



Three new species of the open-holed trapdoor spider genus *Proshermacha* (Mygalomorphae: Anamidae) from southwest Western Australia

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Abstract

The Australian endemic open-holed trapdoor spider genus *Proshermacha* Simon, 1908 currently contains 13 described species distributed throughout southern Australia. We describe three new species from the Southwest Australia biodiversity hotspot: *Proshermacha katana* sp. nov. and *Proshermacha rapier* sp. nov. from the Esperance Plains bioregion, and *Proshermacha scimitar* sp. nov. from the Esperance Plains and Jarrah Forest bioregions. We further conduct a multilocus molecular analysis to reveal the phylogenetic placement of two of these newly-described species.

Cite this paper as: Sagastume-Espinoza KO, Wilson JD & Harvey MS (2025). Three new species of the open-holed trapdoor spider genus *Proshermacha* (Mygalomorphae: Anamidae) from southwest Western Australia. *Australian Journal of Taxonomy* 104: 1–20. doi: <https://doi.org/10.54102/ajt.jgkav>

ZooBank LSID: <https://zoobank.org/References/73F241F8-E558-4C13-A270-89DAFAFF7050>

Introduction

The Australian endemic genus *Proshermacha* Simon, 1908 (Anamidae Simon, 1889) is a poorly studied lineage of open-holed trapdoor spiders with thirteen species currently described (World Spider Catalog 2025). The genus occurs throughout southern Australia, from south-western Western Australia to western Victoria. Most described species are recorded from south-west-

ern Western Australia or South Australia, with *P. armigera* (Rainbow and Pulleine, 1918) and *P. credo* Wilson, Rix, & Harvey 2023 showing the northernmost distribution in the Avon Wheatbelt and Murchison IBRA bioregions, respectively (Harvey *et al.* 2020; Wilson *et al.* 2023). While most records come from the mesic zone, collection records of numerous undescribed and a few described species have been found in arid ecosystems (Harvey *et al.* 2018; Wilson *et al.* 2023). After the genus

This paper was submitted on 25 June 2025 and published on 9 October 2025 (2025-10-08T21:37:34.758Z). It was reviewed by Andre do Prado and an anonymous reviewer, and edited by Subject Editor Volker Framenau under the guidance of Associate Editor Tom May. Mark Harvey is an Editor of the Australian Journal of Taxonomy. He did not at any stage have access to the manuscript while in peer review, and had no influence on its acceptance or handling, as is standard practice for manuscripts submitted by editors. Australian Journal of Taxonomy. ISSN: 2653-4649 (Online).

was revalidated by Harvey *et al.* (2018), four new species have been described in the span of a few years (Harvey *et al.* 2023; Leenders *et al.* 2023; Wilson *et al.* 2023), with many more still to be described (Harvey *et al.* 2018; MSH, unpublished data), highlighting the taxonomic importance of the genus as a significant part of the mygalomorph fauna of southern Australia.

Here we describe three new species from south-western Western Australia: *P. katana* sp. nov. and *P. rapier* sp. nov. from the Esperance Plains bioregion, and *P. scimitar* sp. nov. from the Esperance Plains and Jarrah Forest bioregions (Fig. 1). These taxa were recently included in a geometric morphometric analysis, which supported the recognition of two morphologically distinct species (Sagastume-Espinoza *et al.* 2024). Building on this, we here performed additional statistical analyses of male palpal bulb size, through which we delimited a third species. We also present a multi-locus molecular phylogenetic analysis that includes multiple sequences for two of the three species described here, supporting their monophyly and clarifying their phylogenetic position within *Proshermacha*.

Methods

Morphology. Species delimitation and description was conducted using an integrative species concept following Wilson *et al.* (2023) and *sensu* De Queiroz (2007), incorporating morphological character examination and morphometric analysis, molecular distinctiveness, and geographical isolation. All specimens were examined following the taxonomic methods utilised by Huey *et al.* (2019) and are preserved in 70% ethanol and lodged at the Western Australia Museum, Perth (WAM). Auto-montaged digital images were taken at different focal planes with a Leica MZ16A microscope with mounted Leica DFC500 digital camera and processed using the Leica Application Suite (LAS) Software (ver. 4.6) at the Western Australian Museum.

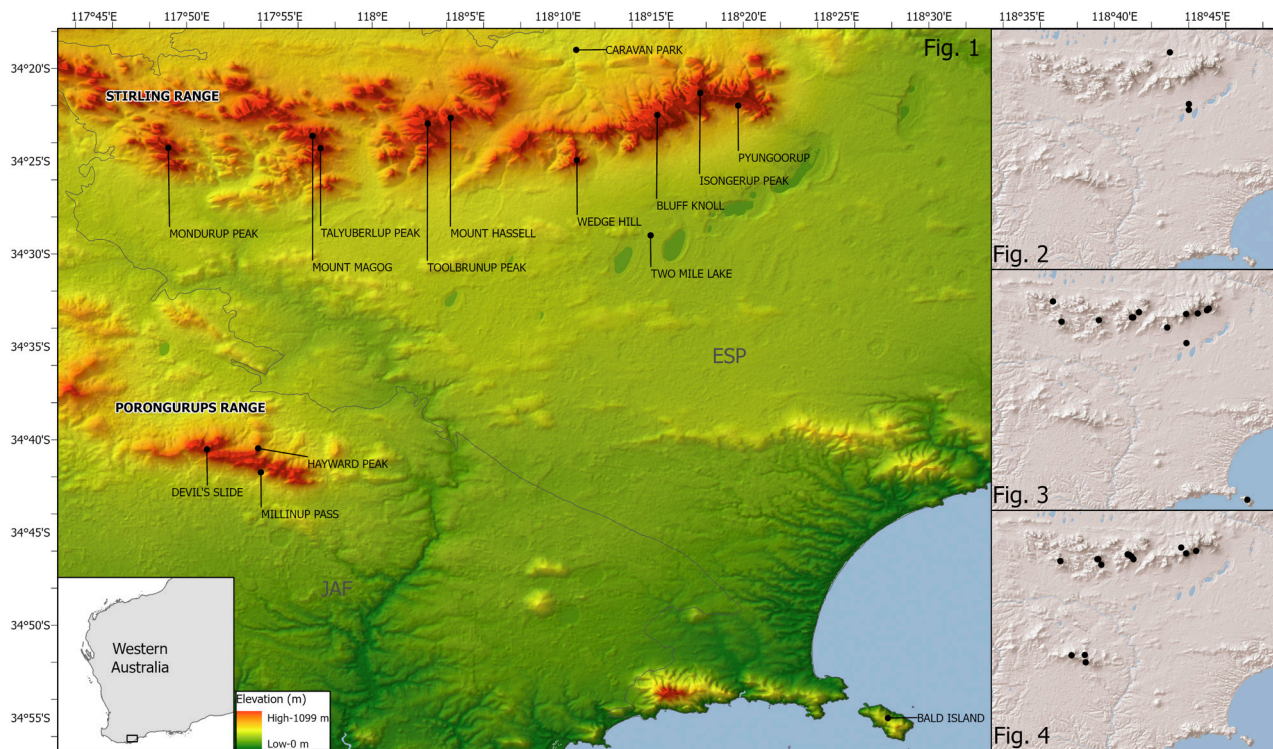
Body dimensions were taken with the measurement tool in the LAS software by measuring the legs along the dorsal prolateral edge with the leg in lateral view. Total body length measurements were taken in dorsal view and include the chelicerae, carapace, and abdomen, but exclude the spinnerets. The bulb was measured with the measurement tool incorporated in tpsDIG2 version 2.31 (Rohlf, 2017) in ventral view and being held in place by colourless styling gel. Measurements are expressed in millimetres, to two decimal places.

The following abbreviations are used for species descriptions and follow Castalanelli *et al.* (2020): TIL, tibia I length; TID, tibia I depth (width); TIS, tibia I length from base to distal face of spur; TISH, height of tibia spur (excluding megaspine); MIL, metatarsus I length; MID, metatarsus I depth (width). Abbreviations for measurements and ratios of the bulb correspond to landmark (LM) placement in Sagastume-Espinoza *et al.* (2024) as follows: PBL, palpal bulb total length measured

from the tip of the embolus (LM14) to the middle point between left and right bulb origin (LM28); BL, bulb (excluding embolus) length measured from the right side end of the bulb (LM21) to the middle point between left and right bulb origin (LM28); BW, bulb width measured from the left side middle section of the seminal duct (LM4) to the right side middle section of the seminal duct (LM24); EL, embolus length measured from the tip of the embolus (LM14) to the right side end of the bulb (LM21); BT, bulb thickness (ratio) calculated as BL/BW; RLE, relative length of embolus (ratio) calculated as PBL/EL.

Morphometrics and statistical analyses. All statistical analyses were conducted using R-Studio version 4.0.5 (R Core Team 2021). Morphometric statistical analyses (MANOVAs) reported here follow Sagastume-Espinoza *et al.* (2024). In addition, analysis of variance (ANOVA) was conducted using bulb length (after correcting for body size with TIL) as response variable and species as explanatory variable using the “Anova” function of the “car” package (Fox and Weisberg 2019), for data where normality assumptions were violated, to test for differences in bulb size. Pairwise t-test comparisons between species were made using the same variables.

Molecular analysis. The molecular analysis used fragments of three mitochondrial [cytochrome c oxidase subunit I (*COI*), 12S rRNA (12S) and 16S rRNA (16S)] and four nuclear genes [18S ribosomal RNA (18S), 28S ribosomal RNA (28S), Histone H3 (*H3*) and elongation factor 1-gamma (*EF-1γ*)] that were obtained using standard Sanger methodology following the methods used by Harvey *et al.* (2018). Chromatograms were edited using the Geneious software package (ver. Prime 2025.0.3, Biomatters Ltd, see <https://www.geneious.com/>; Kearse *et al.* 2012) and resulting nucleotide sequences for all taxa are deposited in GenBank (Table 1). Sequences were aligned using the MAFFT (ver. 7.490, see <https://mafft.cbrc.jp/alignment/software/>; Katoh *et al.* 2002; Katoh and Standley 2013) plug-in within Geneious with the using the 'auto' options which selects an appropriate alignment strategy based on the data. The full concatenated dataset is 4960 bp and includes sequence data for 5 outgroup taxa and 84 *Proshermacha*. A phylogenetic analysis of this expanded dataset was conducted using maximum likelihood (ML), in the WIQ-TREE online interface (Nguyen *et al.* 2015; Trifinopoulos *et al.* 2016). ModelFinder (Kalyaanamoorthy *et al.* 2017) was used to choose models of DNA evolution, with the initial partitioning scheme partitioned by locus, and by codon position (cp) for coding genes (*COI*, *H3*, *EF-1γ*), using AICc as the selection criterion, and allowing partition merging. The final tree inference analysis was conducted using the optimal partitioning scheme and substitution models obtained from the ModelFinder analysis, and 1000 ultrafast bootstrap replicates to assess node support (Minh *et al.* 2013). The optimal partitioning scheme was as follows:



Figures 1-4. Heat elevation map of collection localities within southwest Western Australia (Fig. 1); collection records for *Proshermacha katana* sp. nov. (Fig. 2); collection records for *Proshermacha rapier* sp. nov. (Fig. 3); and collection records for *Proshermacha scimitar* sp. nov. (Fig. 4).

COI-cp-1 = TIM2+F+I+G4

COI-cp-2, EF-1y-cp-2 = TN+F+G4

COI-cp-3, H3-cp-3, EF-1y-cp-1, EF-1y-cp-2, 18S, 28S, = TN+I

H3-cp-1 = TIM2+R3

H3-cp-2 = TIM2+I+R3

12S = TIM2+F+G4

16S = GTR+F+I+G4

The output ML tree was visualized in FigTree ver. 1.4.42 (<http://tree.bio.ed.ac.uk/software/figtree/>), before final editing in GIMP (<https://www.gimp.org/>).

Results

Distribution. The three species described in this study appear to have sympatric distributions, and although most of the records come from Stirling Range National Park (Fig. 1), specimens have also been collected from nearby localities such as the Porongurup National Park. *Proshermacha katana* sp. nov. is currently only known from two lowland localities in the southern Stirling Range National Park, namely Two Mile Lake and the Stirling Range Caravan Park (Fig. 2); however, it is expected the species will have a wider distribution throughout the lowlands outside of Stirling Range National Park. *Proshermacha rapier* sp. nov. has also been collected from Bald Island (confirmed through molecular sequencing),

approximately 65 km south-east of Stirling Range National Park (Fig. 3), while *P. scimitar* sp. nov. has been collected from Porongurup National Park and Stirling Range National Park, approximately 35 km apart (Fig. 4). Both *P. rapier* sp. nov. and *P. scimitar* sp. nov. have been found at mid to high elevations, ranging between 290 m asl up to 950 m (i.e., Bluff Knoll), while *P. katana* sp. nov. seems to be restricted to the lowlands, with most records found at approximately 160 m.

Morphometrics and statistical analyses. ANOVA revealed significant differences in size between the three putative species analysed ($P < 0.001$ F2,43 = 43.41; Fig. 5). Shape analyses conducted by Sagastume-Espinoza *et al.* (2024) recognized two morphotypes with significant differences (MANOVA) for size, bulb, and tibia shape, but not for metatarsus. Even though bulb and tibia proved to be the structures that captured shape differences the best, they still failed to identify a third morphotype and rather suggested it was likely a size variation of 'Morph 1'. Pairwise comparisons found significant differences in bulb size between the three putative species analysed, where 'Morph 1' was not different to 'Morph 2' ($P = 0.29$) but was significantly different than 'Morph 3' ($P < 0.001$), and 'Morph 2' was significantly different than 'Morph 3' ($P < 0.001$). These combined results suggest that even though there were no significant differences between 'Morph 1' and 'Morph 3' for bulb shape, there are significant differences between the two morphs for bulb size to be considered as differ-

Table 1. Specimens used in the molecular phylogenetic analysis, including taxonomic information, museum voucher code (WAM = Western Australian Museum, SAM = South Australian Museum), coordinates in decimal degrees rounded to two decimal places, and GenBank codes for the seven loci used in this study.

Genus	Species	Voucher Code	Coordinates	COI	12S	16S	18S	28S	H3	EF-1y
<i>Stanwellia</i>	sp. 'MYG417'	WAM T131994	–	MG800170	MG799899	MG799967	MG800042	MG800120	MG800303	MG800244
<i>Aname</i>	<i>melloso</i>	WAM T107182	–	KJ744651	PV805844	MG799958	MG800030	MG800107	MG800294	MG800231
<i>Swolnpes</i>	<i>darwini</i>	WAM T97003	–	KY241280	KY214183	KY241236	KY241252	KY241267	KY241289	MG800223
<i>Teyloides</i>	<i>bakeri</i>	SAM NN29525	–	MG800144	MG799861	–	MG799991	MG800068	MG800265	MG800190
<i>Chenistonia</i>	sp. 'MYG348'	WAM T72687	–	KJ745221	KY214180	KY241231	KY241247	KY241262	KY241284	MG800196
<i>Proshermacha</i>	<i>credo</i>	WAM T110238	-29.23 120.43	PV791747	–	PV806050	PV805907	PV806018	PV796324	–
<i>Proshermacha</i>	<i>credo</i>	WAM T110249	-29.22 120.44	PV791748	–	PV806051	PV805908	PV806019	PV796325	–
<i>Proshermacha</i>	<i>credo</i>	WAM T115544	-30.31 120.69	PV791749	–	PV806052	PV805909	PV806020	PV796326	–
<i>Proshermacha</i>	<i>credo</i>	WAM T116019	-30.36 120.72	PV791750	–	PV806053	PV805910	PV806021	PV796327	–
<i>Proshermacha</i>	<i>credo</i>	WAM T114998	-30.26 120.69	MG800163	–	MG799960	MG800033	MG800110	MG800296	MG800234
<i>Proshermacha</i>	<i>credo</i>	WAM T118636	-30.31 120.69	PV791751	–	–	–	–	–	–
<i>Proshermacha</i>	<i>credo</i>	WAM T118993	-30.31 120.69	PV791752	–	–	–	–	–	–
<i>Proshermacha</i>	<i>robertblosfeldsi</i>	WAM T130799	-34.70 116.22	OR141942	–	–	–	–	–	–
<i>Proshermacha</i>	<i>robertblosfeldsi</i>	WAM T157103	-34.52 116.04	OR141943	–	–	–	–	–	–
<i>Proshermacha</i>	<i>telaporta</i>	WAM T81483	-30.98 115.72	KJ745286	–	PV806055	PV805912	PV806023	OQ918665	–
<i>Proshermacha</i>	<i>telaporta</i>	WAM T77026	-30.17 115.42	OR141941	–	–	–	–	–	–
<i>Proshermacha</i>	<i>villosa</i>	WAM T146686	-34.03 115.77	OQ918548	–	PV806056	PV805913	PV806024	OQ918667	–
<i>Proshermacha</i>	<i>villosa</i>	WAM T146688	-34.07 115.77	OQ918549	–	PV806057	PV805914	PV806025	OQ918667	–
<i>Proshermacha</i>	<i>villosa</i>	WAM T146687	-34.03 115.77	–	–	PV806072	PV805929	PV806040	–	–
<i>Proshermacha</i>	<i>wilga</i>	WAM T64919	-33.67 120.20	KJ745218	–	PV806058	PV805915	PV806026	OQ918660	–
<i>Proshermacha</i>	<i>wilga</i>	WAM T132271	-33.67 120.20	OQ918553	–	–	–	–	–	–
<i>Proshermacha</i>	<i>wilga</i>	WAM T132277	-33.67 120.20	OQ918554	–	–	–	–	–	–
<i>Proshermacha</i>	<i>wilga</i>	WAM T132303	-33.69 120.20	OQ918555	–	–	–	–	–	–
<i>Proshermacha</i>	<i>wilga</i>	WAM T132500	-33.56 120.04	OQ918556	–	–	–	–	–	–
<i>Proshermacha</i>	<i>wilga</i>	WAM T65204	-33.69 120.20	KJ745219	–	MG799927	MG799998	MG800075	MG800270	MG800195
<i>Proshermacha</i>	<i>wilga</i>	WAM T78550	-33.89 121.86	KJ745284	–	–	–	–	–	–
<i>Proshermacha</i>	<i>wilga</i>	WAM T80940	-33.55 120.12	OQ918550	–	OQ919019	OQ919012	OQ919006	OQ918664	–
<i>Proshermacha</i>	<i>wilga</i>	WAM T80952	-33.53 120.10	MG800150	–	MG799939	MG800010	MG800087	MG800275	MG800209
<i>Proshermacha</i>	<i>wilga</i>	WAM T81022	-33.57 120.05	OQ918551	–	–	–	–	–	–
<i>Proshermacha</i>	<i>wilga</i>	WAM T81277	-33.53 120.07	OQ918552	–	–	–	–	–	–
<i>Proshermacha</i>	<i>wilga</i>	WAM T88469	-33.69 120.20	KJ745300	–	–	–	–	–	–
<i>Proshermacha</i>	<i>rapier</i>	WAM T146084	-34.92 118.46	PV791740	–	PV806042	PV805899	PV806010	–	PV796339
<i>Proshermacha</i>	<i>rapier</i>	WAM T147593	-34.38 118.29	–	–	PV806043	PV805900	PV806011	PV796319	PV796340
<i>Proshermacha</i>	<i>rapier</i>	WAM T147636	-34.37 118.33	PV791744	–	PV806047	PV805904	PV806015	PV796322	PV796344
<i>Proshermacha</i>	<i>rapier</i>	WAM T147637	-34.37 118.33	PV791745	–	PV806048	PV805905	PV806016	–	PV796345
<i>Proshermacha</i>	<i>rapier</i>	WAM T147659	-34.38 118.08	PV791746	–	PV806049	PV805906	PV806017	PV796323	PV796346
<i>Proshermacha</i>	<i>rapier</i>	WAM T147688	-34.63 117.89	–	–	PV806073	–	–	–	–
<i>Proshermacha</i>	<i>rapier</i>	WAM T164049	-34.35 117.78	PV791753	–	–	–	–	–	–
<i>Proshermacha</i>	<i>scimitar</i>	WAM T147595	-34.38 118.29	PV791741	PV805845	PV806044	PV805901	PV806012	PV796320	PV796341
<i>Proshermacha</i>	<i>scimitar</i>	WAM T147596	-34.38 118.29	PV791742	PV805846	PV806045	PV805902	PV806013	PV796321	PV796342

<i>Proshermacha scimitar</i>	WAM T147609	-34.39	118.05	PV791743	PV805847	PV806046	PV805903	PV806014	–	PV796343
<i>Proshermacha scimitar</i>	WAM T78506	-34.68	117.85	PV791755	–	PV806054	PV805911	PV806022	PV796328	–
<i>Proshermacha scimitar</i>	WAM T78511	-34.70	117.90	PV791754	–	–	–	–	–	–
<i>Proshermacha scimitar</i>	WAM T81370	-34.67	117.90	MG800153	–	MG799942	MG800013	MG800090	MG800278	MG800212
<i>Proshermacha scimitar</i>	WAM T163974	-34.40	117.91	PV791756	–	–	–	–	–	–
<i>Proshermacha scimitar</i>	WAM T135846	-34.69	117.91	PV791782	–	–	–	–	–	–
<i>Proshermacha</i> sp. 'MYG344'	WAM T146083	-34.16	122.24	PV791739	–	PV806041	PV805898	PV806009	–	PV796338
<i>Proshermacha</i> sp. 'MYG344'	WAM T95734	-34.08	123.19	PV791757	–	PV806059	PV805916	PV806027	PV796329	–
<i>Proshermacha</i> sp. 'MYG344'	WAM T112589	-33.15	121.71	PV791758	–	PV806060	PV805917	PV806028	PV796330	–
<i>Proshermacha</i> sp. 'MYG344'	WAM T57576	-33.92	122.58	KJ745211	–	OQ919017	OQ919007	OQ918997	OQ918659	–
<i>Proshermacha</i> sp. 'MYG344'	WAM T132981	-33.99	122.22	MG800181	–	MG799978	MG800054	MG800132	MG800311	MG800251
<i>Proshermacha</i> sp. 'MYG344'	WAM T59021	-33.92	122.58	PV791759	–	–	–	–	–	–
<i>Proshermacha</i> sp. 'MYG349'	WAM T72701	-33.66	120.36	KJ745222	–	MG799928	MG799999	MG800076	OQ918669	MG800197
<i>Proshermacha</i> sp. 'MYG357'	WAM T78517	-34.98	116.80	PV791760	–	–	–	–	–	–
<i>Proshermacha</i> sp. 'MYG357'	WAM T78518	-34.98	116.80	PV791761	–	–	–	–	–	–
<i>Proshermacha</i> sp. 'MYG357'	WAM T78520	-34.83	116.80	PV791762	–	–	–	–	–	–
<i>Proshermacha</i> sp. 'MYG357'	WAM T78522	-34.83	116.80	KJ745276	–	OQ919020	OQ919010	OQ918998	OQ918662	–
<i>Proshermacha</i> sp. 'MYG357'	WAM T78523	-34.86	116.76	PV791763	–	–	–	–	–	–
<i>Proshermacha</i> sp. 'MYG357'	WAM T78524	-35.00	117.25	PV791764	–	–	–	–	–	–
<i>Proshermacha</i> sp. 'MYG357'	WAM T78535	-35.01	117.30	KY241279	–	KY241232	KY241248	KY241263	KY241285	MG800206
<i>Proshermacha</i> sp. 'MYG357'	WAM T78536	-35.01	117.30	PV791765	–	–	–	–	–	–
<i>Proshermacha</i> sp. 'MYG357'	WAM T78564	-34.98	116.80	KJ745285	–	OQ919021	OQ919011	OQ918999	OQ918663	–
<i>Proshermacha</i> sp. 'MYG429'	WAM T132933	-31.61	119.56	PV791766	–	PV806061	PV805918	PV806029	–	–
<i>Proshermacha</i> sp. 'MYG429'	WAM T96060	-31.31	119.39	MG800158	–	MG799948	MG800020	MG800097	MG800285	MG800220
<i>Proshermacha</i> sp. 'MYG429'	WAM T151294	-31.61	119.55	MW039194	–	–	–	–	–	–
<i>Proshermacha</i> sp. 'MYG464'	WAM T85757	-34.13	116.61	MG800154	–	MG799943	MG800014	MG800091	MG800279	–
<i>Proshermacha</i> sp. 'MYG464'	WAM T62902	-34.14	116.59	PV791767	–	–	–	–	–	–
<i>Proshermacha</i> sp. 'MYG464'	WAM T85758	-34.13	116.61	PV791768	–	–	–	–	–	–
<i>Proshermacha</i> sp. 'MYG465'	WAM T132960	-35.05	117.75	MG800180	–	MG799977	MG800053	MG800131	–	–
<i>Proshermacha</i> sp. 'MYG465'	WAM T78507	-35.09	117.90	KJ45268	–	OQ919024	OQ919009	OQ919002	OQ918661	–
<i>Proshermacha</i> sp. 'MYG467'	WAM T131982	-37.20	142.53	MG800169	–	MG799966	MG800041	MG800119	OQ918666	MG800242
<i>Proshermacha</i> sp. 'MYG468'	WAM T78541	-34.22	119.43	PV791769	–	–	–	–	–	–
<i>Proshermacha</i> sp. 'MYG469'	WAM T94764	-30.37	119.91	PV791770	–	PV806062	PV805919	PV806030	–	–
<i>Proshermacha</i> sp. 'MYG469'	WAM T99731	-30.35	119.43	PV791772	–	PV806063	PV805920	PV806031	PV796331	–
<i>Proshermacha</i> sp. 'MYG469'	WAM T99732	-30.01	119.34	–	–	PV806070	PV805927	PV806038	PV796337	–
<i>Proshermacha</i> sp. 'MYG469'	WAM T110141	-29.87	119.28	–	–	PV806071	PV805928	PV806039	–	–
<i>Proshermacha</i> sp. 'MYG469'	WAM T94765	-30.49	120.00	MG800156	–	MG799945	MG800016	MG800093	MG800281	MG800214
<i>Proshermacha</i> sp. 'MYG469'	WAM T94776	-30.49	120.00	PV791771	–	–	–	–	–	–
<i>Proshermacha</i> sp. 'MYG470'	WAM T134205	-31.56	131.97	–	–	MG799980	MG800057	MG800135	–	MG800255
<i>Proshermacha</i> sp. 'MYG471'	WAM T132903	-33.44	116.35	–	MG799907	MG799974	MG800050	MG800128	MG800309	–
<i>Proshermacha</i> sp. 'MYG491'	WAM T131626	-34.34	118.17	PV791773	–	PV806064	PV805921	PV806032	–	–
<i>Proshermacha</i> sp. 'MYG502'	WAM T126768	-31.01	119.34	PV796082	–	–	–	–	–	–
<i>Proshermacha</i> sp. 'MYG502'	WAM T126769	-31.01	119.34	PV796083	–	–	–	–	–	–
<i>Proshermacha</i> sp. 'MYG503'	WAM T96491	-27.23	120.49	PV791776	–	PV806065	PV805922	PV806033	PV796332	–
<i>Proshermacha</i> sp. 'MYG503'	WAM T96492	-27.23	120.49	PV791777	–	PV806066	PV805923	PV806034	PV796333	–

<i>Proshermacha</i> sp. 'MYG503'	WAM T96490	-27.25	120.49	PV791775	–	–	–	–	–	–
<i>Proshermacha</i> sp. 'MYG504'	WAM T110345	-28.81	122.14	PV791780	–	PV806068	PV805925	PV806036	PV796335	–
<i>Proshermacha</i> sp. 'MYG505'	WAM T130469	-29.66	117.23	PV791781	–	PV806069	PV805926	PV806037	PV796336	–
<i>Proshermacha</i> sp. 'MYG505'	WAM T44393	-29.70	117.40	PV791774	–	–	–	–	–	–
<i>Proshermacha</i> sp. 'MYG506'	WAM T109003	-30.90	121.94	PV791778	–	PV806067	PV805924	PV806035	PV796334	–
<i>Proshermacha</i> sp. 'MYG506'	WAM T109004	-30.90	121.94	PV791779	–	–	–	–	–	–
<i>Proshermacha</i> sp. 'MYG921'	WAM T153309	-28.79	119.99	PV796084	–	–	–	–	–	–
<i>Proshermacha</i> sp. 'MYG921'	WAM T153310	-28.79	119.98	PV796085	–	–	–	–	–	–

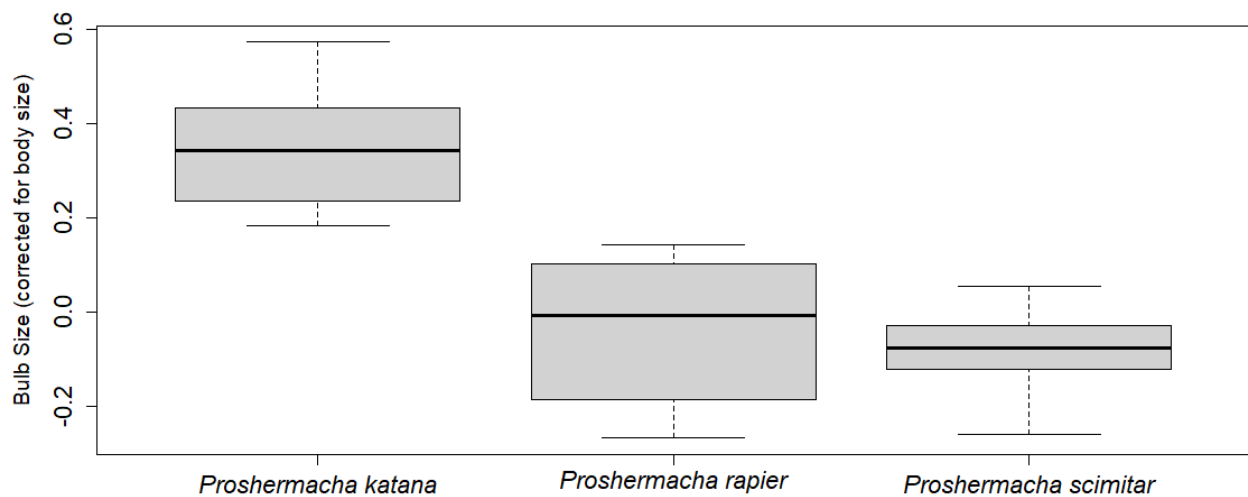


Figure 5. Boxplot showing bulb size (after corrected for body size) of the three putative species. Boxes represent 75% IQR, inside line represents median residual values and whiskers show data spread.

ent species. We therefore recognise three new species based on morphological and phylogenetic differences: 'Morph 1' as *P. rapier* sp. nov., 'Morph 2' as *P. scimitar* sp. nov., and 'Morph 3' as *P. katana* sp. nov.

Molecular analysis. The phylogenetic analysis recovered a monophyletic *Proshermacha* (UFBoot = 98), with intergeneric relationships between it and the anamid outgroups consistent with Harvey *et al.* (2018). Representatives of two of the species described here were included in the analysis, *P. rapier* sp. nov., and *P. scimitar* sp. nov., and were recovered as two distinct monophyletic groups with perfect support (Fig. 6). The analysis revealed these species to be distantly related to each other within *Proshermacha*, with *P. scimitar* sp. nov. recovered in an early-branching lineage of the genus, along with the described species *P. robertblosfeldsi* Harvey, Wilson & Rix, 2023, whereas *P. rapier* sp. nov. was recovered in a clade with *P. villosa* (Rainbow & Pulleine, 1918), and *P. wilga* Leenders, Beach & Harvey, 2023.

Taxonomy

Family Anamidae Simon, 1889

Subfamily Teylinae Main, 1985

Proshermacha Simon, 1908

Proshermacha Simon, 1908: 363.

Type species

Proshermacha subarmata Simon, 1908, by subsequent designation of Rainbow (1911).

Diagnosis

Species of *Proshermacha* can be distinguished from other Anamidae by characters defined in Harvey *et al.* (2018), Harvey *et al.* (2020) and Rix *et al.* (2020). The genus differs from all Anaminae (genera *Aname* L. Koch, 1873, *Hesperonatalius* Castallanelli, Huey, Hillyer & Harvey, 2017, *Kwonkan* Main, 1983, *Swolnpes* Main & Framenau, 2009 and *Troglodiplura* Main, 1969) by the long pedipalpal tarsus which is medially constricted in lateral view. It differs from other genera of Teylinae as follows:

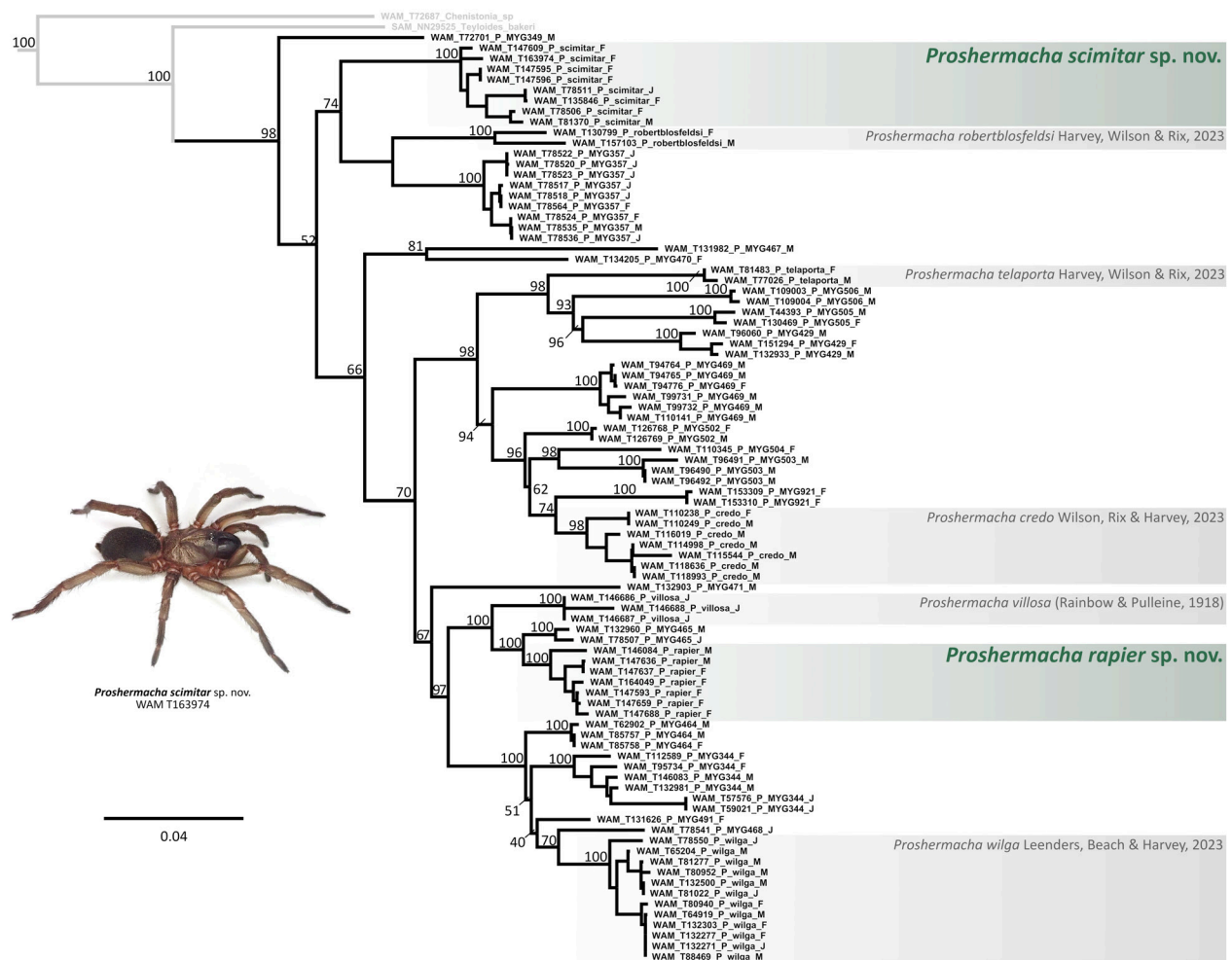


Figure 6. IQ-TREE Maximum Likelihood phylogeny for the genus *Proshermacha*, generated using a concatenated alignment of seven gene fragments (*COI*, 12S, 16S, 18S, 28S, *H3*, and *EF-1 α*). Support values are displayed for deeper nodes (not intraspecific nodes) and represent Ultrafast Bootstrap values. Two of the three new species described in this study are in the phylogeny and highlighted in green, whereas species described previously are highlighted in grey. The habitus image on the left shows an adult female of *Proshermacha scimitar* sp. nov.

from *Chenistonia* Hogg, 1901 by the long tapering embolus (short in *Chenistonia*); from most species of *Teyl* Main, 1975 and *Namea* Raven, 1984 by the embolus arising from the distal end of the pedipalpal bulb (Figs 18–19, 47–48, 76–77) and presence of a tibial megaspor on male leg I (Figs 20–23, 49–52, 78–81); and from *Teyloides* Main, 1983 by the embolus arising from the distal end of the pedipalpal bulb (Figs 18–19, 47–48, 76–77).

Proshermacha katana Sagastume-Espinoza, Wilson & Harvey, sp. nov.

Figs 2, 5, 7–35

ZooBank LSID: <https://zoobank.org/NomenclaturalActs/4E75A7EC-C0C2-493F-9F1F-492C97221E6D>

Holotype

AUSTRALIA: *Western Australia*: male holotype, Stirling Range National Park, 12 km S. of Bluff Knoll, 34°29'S, 118°15'E, wet pitfall, 162 m, 13 October 1989, G. Friend, G. Hall, D. Mitchell (WAM T160894).

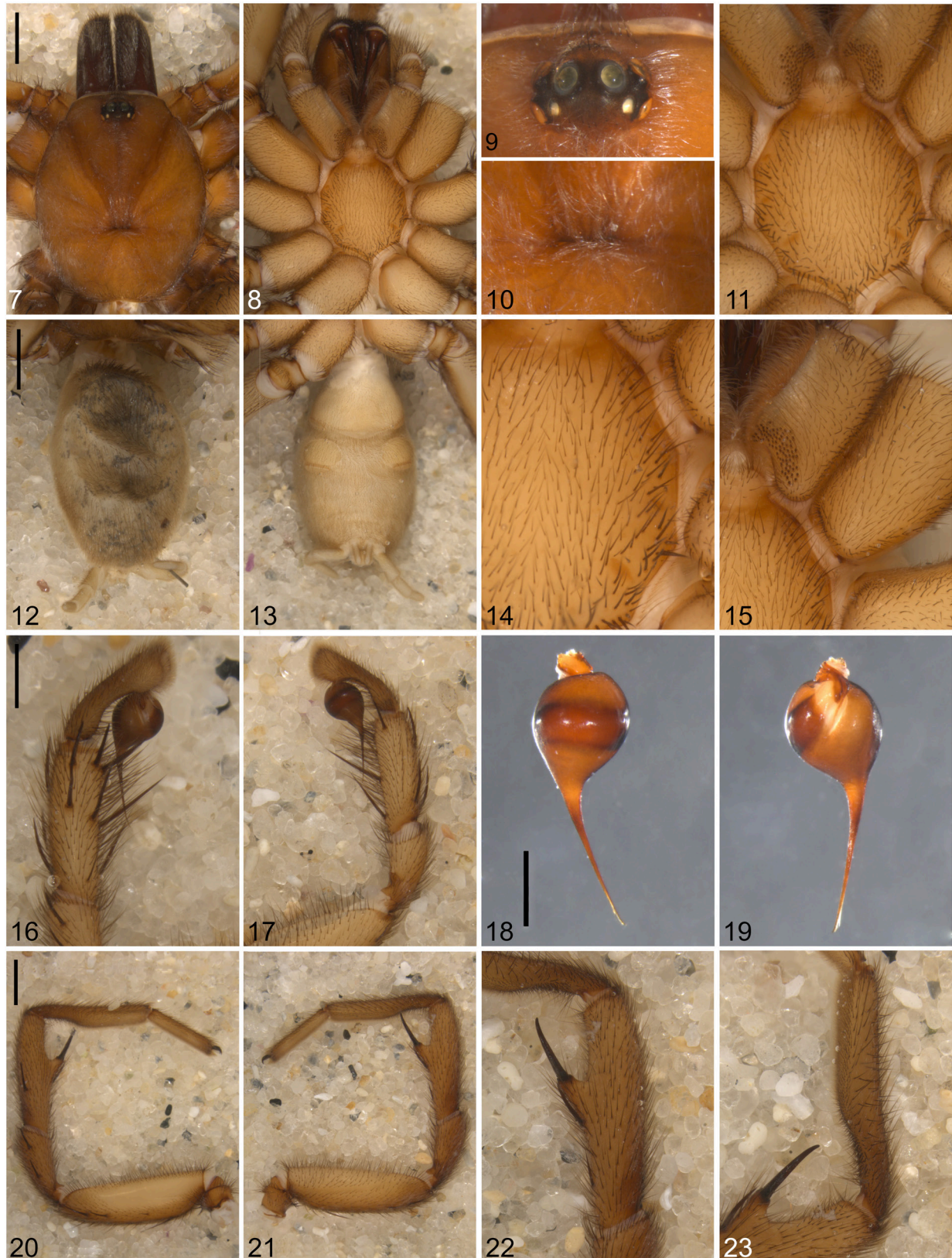
Paratypes

AUSTRALIA: *Western Australia*: 1 female, same data as male holotype (WAM T28169); 1 male Stirling Range National Park, NW. of Two Mile Lake, 34°28'S, 118°15'E, wet pitfall, 159 m, 10 September 1990, G. Friend (WAM T41776).

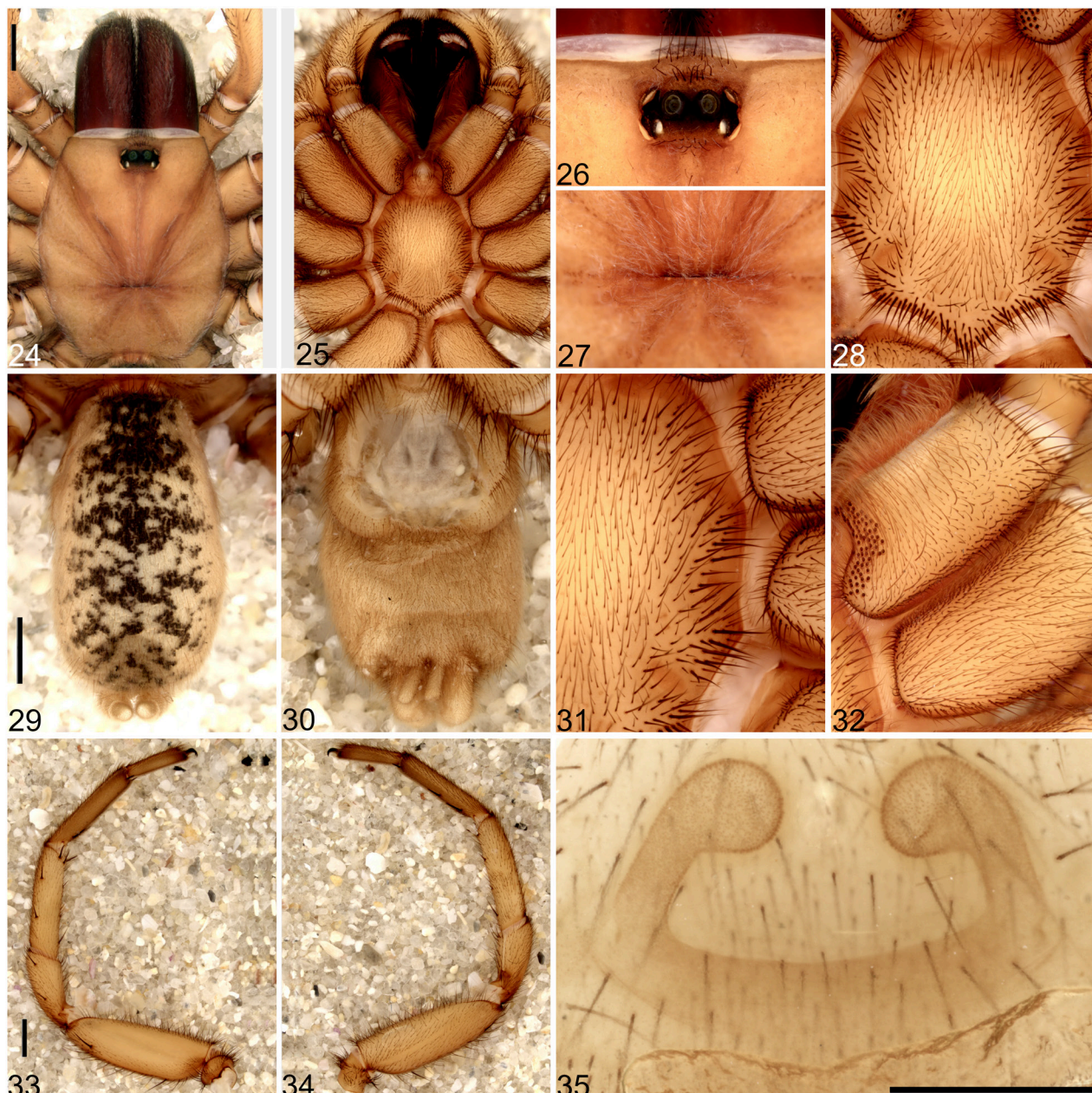
Other material examined

AUSTRALIA: *Western Australia*: 4 males, Stirling Range National Park, NW. of Two Mile Lake, 34°28'S, 118°15'E, wet pitfall, 159 m, 10 September 1990, G. Friend (WAM T41777; WAM T41778; WAM T41780; WAM T56754); 1 male, Stirling Range Caravan Park, 34°19'S, 118°11'E, wandering in shower cubicle, 219 m, 27 November 1991, B. Y. Main (WAM T145354).

Diagnosis. Males of *Proshermacha katana* sp. nov. can be distinguished from *P. robertblosfeldsi*, *P. scimitar* sp. nov. and *P. 'MYG357'* by the absence of flanges on the embolus of the palpal bulb (Figs 16–19; cf. Figs 76, 77, Harvey *et al.* 2018 - fig. 7, Harvey *et al.* 2023 - figs 49–52). They can be further distinguished from *P. rapier* sp. nov. by the presence of a shorter embolus (Figs 18, 19; cf. Figs 47, 48, see also the *Morphometrics and statistical*



Figures 7–23. *Proshermacha katana* sp. nov., holotype male (WAM T160894): 7, cephalothorax, dorsal view; 8, cephalothorax, ventral view; 9, ocular region; 10, fovea; 11, sternum; 12, abdomen, dorsal view; 13, abdomen, ventral view; 14, left sternal sigilla; 15, left maxillae and anterior coxae; 16, left pedipalp, prolateral view; 17, left pedipalp, retrolateral view; 18, right bulb, retrolateral view; 19, right bulb, prolateral view; 20, left leg I, prolateral view; 21, left leg I, retrolateral view; 22, tibia I, retrolateral view; 23, metatarsus I, retrolateral view. Scale bars = 2 mm (7, 12, 16, 20), 1 mm (18).



Figures 24–35. *Proshermacha katana* sp. nov., paratype female (WAM T28169): 24, cephalothorax, dorsal view; 25, cephalothorax, ventral view; 26, eye region; 27, fovea; 28, sternum; 29, abdomen, dorsal view; 30, abdomen, ventral view; 31, left sternal sigilla; 32, left maxillae and anterior coxae; 33, left leg I prolateral view; 34, left leg I retrolateral view; 35, spermatheca, dorsal view. Scale bars = 2 mm (24, 29, 33), 1 mm (35).

analyses section). The male palpal bulb is most similar to that of *P. credo* and *P. wilga* but can be distinguished from them by the more curved embolus (Fig. 18, 19; cf. Wilson *et al.* 2023 - figs 11–13, Leenders *et al.* 2023 - figs 13–15). No accurate comparison can be made with *P. tepperi* (Hogg, 1902) given the rudimentary drawings showing the male palpal bulb (Main 1964). Males are unknown for all other described *Proshermacha* species.

Females of *P. katana* sp. nov. have spermathecae reminiscent of other species of *Proshermacha* for which the spermathecal morphology has been documented, and most closely resemble *P. credo* and *P. wilga* in the presence of spermathecae with globose crowns. However,

they can be distinguished from these species by the presence of spermathecal stalks that are more widely spaced, less elongate, and not curving medially (Fig. 45; cf. Leenders *et al.* 2023 - fig. 29; Wilson *et al.* 2023 - fig. 29).

In both sexes the abdomen presents narrow dark markings on the dorsal surface contrasting the pale abdomen (Figs 12; 29).

Description: male holotype (WAM T160894)

Dimensions (mm): total body length (with chelicerae, but excluding spinnerets) 19.03, carapace length 8.04, width 6.64; sternum length 3.78, width 3.18. Femur I length

6.78, width 2.12, L/W 3.2; patella I 3.67; tibia I 5.79; metatarsus I 5.18; femur II 5.54; femur III 5.61; femur IV length 6.38, width 1.99, L/W 3.2. Abdomen length 7.82, width 5.16.

Colour (in alcohol) (Figs 7–23): carapace dark yellow-brown with darker markings in cephalic region; legs dark yellow, tarsi paler; prolateral face of femur I paler than other segments. Chelicerae uniformly dark red-brown. Abdomen dorsally pale yellow with darker chevrons mid-dorsally, and ventrally pale yellow.

Cephalothorax: carapace (Fig. 7) 1.21 × longer than broad; pilose; silver setae present; with larger brown setae dorsally; clypeal edge slightly convex. Eyes (Fig. 9): on distinct mound; from above, anterior eye row slightly procurved, posterior eye row slightly recurved; AME about same size as ALE; ALE and AME the largest; PME smallest; eye group length 0.91, width 1.36. Fovea (Fig. 10) straight. Chelicerae (Figs 7, 8) densely setose with thick black setae and smaller silver setae; rastellum absent; promargin of tooth row with 8 teeth, first one smaller, retromargin with 9 small teeth in 2 rows. Labium (Fig. 11) fused to sternum, without cuspules. Maxillae (Fig. 15) with 80–85 cuspules, located on the basal edge; maxillae about same colour as coxae I–IV (Fig. 8). Sternum (Figs 11, 14): oval, posteriorly pointed; 1.19 × longer than broad; setae over entire surface, setae on lateral and posterior margins longer than others; with 3 pairs of sigilla, each pair increasing in size from anterior to posterior; posterior pair elliptical.

Pedipalp (Figs 16, 17): tibia cylindrical, narrow, with 4 retrolateral spines, 2 prolateral spines, 3 ventral spines, and 3 dorsal spines; asetose depression absent; PDL/PTL 0.42; tarsus long, with medial constriction when viewed laterally; densely setose.

Palpal bulb (Figs 18, 19): bulb ovoid, PBL 2.78, BL 1.14, BW 1.08 (BT 1.05); embolus slightly curved, tapering to a fine point without a flange, EL 1.67, RLE 1.67.

Variation: Based on the examined males (N = 7), PBL can vary between 2.72–2.95 ($\bar{x}$ 2.81, SE 0.03 [CI = 2.73, 2.88]), BT ratio ranges between 1.08–1.20 ($\bar{x}$ 1.13, SE 0.02 [CI = 1.08, 1.17]), and RLE ratio ranges between 1.63–1.77 ($\bar{x}$ 1.71, SE 0.02 [CI = 1.67, 1.75]).

Legs (Figs 8, 20–23): coxal cuspules absent; coxa I with some setae noticeably shorter than others; tibia I moderately thickened, cylindrical, with large megaspor; TIL/TID 4.15; TIS/TIL 0.62; TISH/TID 0.40; metatarsus elongate, slightly incrassate, with a narrow metatarsal depression; MIL/MID 4.33; MIPEL/MIL 0.45; scopula present on all tarsi, and on metatarsi I and II; claws with 2 rows of teeth; claw tufts absent.

Abdomen (Figs 12, 13): 1.52 × longer than broad, densely pilose. Spinnerets: 2 pairs of spinnerets; PMS unsegmented and separated by about twice the diameter of spinneret; PLS 3-segmented, apical segment elongate, digitiform.

Description: female (WAM T28169)

Dimensions (mm): total body length (with chelicerae, but excluding spinnerets) 23.56; carapace length 9.4, width 8.2; sternum length 5.09, width 4.16. Leg I: femur length 7.85, width 2.6, L/W 3.02; patella 4.32; tibia 5.58; metatarsus 4.78; tarsus 3.12. Femur II 6.34; femur III 6.24; femur IV length 7.6, width 2.34, L/W 3.25. Abdomen length 9.07, width 5.13.

Colour (in alcohol) (Figs 24–34): carapace uniformly yellow-brown, darker around eye region; legs uniformly yellow-brown, darker at the joints. Chelicerae uniformly red-brown. Abdomen dorsally pale yellow-brown with black indistinct chevrons and ventrally pale yellow-brown.

Cephalothorax: carapace (Fig. 24) 1.15 × longer than broad; pilose; silver setae present throughout, most abundant near the fovea and reducing towards the eye group; with larger brown setae dorsally around the carapace edge; clypeal edge slightly convex. Eyes (Fig. 26): eye group rectangular, on distinct mound; length 0.96, width 1.66 (width/length 1.74); from above, anterior eye row straight, posterior eye row slightly recurved; AME slightly larger than PME; AME largest; PME smallest. Fovea (Fig. 27) straight. Chelicerae (Figs 24, 25): densely setose with thick black setae and smaller silver setae; rastellum absent; promargin of tooth row with 8 large teeth; retromargin with 2 teeth row, retrolateral row with 11 small teeth, medial row with 8 small teeth, the 2 proximal smallest. Labium (Fig. 25): fused to sternum, without cuspules (W/L 1.67). Maxillae (Fig. 32): with 73–76 cuspules, located on the basal 20% of maxilla; about same colour as coxae I–IV. Sternum (Fig. 28): oval, posteriorly pointed; 1.22 × longer than broad; with setae over entire surface, setae on lateral and posterior margins longer than others; with 3 pairs of sigilla (Fig. 31), each pair increasing in size from anterior to posterior; posterior pair elliptical.

Pedipalp: with thick scopula.

Legs (Figs 33, 34): coxal cuspules absent; coxa covered in setae, longest at the edge closest to femur, ventral side with smaller setae noticeably shorter than others; scopula present on all tarsi, and on metatarsi I and II; claws with 2 rows of teeth; claw tufts absent. Leg I dimensions (mm): femur 7.85; patella 4.32; tibia 5.58; metatarsus 4.78; tarsus 3.12; spination, femur 4 (1 PL, 2 RL and 1 D), patella 2 (2 PL), tibia 8 (2 PL, 2 V, 4 RL; 2 middle RL ones smaller), metatarsus 5 (2 PL, 3 RL), tarsus 0, total 19.

Abdomen (Figs 29, 30): 1.77 × longer than wide, pilose; spinnerets in 2 pairs; PMS unsegmented and separated by about half diameter of spinneret; PLS 3-segmented, apical segment short.

Genitalia (Fig. 35): with 1 pair of widely spaced spermathecae, each with a single receptacle, with short straight stalks (length about 1.9 × width at crown) ending in a globous spermathecae head.

Remarks. Little is known about the biology of *P. katana* sp. nov., other than that male specimens have been collected during spring months, between September and November. *Proshermacha katana* sp. nov. was previously known as *Proshermacha* 'MYG794' in the Western Australia Museum Database and as 'Morph 3' under the *Morphometrics and statistical analyses* section.

Distribution. Specimens of *P. katana* sp. nov. have been collected from three localities within Stirling Range National Park, at relatively low elevations between 159 and 219 m in the Esperance Plains IBRA 7.0 bioregion (Fig. 2). Although the species is expected to occur in the lowlands surrounding the Stirling Range National Park and adjacent areas, recent efforts to collect new specimens have been unsuccessful. It is suspected that the vegetation structure has changed significantly in the past 20 years, probably shifting from closed tallerack woodland to open shrubland with scattered tallerack (K. Bain & S. Comer pers. communication, 29 April 2024).

Etymology. The species epithet is a noun in apposition referring to the male bulb shape, which resembles a curved, single-edged Japanese sword commonly used by samurai in feudal Japan in the early 13th century.

Proshermacha rapier Sagastume-Espinoza, Wilson & Harvey, sp. nov.

Figs 3, 5, 6, 36–64, 94, 95

ZooBank LSID: <https://zoobank.org/NomenclaturalActs/E530E76A-FB2A-434A-B84C-6C669BDE3760>

Holotype

AUSTRALIA: *Western Australia*: male holotype, Stirling Range National Park, gully south of Pyungoorup Peak, 34°22'00"S, 118°19'43"E, in burrow, 363 m, 28 March 2019, M. G. Rix & M. S. Harvey (WAM T147636).

Paratype

AUSTRALIA: *Western Australia*: 1 female (allotype), same data as holotype (WAM T147637).

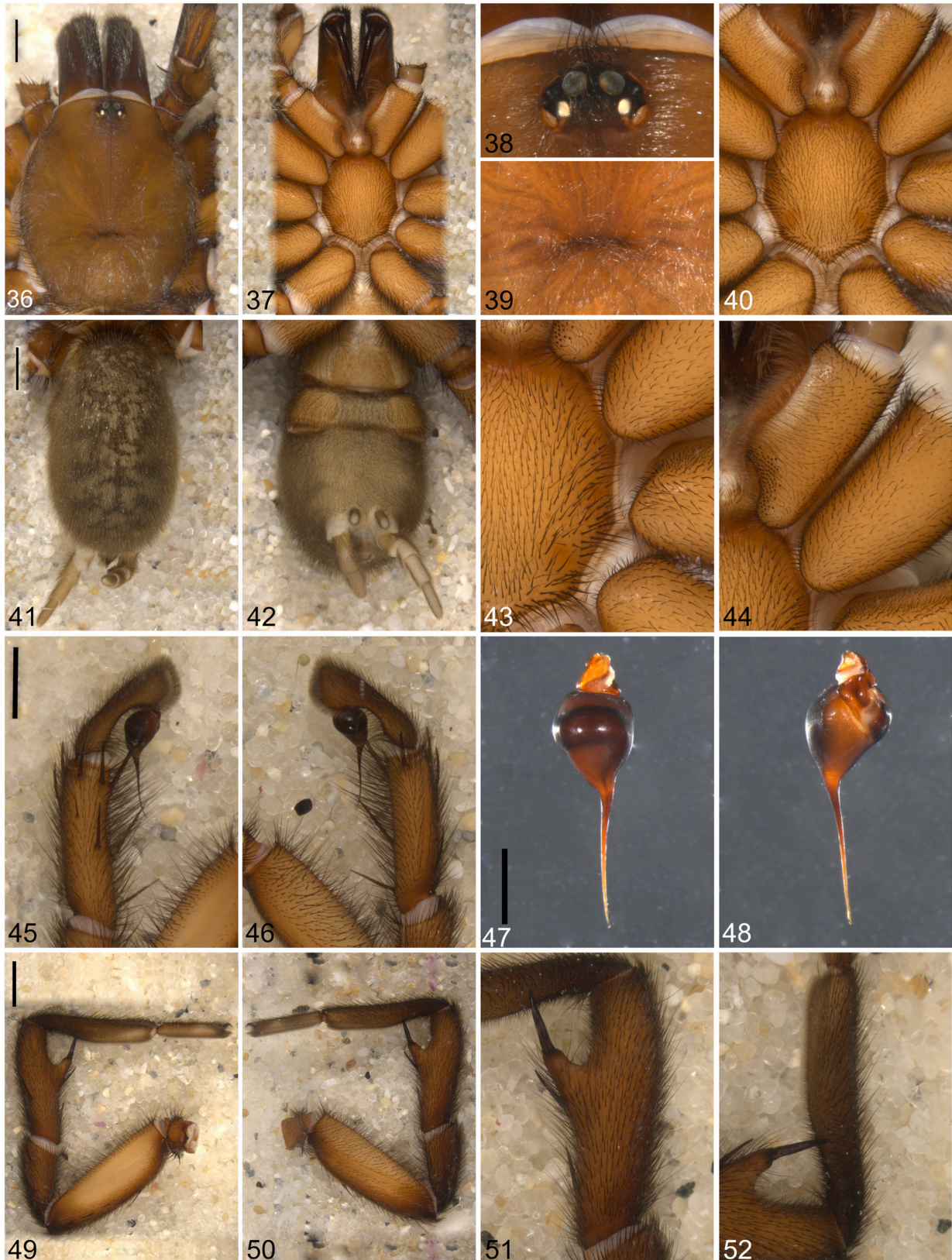
Other material examined

AUSTRALIA: *Western Australia*: 1 male, Stirling Range National Park, Mondurup Peak, 34°24'17"S, 117°48'45"E, wet pitfall trap, 770 m, 30 August 1995, S. Barrett (WAM T32573); 1 male, Stirling Range National Park, Toolbrunup Peak track, 34°23'32"S, 118°03'32"E, wet pitfall trap, 600–650m, 23 April 1996, J. M. Waldock, B.Y. Main (WAM T42317); 1 male, Stirling Range National Park, Mount Magog, 34°23'59"S, 117°56'35"E, wet pitfall trap, 4 September 1996, M. S. Harvey, J. M. Waldock, B. Y. Main (WAM T42318); 1 male, Stirling Range National Park, Mount Magog, 34°23'59.8"S, 117°56'37.5"E, wet pitfall trap, 650 m, 19 September 1995, S. Barrett (WAM T146074); 1 male, Stirling Range National Park, Bluff Knoll, 34°22'56.1"S, 118°14'54.7"E, wet pitfall trap, 950 m, 19 June 1996, S. Barrett (WAM T146075); 1 male, Stirling Range National Park, Mount Magog, 34°23'59.8"S, 117°56'37.5"E, wet pitfall trap, 650 m, 19 September 1995, S. Barrett (WAM T146076); 1 male, Stirling Range National Park, Mondurup Peak, 34°24'17.5"S, 117°48'44.7"E, wet pitfall trap, 770 m,

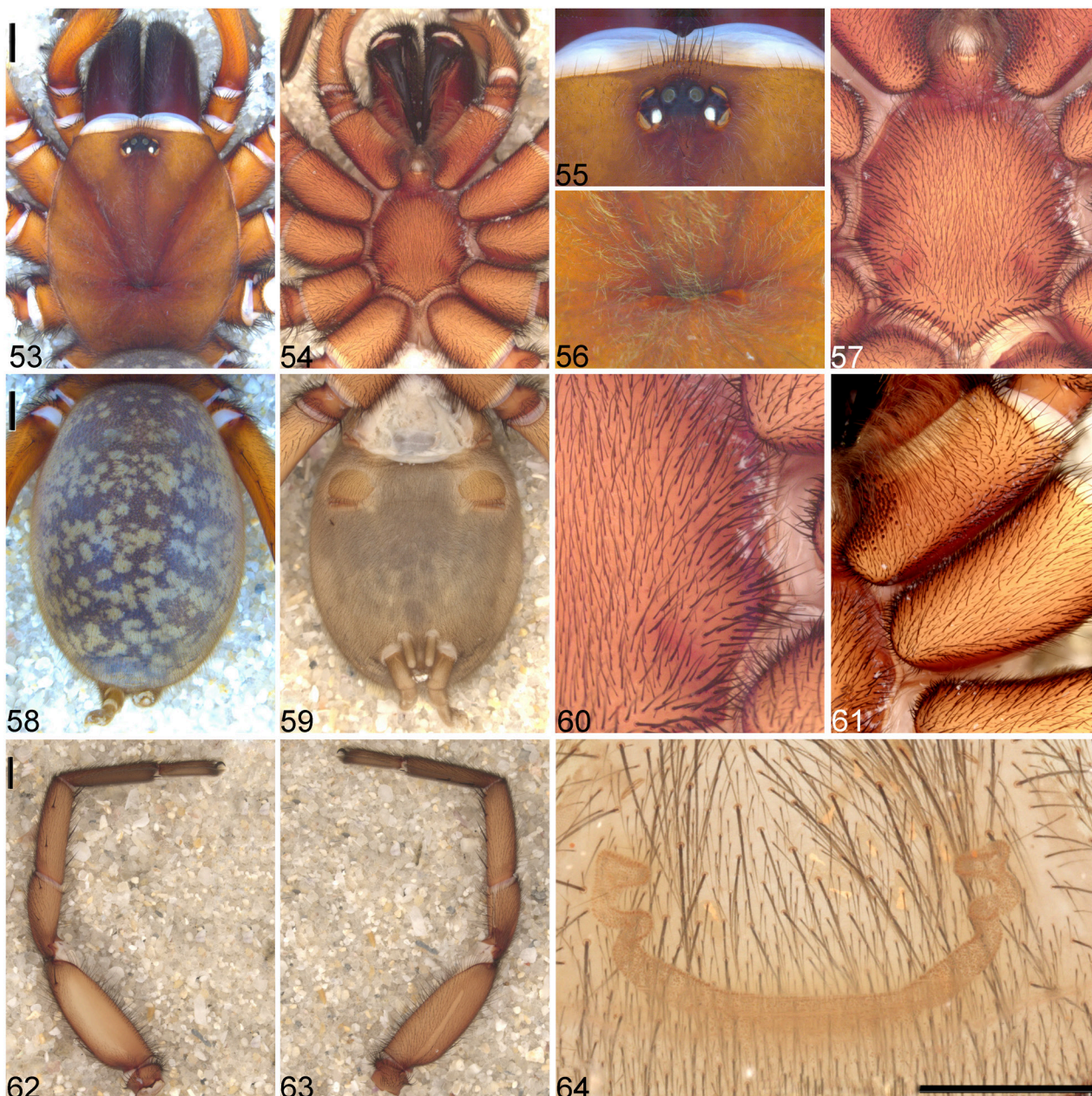
16 June 1996, S. Barrett (WAM T146077); 1 female, Stirling Range National Park, north-east of Mount Hassell on Stirling Range Drive, 34°22'36.7"S, 118°05'00.5"E, in burrow, 388 m, 28 March 2019, M. Hillyer, J. M. Waldock (WAM T147659); 1 male, Stirling Range National Park, Mount Magog, 34°23'59.8"S, 117°56'37.5"E, wet pitfall trap, 650 m, 19 September 1995, S. Barrett (WAM T153892); 1 male, Stirling Range National Park, Mondurup Peak, 34°24'17.5"S, 117°48'44.7"E, wet pitfall trap, 16 June 1996, S. Barrett (WAM T153895); 1 male, Stirling Range National Park, Mondurup Peak, 34°24'17.5"S, 117°48'44.7"E, wet pitfall trap, 770 m, 16 June 1996, S. Barrett (WAM T153896); 1 male, Stirling Range National Park, south of Pyungoorup Peak, 34°22'17"S, 118°19'20"E, wet pitfall trap, 4 September 1996, M. S. Harvey, J. M. Waldock, B. Y. Main (WAM T42319); 1 female, Stirling Range National Park, Wedge Hill, 34°25'17"S, 118°10'58"E, wet pitfall trap, 2 May 1996, M. S. Harvey, J. M. Waldock, B. Y. Main (WAM T42320); 1 male, Stirling Range National Park, north-west of Two Mile Lake, 34°28'S, 118°15'E, wet pitfall trap, 10 September 1990, G. Friend (WAM T44164); 1 male, Stirling Range National Park, south face of Pyungoorup Peak, 34°22'17"S, 118°19'20"E, wet pitfall, 27 April 1996, M. S. Harvey (WAM T115460); 1 female, Stirling Range National Park, Isongerup Peak, 34°22'51.03"S, 118°17'21.01"E, in burrow, 314 m, 25 March 2019, M. G. Rix, M. S. Harvey (WAM T147593); 1 male, Bald Island, 34°55'00"S, 118°27'47"E, 28 June 2018, S. Comer (WAM T146084); 1 male, Bald Island, site BA3, 34°54'47"S, 118°27'43"E, 3 August 2005, S. Comer (WAM T88775); 1 male, Bald Island, site BA1, 34°54'58"S, 118°27'25"E, 12 March 2005, S. Comer (WAM T88776); 2 males, Bald Island, site BA2, 34°55'51"S, 118°28'12"E, 3 August 2005, S. Comer (WAM T88777; WAM T88778); 1 female, Hume Lowlands, Stirling Range National Park, 34°20'46"S, 117°46'56"E, 7 June 2024, K. Sagastume-Espinoza, H. Clark (WAM T164049).

Diagnosis. Males of *P. rapier* sp. nov. can be distinguished from *P. robertblosfeldsi*, *P. scimitar* sp. nov. and *P. sp.* 'MYG357' by the absence of flanges on the embolus of the palpal bulb (Figs 47, 48; cf. Figs 76, 77, Harvey *et al.* 2018 - fig. 7, Harvey *et al.* 2023 - figs 49–52). The male palpal bulb is most similar to that of *P. credo* and *P. katana* sp. nov., but can be distinguished from *P. credo* by the presence of a shorter embolus (Figs 47, 48; cf. Wilson *et al.* 2023 - figs 11–13), and from *P. katana* sp. nov. by a straighter embolus (Figs 47, 48; cf. Figs 18, 19). No accurate comparison can be made with *P. tepperi* given the rudimentary drawings showing the male palpal bulb (Main 1964). Males are unknown for all the other described *Proshermacha* species.

Females of *P. rapier* sp. nov. have spermathecae noticeably distinct from all other species for which the spermathecal morphology has been documented. In all other *Proshermacha* species the spermathecae have relatively straight receptacles with a globular or bulbous spermathecal head (e.g. see Harvey *et al.* 2023; Leenders *et al.* 2023; Wilson *et al.* 2023). However, the spermathecae of *P. rapier* sp. nov. are unique in the presence of short, spiral stalks ending in a chalice-shaped spermathecal head (Fig. 64).



Figures 36–52. *Proshermacha rapier* sp. nov., holotype male (WAM T147636): 36, cephalothorax, dorsal view; 37, cephalothorax, ventral view; 38, ocular region; 39, fovea; 40, sternum; 41, abdomen, dorsal view; 42, abdomen, ventral view; 43, left sternal sigilla; 44, left maxillae and anterior coxae; 45, left pedipalp, prolateral view; 46, left pedipalp, retrolateral view; 47, left bulb, retrolateral view; 48, left bulb, prolateral view; 49, left leg I prolateral view; 50, left leg I retrolateral view; 51, tibia I, retrolateral view; 52, metatarsus I, retrolateral view. Scale bars = 2 mm (36, 41, 45, 49), 1 mm (47).



Figures 53–64. *Proshermacha rapier* sp. nov., paratype female (WAM T147637): 53, cephalothorax, dorsal view; 54, cephalothorax, ventral view; 55, eye region; 56, fovea; 57, sternum; 58, abdomen, dorsal view; 59, abdomen, ventral view; 60, left sternal sigilla; 61, left maxillae and anterior coxae; 62, left leg I prolateral view; 63, left leg I retrolateral view; 64, spermatheca, dorsal view. Scale bars = 2 mm (53, 58, 62), 1 mm (64).

In both sexes, although most noticeable in females, the abdomen has dark chevrons on the dorsal surface that contrast with the pale abdomen (Figs 41, 58).

Description: male holotype (WAM T147636)

Dimensions (mm): total body length (with chelicerae, but excluding spinnerets) 25.31, carapace length 10.53, width 8.74; sternum length 5.34, width 4.25. Femur I length 9.09, width 2.85, L/W 3.18; patella I 4.97; tibia I 7.56; metatarsus I 7.64; femur II 7.79; femur III 7.31; femur IV length 7.84, width 2.28, L/W 3.45. Abdomen length 10.65, width 6.33.

Colour (in alcohol) (Figs 36–52): carapace dark yellow-brown with darker markings in cephalic region; legs brown, tarsi paler; prolateral face of femur I paler than other segments. Chelicerae uniformly dark red-brown. Abdomen dorsally grey with darker chevrons mid-dorsally, and ventrally pale grey-brown.

Cephalothorax: carapace (Fig. 36) 1.20 × longer than broad; pilose; silver setae present; with larger brown setae dorsally most abundant at the edge; clypeal edge convex. Eyes (Fig. 38): on distinct mound; from above, anterior eye row straight, posterior eye row slightly recurved; AME about same size as ALE; ALE and AME the largest; PME smallest; eye group length 0.86, width 1.53.



Figures 94–95. *Proshermacha rapier* sp. nov., live habitus female (WAM T164049). Photos courtesy of H. Clark.

Fovea (Fig. 39) procurved. Chelicerae (Figs 36, 37) densely setose with thick small silver setae and black setae at the retromarginal edge; rastellum absent; promargin of tooth row with 9 large teeth, retromargin in two rows, 6 very small teeth in middle row, 7 small teeth in retromarginal row. Labium (Fig. 37) fused to sternum, without cuspules. Maxillae (Fig. 44) with 110–115 cuspules, located on the basal edge; maxillae about same colour as coxae I–IV (Fig. 40). Sternum (Figs 40, 43): oval, posteriorly pointed; $1.26 \times$ longer than broad; setae over entire surface, setae on lateral and posterior margins longer than others; with 3 pairs of sigilla, each pair increasing in size from anterior to posterior; posterior pair almost round.

Pedipalp (Figs 45, 46): tibia cylindrical, narrow, with 5 retrolateral spines, 2 prolateral spines, 2 ventral spines, and 3 dorsal spines; asetose depression absent; PDL/PTL 0.35; tarsus long, with medial constriction when viewed laterally; densely setose.

Palpal bulb (Figs 47, 48): bulb ovoid, PBL 2.98, BL 1.25, BW 1.03 (BT 1.22); embolus mostly straight, tapering to a fine point without a flange, EL 1.75, RLE 1.7.

Variation: Based on the examined males ($N = 13$), PBL can vary between 2.86–3.43 ($\bar{x}$ 3.22, SE 0.05 [CI = 3.11, 3.33]), BT ratio ranges between 1.17–1.32 ($\bar{x}$ 1.24, SE 0.01 [CI = 1.21, 1.27]), and RLE ratio ranges between 1.55–1.68 ($\bar{x}$ 1.61, SE 0.01 [CI = 1.58, 1.63]).

Legs (Figs 49–52): coxal cuspules absent; coxa I with some setae noticeably shorter than others; tibia I moderately thickened, cylindrical, with large megaspor; TIL/TID 4.06; TIS/TIL 0.66; TISH/TID 0.50; metatarsus elongate, slightly incrassate, with a narrow metatarsal depression; MIL/MID 5.21; MIPEL/MIL 0.44; scopula present on all tarsi, and on metatarsi I and II; claws with 2 rows of teeth; claw tufts absent.

Abdomen (Figs 41, 42): $1.68 \times$ longer than broad, densely pilose. Spinnerets: 2 pairs of spinnerets; PMS unsegmented and separated by about the diameter of spin-

neret; PLS 3-segmented, apical segment elongate, digitiform.

Description: female (WAM T147637)

Dimensions (mm): total body length (with chelicerae, but excluding spinnerets) 32.74; carapace length 11.55, width 9.86; sternum length 5.55, width 4.94. Leg I: femur length 8.62, width 3.11, L/W 2.77; patella 4.42; tibia 6.18; metatarsus 5.45; tarsus 3.45. Femur II 7.87; femur III 6.95; femur IV length 8.51, width 2.81, L/W 3.03. Abdomen length 15.77, width 10.94.

Colour (in alcohol) (Figs 53–63): carapace yellow-brown, with darker yellow-red around fovea region; legs uniformly yellow-brown, darker at the joints. Chelicerae uniformly red-brown. Abdomen dorsally pale grey with black indistinct chevrons and ventrally pale yellow-grey.

Cephalothorax: carapace (Fig. 53) $1.17 \times$ longer than broad; pilose; silver setae present throughout, most abundant near the fovea and reducing towards the eye group; with larger brown setae dorsally around the carapace edge; clypeal edge slightly convex. Eyes (Fig. 55): eye group quadrate, on distinct mound; length 1.68, width 1.99 (width/length 1.18); from above, anterior eye row straight, posterior eye row slightly recurved; ALE slightly larger than AME; ALE largest; PME smallest. Fovea (Fig. 56) procurved. Chelicerae (Figs 53, 54): densely setose with thick black setae at the retromargin and smaller silver setae dorsally; rastellum absent; promargin of tooth row with 8 large teeth, the first distal smallest, and the two proximal largest and curved; retromargin with 2 teeth row, retrolateral row with 6 small teeth, medial row with 5 small teeth. Labium (Fig. 54): fused to sternum, without cuspules (W/L 1.28). Maxillae (Fig. 61): with 153–158 cuspules, located on the base of maxilla; about same colour as coxae I–IV. Sternum (Fig. 57): oval, posteriorly pointed; $1.12 \times$ longer than broad; with setae over entire surface, setae on lateral and posterior margins longer than others; with 3 pairs of sigilla (Fig. 60), each pair increasing in size from anterior to posterior; posterior pair elliptical.

Pedipalp: with thick scopula.

Legs (Figs 62, 63): coxal cuspules absent; coxa covered in setae, longest at the edge closest to femur, ventral side with smaller setae noticeably shorter than others; scopula present on all tarsi, and on metatarsi I and II; claws with 2 rows of teeth; claw tufts absent. Leg I dimensions (mm): femur 8.62; patella 4.42; tibia 6.18; metatarsus 5.45; tarsus 3.45; spination, femur 2 (1 RL and 1 D), patella 2 (2 RL), tibia 7 (4 PL, 1 V, 2 RL), metatarsus 2 (2 PL), tarsus 0, total 13.

Abdomen (Figs 58, 59): 1.44 × longer than wide, pilose; spinnerets in 2 pairs; PMS unsegmented and separated by about diameter of spinneret; PLS 3-segmented, apical segment short.

Genitalia (Fig. 64): with 1 pair of widely spaced spermathecae, each with a single receptacle, with short spiral stalks ending in a chalice-shaped spermathecae head.

Remarks. Little is known of the biology or life history of *P. rapier* sp. nov., other than that most specimens have been collected from wet pitfall traps in winter months, between June and September. *Proshermacha rapier* sp. nov. has been previously known as *Proshermacha* 'MYG730' in the Western Australian Museum database and as 'Morph 1' in Sagastume-Espinoza *et al.* (2024).

Distribution. *Proshermacha rapier* sp. nov. has been collected from nine localities within the Stirling Range National Park, and one locality from Bald Island, ca. 70 km apart, in the western Esperance Plains IBRA 7.0 bioregion (Fig. 3). This species appears to be most common at mid to high elevation, with most records ranging between 300–950 m (Bluff Knoll). However, records from Bald Island and Two Mile Lake suggest the species can also be found at low elevations of approximately 150 m (Fig. 3).

Etymology. The species epithet is a noun in apposition referring to the shape of the male bulb resembling a straight, slender, and sharply pointed rapier sword such as those used in Renaissance Spain during the 17th century.

Proshermacha scimitar

Sagastume-Espinoza, Wilson & Harvey, sp. nov.

Figs 4–6, 65–93

ZooBank LSID: <https://zoobank.org/NomenclaturalActs/5088F108-4071-4E3E-AB06-4A926011C2A2>

Holotype

AUSTRALIA: *Western Australia*: male holotype, Porongurup National Park, Hayward Peak, 34°40'28"S, 117°53'51"E, in burrow, 359 m, 15 July 2007, M. L. Moir (WAM T81370).

Paratypes

AUSTRALIA: *Western Australia*: 1 female (allotype), Porongurup National Park, Devil's Slide, 34°40'31"S, 117°51'05"E, in

burrow, 608 m, 15 October 2006, M. L. Moir, J. M. Waldock (WAM T78506).

Other material examined

AUSTRALIA: *Western Australia*: 1 male, Stirling Range National Park, north side of Bluff Knoll, 34°23'S, 118°15'E, 897 m, 17 December 1991, A. Rose (WAM T28168); 1 male, Stirling Range National Park, Toolbrunup Peak, 34°24'S, 118°04'E, wet pitfall, 600–650 m, 10 June 1993, J. M. Waldock, A. Sampey, A. Rose (WAM T31393); 1 male, Stirling Range National Park, Toolbrunup Peak, 34°23'11"S, 118°02'48"E, wet pitfall, 750 m, 20 March 1995, S. Barrett (WAM T32583); 1 male, same data (WAM T32585); 1 male, Stirling Range National Park, Toolbrunup Peak, 34°23'12"S, 118°02'48"E, wet pitfall, 780 m, 2 September 1995, S. Barrett (WAM T32587); 1 male, Stirling Range National Park, Toolbrunup Peak, 34°23'32"S, 118°03'32"E, wet pitfall, 600–650 m, 23 April 1996, J. M. Waldock, B. Y. Main (WAM T42321); 1 male, Stirling Range National Park, picnic site Talyuberlup Peak, 34°24'56"S, 117°57'18"E, wet pitfall, 350 m, 4 September 1996, M. S. Harvey, J. M. Waldock, B. Y. Main (WAM T42322); 1 male, Stirling Range National Park, picnic site Talyuberlup Peak, 34°24'56"S, 117°57'18"E, wet pitfall, 350 m, J. M. Waldock, B. Y. Main (WAM T42350); 1 male, Stirling Range National Park, picnic site Talyuberlup Peak, 34°24'56"S, 117°57'18"E, wet pitfall, 350 m, 6 September 1996, M. S. Harvey, J. M. Waldock, B. Y. Main (WAM T44330); 1 juvenile, Porongurup National Park, Millinup Pass, 34°41'45"S, 117°54'00"E, in burrow, 293 m, 15 October 2006, M. L. Moir, J. M. Waldock (WAM T78511); 1 male, Stirling Range National Park, Toolbrunup Peak, 34°23'32"S, 118°03'32"E, wet pitfall, 600–650 m, 3 May 2011, M. S. Harvey, J. M. Waldock, B. Y. Main (WAM T115461); 1 male, Stirling Range National Park [CALM Project, 1991–1992], 34°22'S, 118°14'E, in burrow, 341 m, November 1991, K. Gaull (WAM T140319); 1 male, same data (WAM T140320); 1 male, Stirling Range National Park, Mount Magog, 34°23'59"S, 117°56'40"E, wet pitfall, 800 m, 19 September 1995, S. Barrett (WAM T145073); 1 male, Stirling Range National Park, Toolbrunup Peak, 34°23'11"S, 118°02'48"E, wet pitfall, 800 m, 14 June 1996, S. Barrett (WAM T145076); 1 male, Stirling Range National Park, Mondurup Peak, 34°24'18"S, 117°48'44"E, wet pitfall, 775 m, 16 June 1996, S. Barrett (WAM T145077); 1 male Stirling Range National Park, Mount Magog, 34°23'59"S, 117°56'40"E, wet pitfall, 800 m, 18 June 1996, S. Barrett (WAM T145078); 1 female, Stirling Range National Park, gully adjacent to Isongerup Peak, 34°22'36.22"S, 118°17'07.92"E, in burrow, 337 m, 25 March 2019, M. G. Rix, M. S. Harvey (WAM T147595); 1 female, same data (WAM T147596); 1 female, Stirling Range National Park, gully adjacent to track Toolbrunup Peak, 34°23'17"S, 118°03'08"E, in burrow, 614 m, 27 March 2019, M. G. Rix, M. S. Harvey (WAM T147609); 1 male, Stirling Range National Park, picnic site Talyuberlup Peak, 34°24'56"S, 117°57'18"E, wet pitfall, 350 m, 25 April 1996, J. M. Waldock, B. Y. Main (WAM T153887); 1 male and 3 females, same data (WAM T153888; WAM T153889; WAM T153890; WAM T153891, respectively); 1 male, Stirling Range National Park, Mount Magog, 34°23'59"S, 117°56'40"E, wet pitfall, 800 m, 18 June 1996, S. Barrett (WAM T153893); 1 male, same data (WAM T153894); 1 male, Stirling Range National Park, Toolbrunup Peak, 34°23'11"S, 118°02'48"E, wet pitfall, 800 m, 14 June 1996, S. Barrett (WAM T153897); 2 males, same data (WAM T153898; WAM T153899); 1 male, Stirling Range National Park, Toolbrunup Peak, 34°24'S, 118°04'E, wet pitfall, 600–650 m, 10 June 1993, J. M. Waldock, A. Sampey, A.

Rose (WAM T153900); 1 male, same data (WAM T153901); 1 male, Stirling Range National Park, Toolbrunup Peak, 34°23'32"S, 118°03'32"E, wet pitfall, 477 m, 23 April 1996, J. M. Waldock, B. Y. Main (WAM T153902); 1 male, Stirling Range National Park, Toolbrunup Peak, 34°23'11"S, 118°02'48"E, wet pitfall, 750 m, 20 March 1995, S. Barrett (WAM T153903); 1 female, Stirling Range National Park, Mount Magog, 34°23'59"S, 117°56'40"E, wet pitfall, 800 m, 19 September 1995, S. Barrett (WAM T32575); 1 female, Stirling Range National Park, Mount Magog, 34°23'59"S, 117°56'28"E, 454 m, 24 April 1996, M. S. Harvey, J. M. Waldock (WAM T45477); 1 female, Stirling Range National Park, White Gum Flat, 34°24'09"S, 117°54'31"E, excavated burrow in soil, 263 m, 5 June 2024, J. D. Wilson, J. M. Waldock, M. S. Harvey (WAM T163974).

Diagnosis. Males of *P. scimitar* sp. nov. can be distinguished from all described species of the genus except *P. robertblosfeldsi* and *P. 'MYG357'* by the presence of distinct flanges on the male embolus (Figs 76, 77). They can be further distinguished from *P. robertblosfeldsi* and *P. 'MYG357'* by the presence of a shorter, straighter embolus (Figs 76, 77; cf. Harvey *et al.* 2018 - fig. 7C, Harvey *et al.* 2023 - figs 49–52). No accurate comparison can be made with *P. tepperi* given the rudimentary drawings showing the male palpal bulb (Main 1964). Males are unknown for all the other described *Proshermacha* species.

Females of *P. scimitar* sp. nov. have spermathecae that are similar to other species of *Proshermacha* for which the spermathecal morphology has been documented, and most closely resemble *P. robertblosfeldsi* and *P. tela-porta* in the presence of relatively straight, laterally angled spermathecae with indistinct, globular heads (Fig. 93). They differ from these species by having extremely short and almost non-existing stalks ending in indistinct spermathecal heads (Fig. 93; cf. Harvey *et al.* 2023 - figs 34, 35, 66, 67).

Males have a dark abdomen with conspicuous pale markings, while females have a dark abdomen with a blotched pattern on the dorsal surface (Figs 70, 87).

Description: male holotype (WAM T81370)

Dimensions (mm): total body length (with chelicerae, but excluding spinnerets) 21.33, carapace length 8.88, width 6.99; sternum length 4.07, width 3.52. Femur I length 6.68, width 2.51, L/W 2.66; patella I 4.02; tibia I 4.88; metatarsus I 5.13; femur II 5.92; femur III 5.47; femur IV length 6.17, width 2.21, L/W 2.79. Abdomen length 8.63, width 5.25.

Colour (in alcohol) (Figs 65–81): carapace dark brown with darker markings in cephalic region and around the eyes; legs dark red-brown, tarsi paler; prolateral face of femur I paler than other segments, lighter brown. Chelicerae dark red-brown ventrally, almost dark brown, almost black, dorsally. Abdomen dorsally dark brown with conspicuous markings mid-dorsally, and ventrally lighter brown.

Cephalothorax: carapace (Fig. 65) 1.27 × longer than broad; pilose; silver setae present throughout; with larger brown setae dorsally most abundant at the edge; clypeal edge convex. Eyes (Fig. 67): on distinct mound; from above, anterior eye row straight, posterior eye row slightly recurved; AME about slightly smaller than ALE; ALE and PML the largest; PME smallest; eye group length 0.82, width 1.31. Fovea (Fig. 68) straight. Chelicerae (Figs 65, 66) densely setose with thick small silver to black setae and larger black setae at the retromarginal edge; rastellum absent; promargin of tooth row with 9 large teeth, retromargin in two rows, 6 very small teeth in middle row, 11 small teeth in retromarginal row, posterior ones smallest. Labium (Fig. 66) fused to sternum, without cuspules. Maxillae (Fig. 73) with 105–110 cuspules, located on the basal edge; maxillae about same colour as coxae I–IV (Fig. 69). Sternum (Figs 69, 72): oval, posteriorly pointed; 1.16 × longer than broad; setae over entire surface, setae on lateral and posterior margins longer than others; with 3 pairs of sigilla, each pair increasing in size from anterior to posterior, posterior ones elliptical.

Pedipalp (Figs 74, 75): tibia cylindrical, narrow, with 1 retrolateral spine, 5 prolateral spines, 4 ventral spines, and 3 dorsal spines; asetose depression absent; PDL/PTL 0.54; tarsus long, with medial constriction when viewed laterally; densely setose.

Palpal bulb (Figs 76, 77): bulb ovoid, PBL 1.94, BL 1.11, BW 0.82 (BT 1.35); embolus slightly curved, tapering to a thick point with a prominent flange, EL 0.87, RLE 2.23.

Variation: Based on the examined males (N = 26), PBL can vary between 1.77–2.15 ($\bar{x}$ 1.99, SE 0.02 [CI = 1.94, 2.03]), BT ratio ranges between 1.29–1.45 ($\bar{x}$ 1.37, SE 0.01 [CI = 1.35, 1.39]), and RLE ratio ranges between 1.92–2.15 ($\bar{x}$ 2.01, SE 0.01 [CI = 1.98, 2.04]).

Legs (Figs 78–81): coxal cuspules absent; coxa I with some setae noticeably shorter than others, longest at the edges; tibia I narrow, cylindrical, with large megaspor; TIL/TID 3.11; TIS/TIL 0.58; TISH/TID 0.53; metatarsus elongate, slightly incrassate, with a deep metatarsal depression; MIL/MID 3.64; MIPEL/MIL 0.49; scopula present on all tarsi, and on metatarsi I and II; claws with 2 rows of teeth; claw tufts absent.

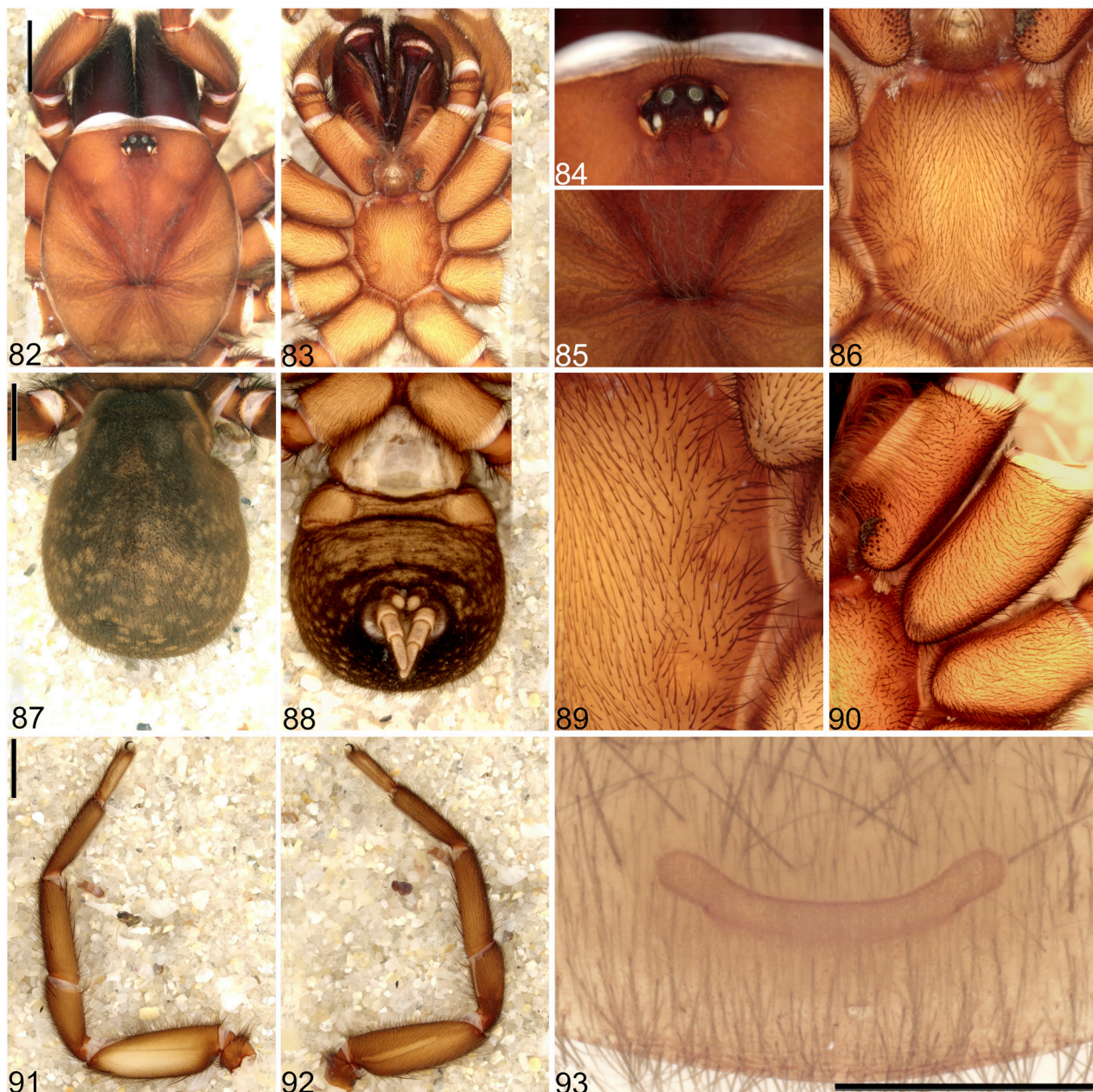
Abdomen (Figs 70, 71): 1.64 × longer than broad, densely pilose. Spinnerets: 2 pairs of spinnerets; PMS unsegmented and separated by about half the diameter of spinneret; PLS 3-segmented, apical segment elongate, digitiform.

Description: female (WAM T78506)

Dimensions (mm): total body length (with chelicerae, but excluding spinnerets) 26.59; carapace length 10.7, width 8.87; sternum length 3.21, width 2.73. Femur I 7.56, width 2.66, L/W 2.84; femur II 6.39; femur III 5.61 (right side); femur IV length 6.72, width 2.63, L/W 2.55. Abdomen length 11.12, width 8.41.



Figures 65–81. *Proshermacha scimitar* sp. nov., holotype male (WAM T81370): 65, cephalothorax, dorsal view; 66, cephalothorax, ventral view; 67, ocular region; 68, fovea; 69, sternum; 70, abdomen, dorsal view; 71, abdomen, ventral view; 72, left sternal sigilla; 73, left maxillae and anterior coxae; 74, left pedipalp, prolateral view; 75, left pedipalp, retrolateral view; 76, left bulb, retrolateral view; 77, left bulb, prolateral view; 78, left leg I prolateral view; 79, left leg I retrolateral view; 80, tibia I, retrolateral view; 81, metatarsus I, retrolateral view. Scale bars = 2 mm (65, 70, 74, 78), 1 mm (76).



Figures 82–93. *Proshermacha scimitar* sp. nov., paratype female (WAM T78506): 82, cephalothorax, dorsal view; 83, cephalothorax, ventral view; 84, eye region; 85, fovea; 86, sternum; 87, abdomen, dorsal view; 88, abdomen, ventral view; 89, left sternal sigilla; 90, left maxillae and anterior coxae; 91, left leg I prolateral view; 92, left leg I retrolateral view; 93, spermatheca, dorsal view. Scale bars = 2 mm (82, 87, 91), 1 mm (93).

Colour (in alcohol) (Figs 82–92): carapace orange-brown, darker in the cephalic area; legs orange-brown dorsally, yellow-brown ventrally, darker at the joints. Chelicerae uniformly dark red-brown. Abdomen dorsally yellow-brown with dark indistinct chevrons extending over most of the dorsal side and forming a mottled pattern, ventrally dark yellow-brown.

Cephalothorax: carapace (Fig. 82) $1.27 \times$ longer than broad; pilose; silver setae present throughout, most abundant near the fovea and reducing towards the eye group; silver setae most abundant near the fovea and the edge, reducing towards the eye group; with fine light brown setae dorsally around posterior carapace

edge, reduced anteriorly; clypeal edge slightly convex. Eyes (Fig. 84): eye group rectangular, on distinct mound; length 0.98, width 0.65 (width/length 1.51); from above, anterior eye row slightly recurved, posterior eye row slightly procurved; AME slightly larger than PME; ALE similar size to PLE; PLE largest; PME smallest. Fovea (Fig. 85) straight. Chelicerae (Figs 82, 83): densely setose with thick black setae and smaller silver setae; rastellum absent; promargin of tooth row with 8 large teeth, the 2 proximal strongly curved; retromargin with 2 teeth row, retrolateral row with 10 small teeth, proximal smallest, medial row with 5 small teeth. Labium (Fig. 83): fused to sternum, without cuspules (W/L 1.87). Maxillae (Fig. 90):

with 125–132 cuspules, located on the basal 30% of maxilla; about same colour as coxae I–IV. Sternum (Fig. 86): oval, posteriorly pointed; $1.17 \times$ longer than broad; with setae over entire surface, setae on lateral and posterior margins longer than others; with 3 pairs of sigilla, each pair increasing in size from anterior to posterior, oval shaped (Fig. 89), each pair increasing in size from anterior to posterior.

Pedipalp: with thick scopula.

Legs (Figs 91, 92): coxal cuspules absent; coxa covered in setae, longest at the edge closest to femur, ventral side with smaller setae noticeably shorter than others; scopula present on all tarsi, and on metatarsi I and II; claws with 2 rows of teeth; claw tufts absent. Leg I dimensions (mm): femur 7.56; patella 4.37; tibia 5.63; metatarsus 4.63; tarsus 2.83; spination, femur 3 (1 RL and 2 D), patella 1 (1 RL), tibia 7 (4 PL, 1 V, 2 RL), metatarsus 5 (2 PL, 2 V, 1 RL), tarsus 0, total 16.

Abdomen (Figs 87, 88): $1.32 \times$ longer than wide, pilose; spinnerets in 2 pairs; PMS unsegmented and separated by about 1.5 the diameter of spinneret; PLS 3-segmented, apical segment elongated, digitiform.

Genitalia (Fig. 93): simple, with 1 pair of spermathecae, each with a single receptacle, with short stalks ending in digitiform spermathecae head.

Remarks. Little is known about the biology of *P. scimitar* sp. nov. other than that most adult male specimens have been collected between March and June, with some records collected during September, indicating a wide temporal pattern of maturation and dispersal. *Proshermacha scimitar* was previously known as *Proshermacha* 'MYG466' in the Western Australian Museum database and as 'Morph 2' in Sagastume-Espinoza et al. (2024).

Distribution. *Proshermacha scimitar* sp. nov. has been collected from several localities at Porongurup National Park and Stirling Range National Park (Fig. 4), located 30 km apart from each other, in the Esperance Plains and Jarrah Forest IBRA 7.0 bioregions. All specimens of *P. scimitar* sp. nov. were collected at mid to high elevations ranging from 263 m up to 897 m (Bluff Knoll). No specimens have been recorded from lowlands (under 200 m).

Etymology. The species epithet is a noun in apposition referring to the resemblance that the male bulb has with the single-edged, convex curved swords widespread throughout the Middle East and Central Asia between the 9th and 15th centuries.

Disclosures

Mark S. Harvey is the Editor-in-Chief of the Australian Journal of Taxonomy. He did not at any stage have access to the manuscript while in peer-review and had no influence on its acceptance for publication.

Acknowledgments

Many of the specimens used in this work were kindly collected by S. Barrett (Department of Biodiversity, Conservation and Attractions), and we are thankful to her and all the other collectors. We also thank J. McRae for her assistance with preparing the *Proshermacha rapier* male slides, V. Marques for his assistance and comments when preparing Figs 1–4, H. Clark for his assistance in the field which resulted in the collection of fresh specimens of *Proshermacha rapier*, and to R. Hare for his comments and discussions on early drafts of this work. We also thank the subject editor Volker Framenau, Andre do Prado and an anonymous reviewer for their valuable comments which significantly improved the manuscript.

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