2.55, patella 1.52, tibia 2.28, tarsus 0.69; all segments with scattered setae, those of the tibia thicker and longer ventrally (Fig. 9a–c). Tibia thin, broader basally, 1.45 wide on the widest point from dorsal and prolateral view (Fig. 9a, b). Bulb roughly pyriform



Figure 9. *Missulena ignea* sp. nov.  $\bigcirc$  holotype (WAM T148118) from Cape Range National Park, WA; a, left pedipalp, prolateral view; b, same, ventral view; c, same, retrolateral view; d, embolar tip, prolateral view. Scale bars a-c = 1 mm, d = 0.1 mm.

(Fig. 9a, b). Embolus short, small swelling near base; tip squared, without an embolar tooth (Fig. 9d).

# Etymology

The specific epithet is a Latin adjective igneus meaning 'fiery', and refers to the bright orange-red colouration of

Variation. Only known from holotype male.



Figure 10. Distributional records for *M. ignea* sp. nov. and *M. minima* sp. nov, and *M. terra* sp. nov.

the pars cephalica, pars thoracica and chelicerae of this species.

#### Distribution

Only known from Cape Range National Park, mid-western WA (Fig. 10).

# Missulena minima sp. nov.

Figs 2d, 10, 11a-n, 12a-d

urn:lsid:zoobank.org:act:0D73A032-0404-476E-8A6D-10E9E6057014

#### Type material

Holotype ♂. AUSTRALIA: Western Australia: West Perenjori Nature Reserve, North MO 01, 01-05x 29.46444°S, 116.21000°E, 15 September 1998–2 April 1999–18 October 1999, Paul Van Heurck, CALM-WAM Wheatbelt, wet pitfall trap (WAM T148307).

#### Diagnosis

Males of *Missulena minima* sp. nov. are morphologically closest to males of *M. mainae* and *M. ignea* sp. nov., which share a bright red pars cephalica, pars thoracica, and chelicerae. They differ from *M. ignea* sp. nov. by the absence of scopulae on tarsus III and IV, and the presence of a swollen metatarsus IV (Fig. 11j vs Fig. 8j). They can be separated from *M. mainae* by the larger num-

ber of spines in the rasps of patella IV, with ca. 35 in *M. minima* sp. nov., whereas *M. mainae* has 12 on patella IV (Fig. 11n vs fig. 10b Miglio *et al.* 2014). They further differ by the smaller size, ranging from 4.14–5.10 in *M. minima* sp. nov., and 5.27–6.09 in *M. mainae*, and by the number of maxillary cuspules, ranging from 86–108 in *M. mainae* and 52–60 in *M. minima* sp. nov. They can be further separated by the shape of the embolus, which is elongate and curved in *M. minima* sp. nov., but is short, with a BEI in *M. mainae* (Fig, 12a–c vs fig. 9g, h, I Miglio *et al.* 2014).

#### Description

Male (based on holotype; WAM T148307). Total length 4.5.

*Colour in ethanol:* Pars cephalica, chelicerae and pars thoracica bright orange-red (Fig. 11a). Faint, mottled black pigmentation around AME (Fig. 11a, e). Sternum pale orange, with eight sigilla of same colour as sternum; maxillae and labium darker orange-brown (Fig. 11b). Abdomen with a strong, metallic blue-purple-turquoise sheen dorsally, ventrally dark brown, with lighter brown over the book lungs; spinnerets dark olive-brown (Fig. 11c, d). Legs olive-brown, metatarsus of all legs paler cream-olive-brown; tarsus I, II pale cream-olive-brown.



Figure 11. *Missulena minima* sp. nov.  $\Im$  holotype (WAM T148307) from West Perenjori Nature Reserve, WA; a, carapace, dorsal view; b, same, ventral view; c, abdomen, dorsal view; d, same, ventral view; e, eyes; f, mouthparts, ventral view; g, rastellum; h, cheliceral teeth, line drawing; i, carapace, lateral view; j, leg IV retrolateral view; k, left patella I, dorsal view; I, same patella II; m, same patella III; n, same patella IV. Scale bars a-g = 0.5 mm; k-n = 0.2 mm; i = 1 mm.

*Carapace*: 2.17 long and 2.44 wide; pars cephalica height 1.04, pars cephalica covers 0.58 of carapace length. Pars cephalica coarsely granulated; pars thoracica coarsely granulated. Posterior and lateral edges recurved, lateral edges undulating; posterior edge with a shallow medial notch (Fig. 11a). Pars cephalica strongly elevated (Fig. 11i). Chelicerae: 1.11 long; inflated and broadly cylindrical; dorsally moderately granulated (Fig. 11a). Sternum:

ovoid with sparse, scattered setae, denser laterally (Fig. 11b); four pairs of sigilla, all lightly depressed and indistinct. Anterior pair small, oval; second pair around the same size as the first; third pair around twice size as the second pair; fourth pair largest, ca. twice the size of the third pair (Fig. 11b). Labiosternal junction distinct (Fig. 11b). Eyes: OQ length 0.32 of width; anterior eyes slightly recurved; posterior eyes strongly recurved (Fig.



Figure 12. *Missulena minima* sp. nov.  $\bigcirc$  holotype (WAM T148307) from West Perenjori Nature Reserve, WA; a, left pedipalp, prolateral view; b, same, ventral view; c, same, retrolateral view; d, embolar tip, prolateral view. Scale bars a-c = 1 mm, d = 0.1 mm.

11e). Cheliceral furrow with row of five teeth prolaterally, two small and widely separated teeth retrolaterally (Fig. 11h). Maxillae: with a dense covering of setae, anteriorly with ca. 54 cuspules, the anterior most cuspules long and well developed (Fig. 11f). Labium: arrow shaped, basally with two defined lateral ridges, extend-

ing medially to around a quarter of the labium width, with sparse covering of setae, anteriorly with ca. 27 cuspules, better developed and longer anteriorly (Fig. 11f). Rastellum moderately pronounced, with 15 (14 right) conical spines (Fig. 11f, g). Around 14 setae forming a fringe over the base the fang of each chelicera.

*Abdomen:* 2.29 long and 2.28 wide; rounded trapezoid; four spinnerets (Fig. 11c, d).

Legs: sparse and scattered brown-black setae on all surfaces. Metatarsus IV inflated ventrally. Leg spination: leg I: tibia rv0, v6, pl2, d0; metatarsus rv0, v5, pl2, d0; tarsus rv2, v4, pl2, d2; leg II: tibia rv4, v6, pl1, d0; metatarsus rv2, v7, pl4, d2; tarsus rv2, v3, pl1, d0; leg III: tibia rv4, v7, pl4, d8; metatarsus rv6, v6, pl1, d5; tarsus rv3, v4, pl3, d4; leg IV: tibia rv3, v4, pl5, d5; metatarsus rv7, v0, pl9, d8; tarsus rv4, v4, pl4, d4. Patella I with two dorsal spines apically (Fig. 11k); patella II with two dorsal spines (Fig. 11l); patella III with covering of ca. 41 spinules on the dorsal and retrolateral surfaces (Fig. 11m); patella IV with ca. 35 spinules on dorsal, retrolateral and prolateral surfaces (Fig. 11n). Tarsus I with a small number of sparse scopulose setae apically; metatarsus II, III with no scopulae; metatarsus IV with scopulae along ventral surface (Fig. 11j). Leg measurements: Leg I: femur 1.89, patella 0.95, tibia 1.32, metatarsus 1.32, tarsus 0.89, total 6.37. Leg II: femur 2.69, patella 1.15, tibia 1.77, metatarsus 1.92, tarsus 1.38, total 8.91. Leg III: femur 1.72, patella 0.94, tibia 1.11, metatarsus 1.39, tarsus 1.11, total 6.27. Leg IV: femur 2.22, patella 0.81, tibia 1.63, metatarsus 1.72, tarsus 1.25, total 7.63. Formula: ||>|V>|>|||.

*Pedipalp:* femur 2.05, patella 0.89, tibia 1.71, tarsus 0.66; all segments with scattered setae, sparse dorsally and those of the tibia thickest and longest ventrally (Fig. 12a-c). Tibia elongate, inflated and bulbous ventrally, 0.63 wide at the widest point from retrolateral view; bulb roughly pyriform (Fig. 12a, b). Embolus elongate, thin and curved, tip with a small embolar tooth (Fig. 12d).

**Variation** (n = 4). There was very little variation in the colouration of the material examined, the carapace of one specimen was a paler orange-red. Total length 4.14–5.10, mean 4.69. Number of maxillary cuspules: 52–60; number of labial cuspules: 20–27; number of spines in the rastellum: left 14–17, mean 15.67, right 15–16; mean 15.67. Number of spinules on the left patella (n = 4): Leg I 0–7, mean 4; Leg II 0–2; mean 1; Leg III 29–39, mean 34.25; Leg IV 20-40, mean 29.

#### Other material examined

AUSTRALIA: Western Australia: 2 ♂ West Perenjori Nature Reserve, North, MO 01, 01-05x2, 29.46444°S, 116.21000°E, 15 September 1998–2 April 1999–18 October 1999, Paul Van Heurck, CALM-WAM Wheatbelt, wet pitfall trap (WAM T148305); ♂ West Perenjori Nature Reserve, North, MO 01, 01-05x2; 29.46444°S, 116.21000°E, 15 September 1998–2 April 1999–18 October 1999, Paul Van Heurck, CALM-WAM Wheatbelt, wet pitfall trap (WAM T148306).

## Etymology

The specific epithet is a Latin Adjective 'minimum' meaning small and refers to the small size of this species compared to other species of *Missulena*.

## Distribution

Only known from West Perenjori Nature Reserve, midwestern WA (Fig. 10).

# Missulena terra sp. nov.

Figs 2e, 10, 13a–n, 14a–d

urn:lsid:zoobank.org:act:8FD78651-8484-4C60-A8FE-E316C3423160

## Type material

*Holotype* 3. AUSTRALIA: *Western Australia*: Mardathuna Station, 24.42852°S, 114.50013°E, 14 January–24 May 1995, MR3, A. Sampey *et al.*, wet pitfall trap, WAM / CALM Carnarvon Survey (WAM T96170).

## Diagnosis

Males of *M. terra* sp. nov. are most similar to seven other species which share a brown carapace and chelicerae: M. durokoppin sp. nov, M. faulderi, M. harewoodi, M. leniae, M. melissae, M. pinguipes, and M. rutraspina. Of these, they differ from *M. durokoppin* sp. nov, *M. faul*deri, M. leniae, and M. rutraspina by having a rounded rectangular shaped and swollen pedipalp tibia, 1.7 the length times the width, which is distinctly more slender in these other species (Fig. 13a, b vs Fig. 4a, b, fig. 7b, c Harms & Framenau 2017; 7f Miglio et al. 2014; Faulder 1995). They differ from *M. pinguipes* by having a smooth carapace, which is granulated in *M. pinguipes* (Fig. 12a vs fig. 5a, c Miglio et al. 2014) and by the shape of metatarsus IV, which is inflated in *M. pinguipes*, but not so in M. terra sp. nov. (Fig. 12j vs fig. 6k Miglio et al. 2014). Males of *M. terra* sp. nov. differ from *M. harewoodi* by the lack of retrolateral and dorsal transverse striations on the chelicerae in M. harewoodi (Fig. 12a vs fig. 1a, d Framenau & Harms 2017). They are further separated by M. harewoodi by the rounded rectangular shape of the pedipalp tibia in *M. terra* sp. nov., which is broadly teardrop shaped and narrowed apically in *M. harewoodi*, and by the shape of the embolus, which has a distinct BEI in *M. terra* sp. nov., thickened until around half the embolus length, but is narrower basally in *M. harewoodi* (Fig. 13a-c vs figs 2a-c Framenau & Harms 2017).

# Description

Male (based on holotype; WAM T96170). Total length 8.25.

*Colour in ethanol:* Pars cephalica and chelicerae dark red-brown, pars thoracica lighter red-brown (Fig. 12a).



Figure 13. *Missulena terra* sp. nov.  $\eth$  holotype (WAM T96170) from Mardathuna Station, WA; a, carapace, dorsal view; b, same, ventral view; c, abdomen, dorsal view; d, same, ventral view; e, eyes; f, mouthparts, ventral view; g, rastellum; h, cheliceral teeth, line drawing; i, carapace, lateral view; j, leg IV retrolateral view; k, left patella I, dorsal view; I, same patella II; m, same patella II; n, same patella IV. Scale bars a-d, i = 1 mm, e-g, k-n = 0.5 mm.

Faint, mottled darker brown pigmentation around AME (Fig. 12a, e). Sternum pale orange-brown, with eight sigilla of same colour as sternum (Fig. 12b). Maxillae and labium darker orange-brown (Fig. 12b, f). Abdomen pale cream, ventrally pale cream; spinnerets pale orangecream (Fig. 12c, d). Legs orange-brown, more or less uniform in colour. *Carapace*: 3.67 long and 4.11 wide; pars cephalica height 1.6; pars cephalica covers 0.62 of carapace length. In dorsal view carapace rounded, with pronounced lateral flanges at the midpoint (Fig. 12a). Pars cephalica smooth with little granulation; with two small, indistinct, rounded indentations posterior to AME (Fig. 12a, e). Pars thoracica with fine granulation; posterior edge strongly recurved and with a shallow medial notch. Lateral edges



Figure 14. *Missulena terra* sp. nov.  $3^{\circ}$  holotype (WAM T96170) from Mardathuna Station, WA; a, left pedipalp, prolateral view; b, same, ventral view; c, same, retrolateral view; d, embolar tip, prolateral view. Scale bars a–c = 1 mm, d = 0.1 mm.

recurved and undulating (Fig. 12a). Pars cephalica strongly elevated (Fig. 12i). Chelicerae: 1.53 long; elongate, and broadly cylindrical; dorsally smooth, and with strong and distinct, regular dorsal and prolateral transverse striations starting at the midpoint and extending to the apex (Fig. 12a). Sternum: ovoid, with sparse, scattered setae. Four pairs of sigilla, all lightly depressed and indistinct; anterior pair small, oval; second pair around the same size as the first; third pair around twice size as the second pair; fourth pair largest, ca. twice the size of the third pair (Fig. 12b). Labiosternal junction fused (Fig. 12b). Eyes: OQ 3.42 times wider than long; anterior eyes slightly procurved; posterior eyes strongly recurved (Fig. 12e). Cheliceral furrow with row of eight strong pyramidal teeth prolaterally, retrolateral edge with one large basal tooth and one small apical tooth (Fig. 12h). Maxillae: with ca. 60-80 weakly developed cuspules anteriorly, the anterior most cuspules better developed (Fig. 12f). Labium: conical, anteriorly with 15–20 weakly developed cuspules, better developed anteriorly (Fig. 12f). Rastellum moderately pronounced, with three (two right) strong, conical spines (Fig. 12d). Around 11 setae forming a fringe over the base the fang of each chelicera and around five over the base of the rastellum.

*Abdomen:* 3.84 long and 3.32 wide; rounded oval; four spinnerets (Fig. 12c, d).

Legs: sparse scattered brown-black setae on all surfaces. Leg spination: leg I: tibia rv3, v4, pl7, d0; metatarsus rv5, v6, pl1, d0; tarsus rv5, v2, pl2, d0; leg II: tibia rv4, v4, pl5, d2; metatarsus rv4, v7, pl3, d0; tarsus rv5, v3, pl5, d0; leg III: tibia rv5, v5, pl6, d3; metatarsus rv3, v0, pl3, d8; tarsus rv11, v0, pl4, d2; leg IV: tibia rv1, v4, pl0, d0; metatarsus rv5, v0, pl5, d2; tarsus rv11, v0, pl9, d2. Patella I rasp consisting of 18 spinules prolaterally, forming a narrow band; with two spines ventrally (Fig. 12k); patella II with ca. seven spines prolaterally, forming a narrow band, ventrally with two spines (Fig. 12I); patella III with dense covering of c. 40-60 spinules on the dorsal and retrolateral surfaces (Fig. 12m); patella IV with three spines retrolaterally (Fig. 12n). Tarsus I, II with scopulae ventrally; tarsus and metatarsus III, IV with scopulae along ventral surfaces (Fig. 12j). Leg measurements: Leg I: femur 3.09, patella 1.40, tibia 2.16, metatarsus 1.82, tarsus 1.24, total 9.71. Leg II: femur 3.09, patella 1.50, tibia 1.82, metatarsus 1.87, tarsus 1.27, total 9.55. Leg III: femur 2.97, patella 1.48, tibia 1.58, metatarsus 1.93, tarsus 1.68, total 9.64. Leg IV: femur 3.72, patella 1.71, tibia 2.45, metatarsus 2.00, tarsus 1.36, total 11.24. Formula: 4>1>3>2.

*Pedipalp*: femur 2.14, patella 0.98, tibia 1.94, tarsus 0.93; all segments with scattered setae, sparse dorsally and those of the tibia thickest and longest ventrally Fig. 13a–c. Tibia stout, inflated, broadly rectangular in shape, with rounded ventral swellings basally and apically, 1.07 wide at the widest point from dorsal and prolateral view, 1.7 the length times width (Fig. 13a, b). Bulb roughly pyriform; embolus moderately short and gently curved with a small embolar tooth apically (Fig. 13a, b) and a distinct BEI, inflated until just prior to midpoint, from where it narrows to the apex (Fig. 13d).

*Variation* (n = 8). All material examined had pars cephalica and chelicerae dark brown, pars thoracica lighter red-brown. The dorsal surface of the abdomen varied from pale cream to dark cream-grey. Total length 6.57–9.41, mean 7.74. Number of maxillary cuspules 55–72, mean 63.13; number of labial cuspules 17–27, mean 21.88; number of spines on the rastellum 3–5 left, mean 3.75, 3–4 right, mean 3.37. Number of spinules in the left patella (n = 9): Leg I 13–32, mean 17.71; Leg II 3–16, mean 8.25; Leg III 50–67, mean 59.71; Leg IV 1–18, mean 11.13.

#### Other material examined

AUSTRALIA: Western Australia: 👌 Cape Cuvier, Quobba Station, 24.4°S, 113.50°E, 15 January-30 May 1995, CU2, A. Sampey, wet pitfall trap, WAM/CALM Carnarvon Survey (WAM T96780); 🕉 9.5 km WNW of Mt Hodgson, site BDRN03, ethylene glycol pitfall trap, 22.4125°S, 121.0702°E, 9 September 2005-12 August 2006, CALM PILBARA Survey (WAM T87322); 👌 Francois Peron National Park, 25.82058°S, 113.54008°E, 18 January-24 May 1995, PE3, M.S. Harvey et al., wet pitfall trap, WAM/ CALM Carnarvon Survey (WAM T96174); 👌 Mardathuna Station, 24.44325°S, 114.51152°E, 14 January-25 May 1995, MR2, A. Sampey et al., wet pitfall trap, WAM/ CALM Carnarvon Survey (WAM T96779); 🖒 Nanga Station, 26.477°S, 114.076°E, 19 January-11 May 1995, NA1, A. Sampey et al., wet pitfall trap, WAM/CALM Carnarvon Survey (WAM T96172); 👌 Nerren Nerren Station, 27.006°S, 114.5414°E, 11 January-11 May 1995, NE4 P, West et al., wet pitfall traps, WAM/ CALM Carnarvon (WAM T96777); 👌 Cape Cuvier, Quobba Station 24.2233°S, 113.50363°E, 15 January-30 May 1995, CU2, A. Sampey et al. wet pitfall trap, WAM/ CALM Carnarvon Survey (WAM T96173); ♂ Kennedy Range National Park, 24.50041°S, 115.01863°E, 14 January-29 May 1995, KE2 P, West et al., wet pitfall trap, WAM/ CALM Carnarvon Survey (WAM T96776).

#### Etymology

The specific epithet is a Latin noun meaning 'earth' or 'land' and is used in reference to the earthy colours of this species.

#### Distribution

*Missulena terra* sp. nov. is known from mid-western WA (Fig. 10)

# Disclosures

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# Supplementary Data

https://figshare.com/s/e81c958db8187587c27f Table S1. Specimens used in the molecular analyses for all relevant and new species with museum registration codes and GenBank accession numbers for COI.

https://figshare.com/s/194edd595ed586c48e3c Figure S1. Maximum likelihood tree of the mitochondrial DNA COI gene for all 170 *Missulena* sequences used and 4 outgroup taxa. Sequences with only GenBank numbers were identified in the genus *Missulena*. Bootstrap support values are shown at each node. Details for all new sequences and those obtained from GenBank are available in Table S1.

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