Zoosyst. Evol. 99 (2) 2023, 307–323 | DOI 10.3897/zse.99.101417

Kangaraneus, a new genus of orb-weaving spider from Australia (Araneae, Araneidae)

Pedro de S. Castanheira[1], Volker W. Framenau[1,2,3]

1 *Harry Butler Institute, Murdoch University, 90 South St, Murdoch, Western Australia 6150, Australia*
2 *Department of Terrestrial Zoology, Western Australian Museum, Locked Bag 49, Welshpool DC, Western Australia, 6986, Australia*
3 *Department of Invertebrates, Museum of Nature Hamburg - Zoology, Leibnitz Institute for the Analysis of Biodiversity Change (LIB), Martin-Luther-King-Platz 3, 20146 Hamburg, Germany*

https://zoobank.org/F1A740F4-6BC2-44B4-9F9F-3222C428B23C

Corresponding author: Pedro de S. Castanheira (pedro.castanheira@murdoch.edu.au)

Academic editor: Danilo Harms ♦ **Received** 3 February 2023 ♦ **Accepted** 12 April 2023 ♦ **Published** 31 May 2023

Abstract

A new Australian genus in the orb-weaving spider family Araneidae Clerck, 1757 is described, *Kangaraneus* **gen. nov.**, with *K. arenaceus* (Keyserling, 1886) **comb. nov.** (New South Wales, Queensland, South Australia, Victoria and Western Australia) as the type species and also including two other species: *Kangaraneus amblycyphus* (Simon, 1908) **comb. nov.** (Australian Capital Territory, New South Wales, Queensland, South Australia, Victoria and Western Australia) and *K. farhani* **sp. nov.** (Australian Capital Territory, New South Wales, South Australia, Victoria and Tasmania). The new genus is included in the informally termed Australasian 'backobourkiine' clade due to the presence of its putative synapomorphies, specifically a single patellar macroseta on the male pedipalp and its median apophysis forming an arch over the radix. It includes medium-sized orb-weaving spiders (total length 3–12 mm) with distinct humeral humps on the almost triangular abdomen. Therefore, within the backobourkiines, it is somatically most similar to *Novakiella* Court & Forster, 1993 but differs considerably in male genitalic characters, including a C-shaped median apophysis with an acute tip. Genitalia are most similar to those in *Quokkaraneus* Castanheira & Framenau, 2023 from which the new genus differs by the lack of the white colouration and the shape of the abdomen.

Key Words

Araneus, backobourkiines, systematics, taxonomy

Introduction

A recent multi-gene molecular study on world-wide orb-weaving spiders in the family Araneidae Clerck, 1757 placed many Australian species in an informally termed clade, the 'backobourkiines' (Scharff et al. 2020). The study did not analyse morphological characters in detail but proposed two synapomorphies of the male pedipalp for this clade: a single macroseta on the pedipalp patella – most 'traditional' Araneinae Clerck, 1757 have two (Scharff and Coddington 1997) – and the base of the median apophysis forming an arch over the radix. The study by Scharff et al. (2020) spawned several genus-level revisions for the backobourkiines, a dominant Oriental and Pacific clade, that currently includes eleven genera in Australia (Table 1). Two of these genera, *Leviana* Framenau & Kuntner, 2022 and *Quokkaraneus* Castanheira & Framenau, 2022, were placed outside the backobourkiines in Scharff et al.'s (2020) preliminary phylogenetic hypothesis, but as their male pedipalps display the proposed synapomorphies, they are tentatively included in the backobourkiines pending further molecular and morphological studies (see discussions in Framenau and Kuntner (2022) and Castanheira and Framenau (2022)).

Copyright *Castanheira, P. de S. & Framenau, V. W.* This is an open access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Table 1. Putative genera of the informally termed backobourkiine clade (sensu Scharff et al. 2020) occurring in Australia.

Genus	Total no. of species (World Spider Catalog 2023)	No. of species in Australia	Remarks
Acroaspis Karsch, 1878	5	5	included in Scharff et al. (2020); paraphyletic with respect to *Socca*; taxonomy unresolved
Backobourkia Framenau, Dupérré, Blackledge & Vink, 2010	4	4	revised in Framenau et al. (2010); *B. thyridota* likely senior synonym of either *B. heroine* (L. Koch, 1871) or *B. brounii* (Urquhart, 1885) pending an examination of type material (whereabouts currently unknown)
Carepalxis L. Koch, 1872	12	5	Taxonomy unresolved; Nearctic species reviewed in Levi (1992) and Ferreira-Sousa and Motta (2022)
Hortophora Framenau & Castanheira, 2021	13	10	revised in Framenau et al. (2021a)
Kangaraneus gen. nov.	3	3	this study
Lariniophora Framenau, 2011	1	1	monotypic (Framenau 2011)
Leviana Framenau & Kuntner, 2022	5	5	revised in Framenau and Kuntner (2022); not within backobourkiines in Scharff et al. (2020), but has putative synapomorphies of backobourkiines
Novakiella Court & Forster, 1993	2	2	revised in Framenau et al. (2021b)
Plebs Joseph & Framenau, 2012	22	7	revised in Joseph and Framenau (2012)
Quokkaraneus Castanheira & Framenau, 2022	1	1	monotypic (Castanheira and Framenau 2022); not within backobourkiines in Scharff et al. (2020), but has putative synapomorphies of backobourkiines
Salsa Framenau & Castanheira, 2022	5	5	revised in Framenau and Castanheira (2022)
Socca Framenau, Castanheira & Vink, 2022	12	12	revised in Framenau et al. (2022)
dehaani-group (sensu Yin et al. 1997)	3	1	*Parawixia dehaani* (Doleschall, 1859) was part of the backobourkiines in Scharff et al. (2020) and not monophyletic with true *Parawixia* F.O. Pickard-Cambridge, 1904 from the New World

The Australian *Araneus arenaceus* (Keyserling, 1886), originally described from New South Wales and Queensland, and *Araneus amblycyphus* Simon, 1908 from Western Australia, are morphologically very similar species and both display the proposed male genitalic synapomorphies of the backobourkiines as mentioned above. However, they do not display any of the genus-level synapomorphies that characterise the backobourkiine genera treated so far (Table 1). They were not included in Scharff et al.'s (2020) or any other recent molecular analysis including Australian araneids (e.g., Kallal and Hormiga 2018) that could facilitate their phylogenetic placement.

Due to their unique morphology, we consider *Araneus arenaceus* and *A. amblycyphus* to represent a new genus within the backobourkiines, pending a comprehensive molecular and systematic study of this clade. The aim of this study is to revise this new genus as a testable hypothesis for future systematic work, specifically to elucidate phylogenetic relationships to or within the backobourkiines.

Methods

This study is based on the examination of virtually all orb-weaving spider specimens in the major Australian museum collections and overseas collections where historical type material is lodged, totalling almost 12,000 records (vials) up to this date.

Descriptions and terminology follow recent publications on Australian backobourkiine orb-weaving spiders (e.g., Castanheira and Framenau 2022; Framenau et al. 2022; Framenau and Castanheira 2022; Framenau and Kuntner 2022). The generic and species descriptions of *Araneus arenaceus* and *A. amblycyphus* are based on recently collected, well preserved specimens in lieu of original type material. Colour patterns were described based on specimens preserved in ca. 75% ethanol.

Microscopic photographs were taken with two different stereo-imaging systems. A setup at the Natural History Museum, Copenhagen (Denmark) allowed taking images with a Nikon D300 digital SLR camera attached via a C-mount adapter to a Leica M16A stereomicroscope. Images of different focal plains were stacked with Automontage (vers. 5.02) software from Syncroscopy to increase depth of field. A second set-up at the Harry Butler Institute, Murdoch University (Australia) supported taking microscopic images in different focal planes with a Leica DMC4500 digital camera mounted to a Leica M205C stereomicroscope and combined using the Leica Application Suite X, v. 3.6.0.20104. All photos and plates were edited with Photoshop CC 2020.

All measurements are given in millimetres. They were taken with an accuracy of one tenth of a millimetre, except for the eye and labium measurements, taken with an accuracy of one hundredth of a millimetre.

Maps were compiled in the software package QGis v. 3.2.6 Buenos Aires (https://qgis.org/en/site/; accessed 1 September 2022). Geographic coordinates were extracted directly from original labels or the registration data as provided by the museums. When no detailed geographic information was available, localities were estimated based on Google Earth v. 9.1.39.3 (https://earth.google.com/web/ accessed 1 September 2022) to the closest minute of Latitude and Longitude.

Abbreviations

Morphology

ALE anterior lateral eyes
AME anterior median eyes
PLE posterior lateral eyes
PME posterior median eyes
TL Total length

Collections

AM	Australian Museum, Sydney (Australia);
CVIC	La Trobe University, Bendigo (Australia);
MNHN	Muséum National d'Histoire Naturelle, Paris (France);
MV	Museums Victoria, Melbourne (Australia);
NHMUK	Natural History Museum, London (United Kingdom);
QM	Queensland Museum, Brisbane (Australia);
QVMAG	Queen Victoria Museum & Art Gallery, Launceston (Australia)
SAM	South Australian Museum, Adelaide (Australia);
WAM	Western Australian Museum, Perth (Australia);
ZMB	Museum für Naturkunde, Zentralinstitut der Humboldt-Universität, Berlin (Germany);
ZMH	Zoologisches Institut und Zoologisches Museum, Universität Hamburg, Hamburg (Germany).

Taxonomy

Order Araneae Clerck, 1757
Family Araneidae Clerck, 1757

***Kangaraneus* gen. nov.**
https://zoobank.org/1AED6CD8-0E08-4945-83FB-9C1EB407717B

Type species. *Epeira arenacea* Keyserling, 1886 (designated here).

Etymology. The genus-group name is a compound noun composed of '*Kang*-' in reference to the Kangaroo, genus *Macropus* Shaw, 1790, the renowned Australian marsupial, and '-*araneus*', a genus-group name for orb-weaving spiders. The gender of the genus-group name *Kangaraneus* is masculine.

Diagnosis. Within the backobourkiines as circumscribed by Scharff et al. (2020; see also Table 1), the male genitalia of *Kangaraneus* gen. nov. are most similar to those of *Quokkaraneus*, due to a similar C-shaped median apophysis with a drawn-out, acute tip and the conductor having a basal protrusion (e.g., Castanheira and Framenau 2022; fig. 1C, D). However, *Kangaraneus* gen. nov. males differ distinctly by the presence of prominent humeral humps on the abdomen (lacking in *Quokkaraneus*) and the lack of white colouration on the carapace and legs (e.g., Castanheira and Framenau 2022; fig. 1A). Females of *Kangaraneus* gen. nov. differ from those of *Quokkaraneus* in somatic characters as described for males above, but also in the general shape of the epigyne scape, which is much wider basally in *Quokkaraneus* (Castanheira and Framenau 2022; fig. 3C), but not in *Kangaraneus* gen. nov. Due to the prominent humeral humps on the abdomen, *Kangaraneus* gen. nov. species are somatically similar to species of *Novakiella* but have a vastly different genital morphology; specifically, the male pedipalp lacks the greatly enlarged conductor lobe of *Novakiella* (e.g., Framenau et al. 2021b; figs 1C, 2A).

Description. Medium-sized orb-weaving spiders, with males (ca. TL 3.2–6.7) on average smaller than females (ca. TL 6.3–10.4). Carapace longer than wide with cephalic region slightly narrower in males than in females, light or dark brown (e.g., Figs 1A, 3A, 5A, 6A). Fovea longitudinal in males and transverse in females (e.g., Figs 1A, 3A). AME largest in males, row of posterior eyes recurved, lateral eyes almost touching; posterior lateral eyes largest in females and separated from PME by less than their diameter; AME slightly protruding from the carapace in both sexes (e.g., Figs 1A, 3A). Sternum slightly longer than wide, brown to beige and sometimes with dusky borders (e.g., Figs 1B, 3B). Labium wider than long, with anterior glabrous pale edge (e.g., Figs 6B, 8B). Maxillae with glabrous lighter antero-mesal section (e.g., Figs 6B, 8B). Chelicerae with four promarginal teeth and three retromarginal teeth (reduced to three and two respectively in *K. farhani* sp. nov.). Leg formula I > II > IV > III; tibiae II in males stronger than tibiae I and with strong prolateral spines (e.g., Figs 1A, 5A). Abdomen sub-triangular, generally wider than long, with two conspicuous humeral humps, but without specialized setae, condyles or other structures; colour dorsally varying from beige to olive-grey and black, sometimes with distinct folium pattern and large pale spot (e.g., Figs 1A, 3A, 5A). Venter brown or grey with irregular black setae, sometimes with two pale spots (e.g., Figs 1B, 3B, 5B, 9B).

Male pedipalp patella with a single macroseta (e.g., Figs 1C, 6C–E, 7A–D); paracymbium hook-shaped (e.g., Figs 1D, 6D, 7A–C, 9D); median apophysis C-shaped, basally strongest and tapering to an acute tip, at ca. half to ¾ length with a prominent bulge ('central protrusion'), base forming an arch over radix (e.g., Figs 1C–E, 7A–D); radix prominent (e.g., Figs 1C, 2A, 10A); terminal apophysis elongate, membranous, bubble-shaped or lanceolate, with a basal lobe and a pointed tip (e.g., Figs 1C, 2A–D, 10A–D); basal conductor lobe inconspicuous, terminally spatulate (e.g., Figs 1C, 2A, 6C, 10A); conductor prominent, laterally broad, apically with a protuberance and basally with an elongate protrusion tapering to a bifid tip (e.g., Figs 1C–E, 7A–D, 9C–E); embolus strong, basally elongate, rectangular, heavily sclerotised, with a curved, uncapped tip (e.g., Figs 1C, 2A–D, 9C). Epigyne wider than long, with very wide lateral borders encircling a wide and convex atrium (Figs 3E, 8C, 11C); central division narrow (Figs 3E, 8E, 11F); scape basally broadest, either tapering (Figs 3C, 8C) or truncated (Fig. 11D); spermathecae around half or more than half atrium length, ovoid, copulatory ducts curved, somewhat in a lyre-formation and heavily sclerotised (Fig. 4A–F).

Distribution. All Australian mainland states and Tasmania, excluding Northern Territory. (Fig. 12).

Included species. *Kangaraneus arenaceus* (Keyserling, 1886) comb. nov. (type-species), *K. amblycyphus* (Simon, 1908) comb. nov., and *K. farhani* sp. nov.

***Kangaraneus arenaceus* (Keyserling, 1886), comb. nov.**
Figs 1A–E, 2A–D, 3A–E, 4A, B, 5A–C, 12

Epeira arenacea Keyserling 1886: 145–148, plate 12, figs 2, 2a, 3, 3a, 3b.
Araneus arenaceus (Keyserling, 1886).- Rainbow 1911: 182; Bonnet 1955: 438.

Type specimens. ***Lectotype*** of *Epeira arenacea* Keyserling, 1886 (designated here): female, Sydney (33°53'S, 151°13'E, New South Wales, AUSTRALIA) (NHM 1890.7.1.4138), **examined**. ***Paralectotypes*:** 5 males, 3 females, same locality as lectotype (ZMH Rack (1961)-catalogue 224), **examined**; 1 male, same locality as lectotype (NHM 1890.7.1.4137), **examined;** 1 female, same locality as lectotype, misidentified (this is *K. amblycyphus* comb. nov.) (NHM 1890.7.1.4139), **examined**.

Other material examined. AUSTRALIA – **New South Wales** • 2 females, 3 juveniles, 'Allambi' Telegraph Point, 31°19'S, 149°15'E (AM KS.56967); • 1 male, Pittwater, 33°38'S, 151°18'E, (AM KS.31675). **Queensland** • 1 male, Blackdown Tableland, SW Rockhampton, 23°50'S, 149°03'E (QM); • 1 female, same locality (QM); • 1 female, Braemar State Forest, 27°13'S, 150°50'E (QM); • 1 male, 2 females, 4 juveniles, Peak Downs, 22°56'S, 148°05'E (ZMH); • 2 females, same locality (ZMH). **South Australia** • 1 female, Bridgewater, 35°S, 138°46'E (SAM); • 1 female, Cape du Couedic, on road to Flinder Chase Ranger Station, Kangaroo Island, 36°03'S, 136°42'E (SAM); • 1 female, Dudley

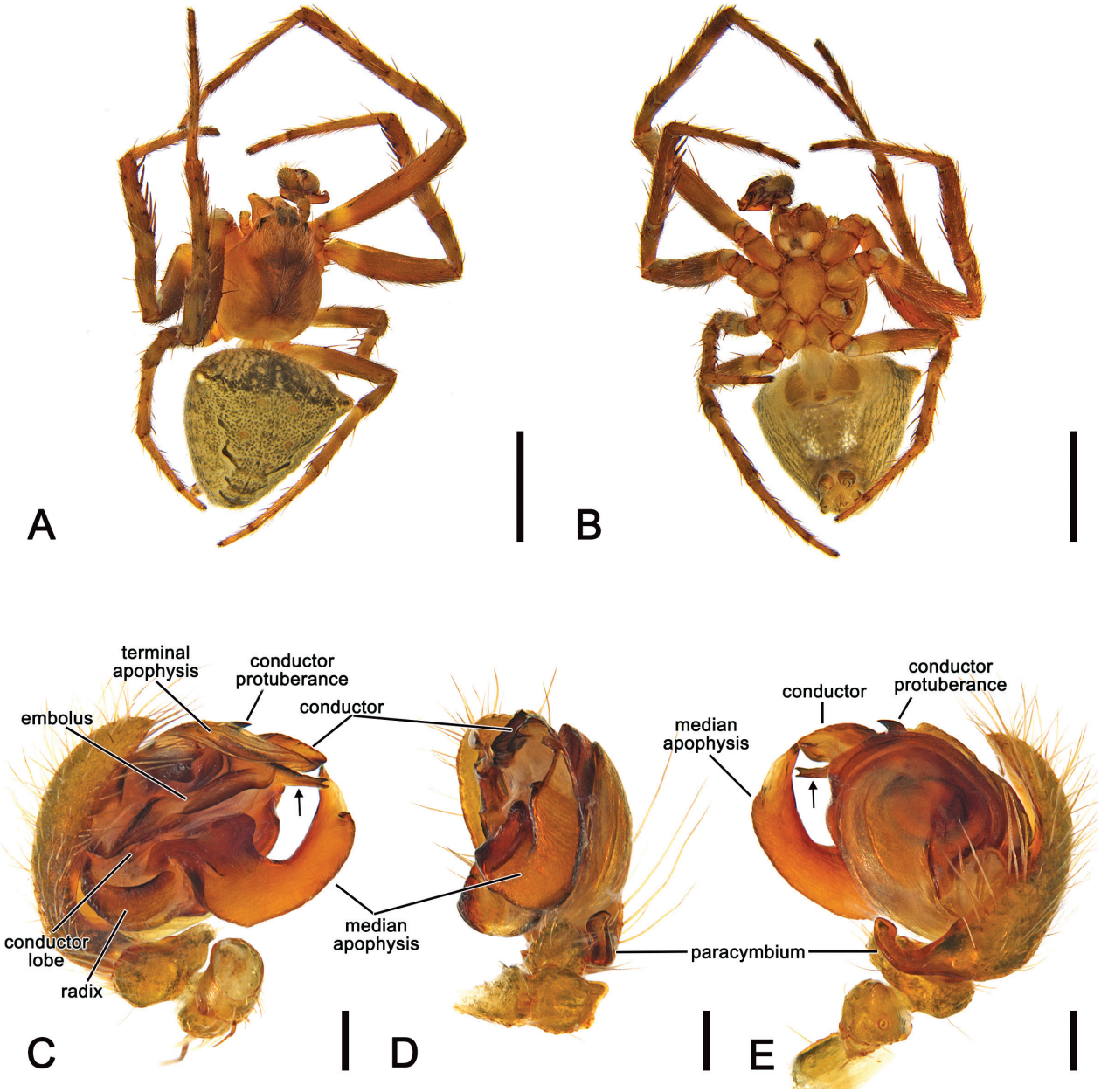

Figure 1. *Kangaraneus arenaceus* (Keyserling, 1886) comb. nov., male (WAM T64400). **A.** Dorsal habitus; **B.** Ventral habitus; **D.** Left pedipalp, ventral view; **E.** Left pedipalp, retrolateral view; **F.** Left pedipalp, dorsal view. Scale bars: 2 mm (**A, B**); 0.2 mm (**C–E**). Arrow points to the conductor basal protrusion.

Conservation Park, Kangaroo Island, 35°48'S, 137°51'E (SAM); • 1 female, Kuitpo Forest Reserve, 35°12'S, 138°40'E (SAM); **Victoria** • 2 females, unknown locality (MV K-10342); • 1 female, Berwick, Quarry Hill, 38°02'S, 145°20'E (QM); • 1 female, 1 juvenile, Spring Gully, 36°48'S, 144°17'E (CVIC 1174). **Western Australia** • 2 females, south-west Western Australia (no exact locality) (SAM); • 1 female, Boddington Bauxite Mine, 32°55'S, 116°26'E (WAM T77221); • 1 female, Busselton, 33°39'S, 115°20'E (AM KS.131227); • 1 female, Fitzgerald National Park, Twertup, 34°01'S, 119°20'E (WAM T75902); • 1 male, Fitzgerald River National Park, on track to Rose Rock, 34°04'S, 119°25'E (WAM T70101); • 1 male, Huntly Mine, 5 km E Banksiadale Dam, 32°39'S, 116°05'E (WAM T64598); • 1 male, same locality (WAM T64400); • 1 male, Jarrahdale (Alcoa) Mine area, 32°20'S, 116°03'E (WAM T48219); • 1 female, Pemberton, 34°26'S, 116°02'E (AM KS.32901); • 1 male, 1 female, 1 juvenile, Shannon National Park, 34°40'S, 116°22'E (WAM T70165).

Diagnosis. Males of *Kangaraneus arenaceus* comb. nov. are most similar to those of *K. amblycyphus* comb. nov. as both have pedipalp with a similar median apophysis with a blunt central protrusion and a conductor with an elongated basal protrusion (Figs 1C–E, 2A–D, 6C–E, 7A–D). However, *K. arenaceus* comb. nov. is identified by a lanceolate terminal apophysis with a more prominent and sclerotised basal lobe, and lacking a distal spine-like tip (present in *K. amblycyphus* comb. nov.). *Kangaraneus arenaceus* comb. nov. is the only species in the genus in which females have baso-lateral flaps on the epigyne base (Figs 3E, 4A, B), and in addition can be differentiated

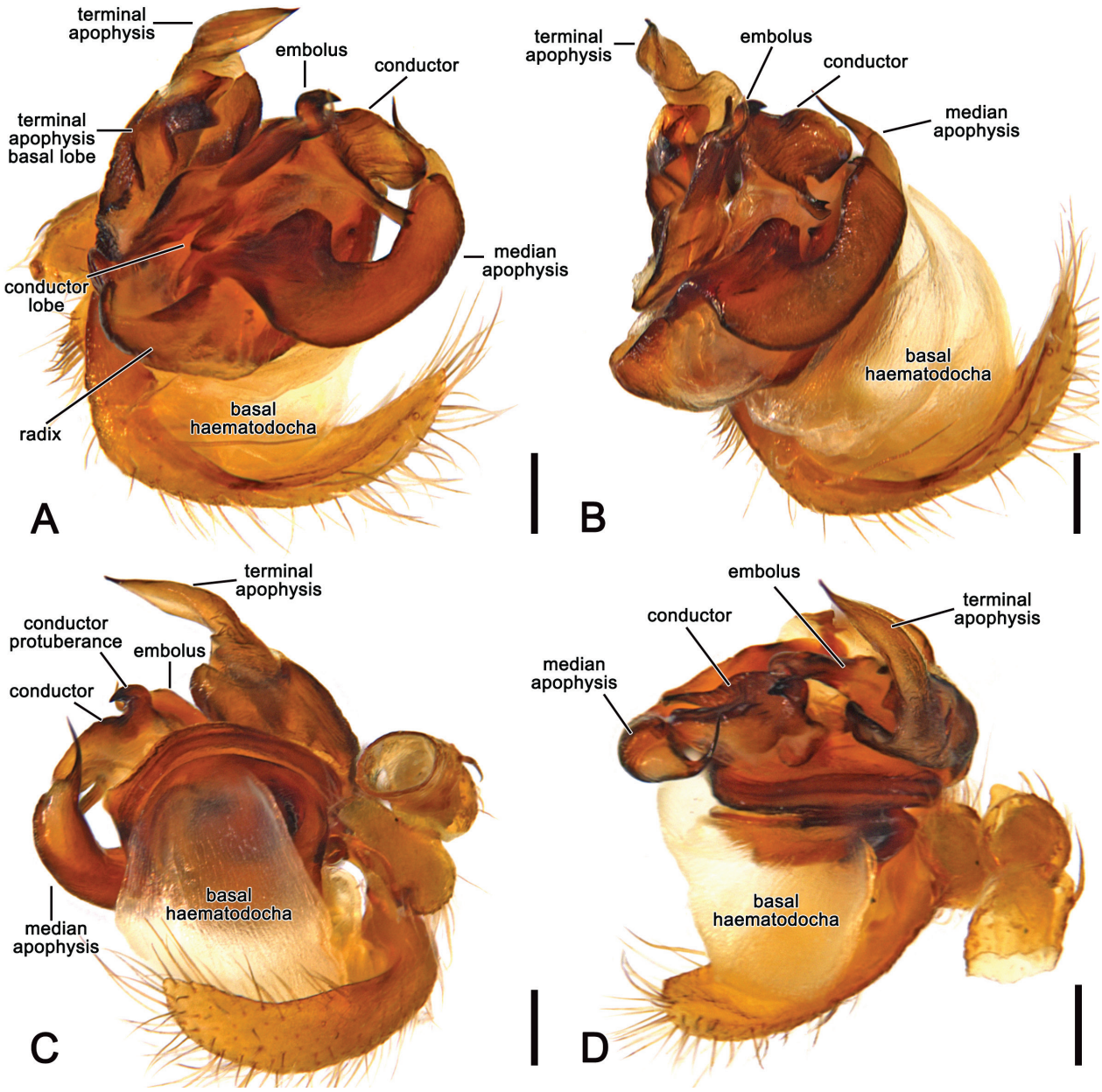

Figure 2. *Kangaraneus arenaceus* (Keyserling, 1886) comb. nov., male expanded left pedipalp (WAM T64598). **A.** Ventral view; **B.** Retrolateral view; **C.** Dorsal view; **D.** Apical view. Scale bars: 0.2 mm.

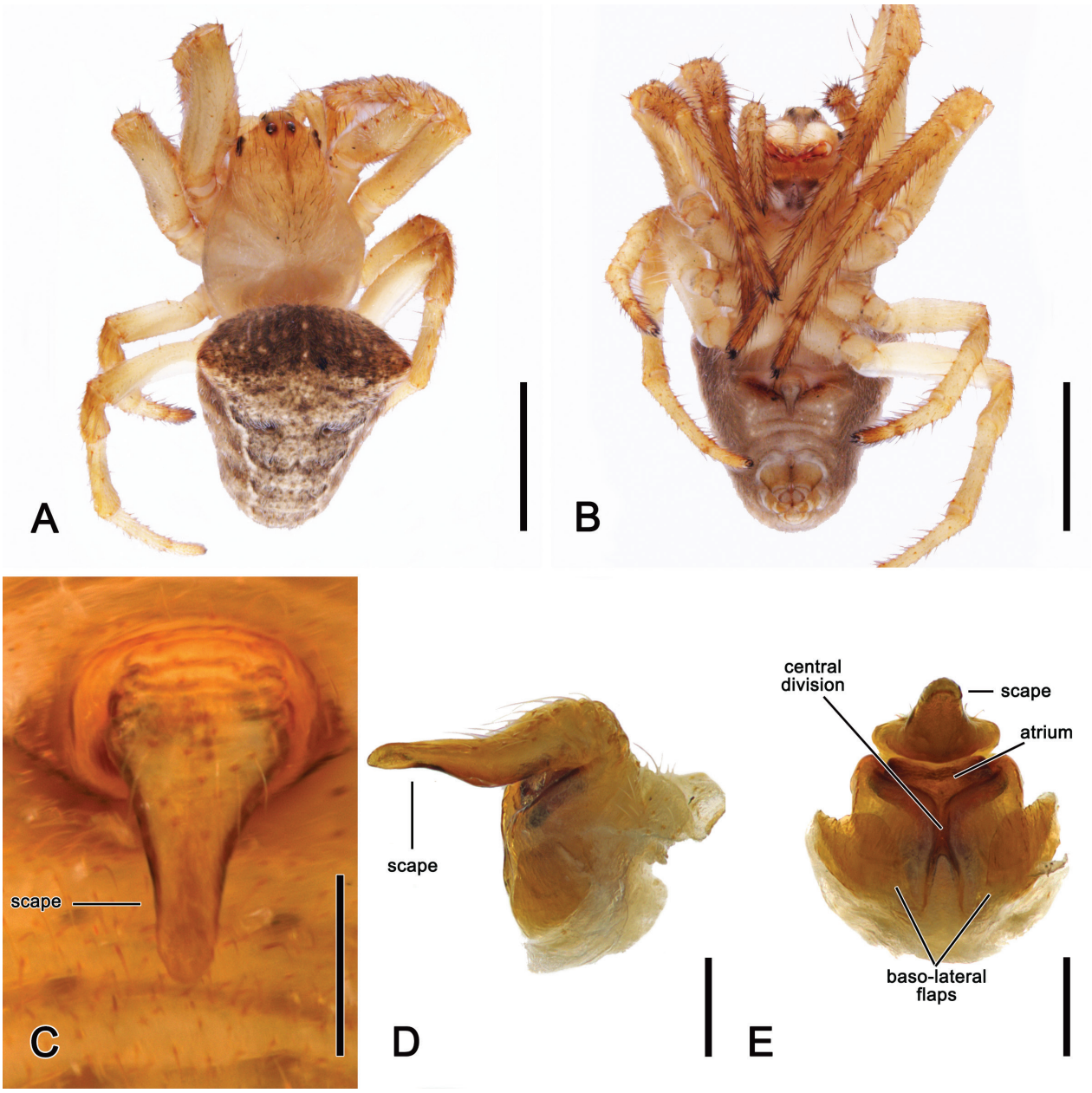

Figure 3. *Kangaraneus arenaceus* (Keyserling, 1886) comb. nov., female, (WAM T77221). **A.** Dorsal habitus; **B.** Ventral habitus; **C.** Epigyne, ventral view; **D.** Epigyne, lateral view; **E.** Epigyne, posterior view. Scale bars: 2 mm (**A, B**); 0.2 mm (**C–E**).

from *K. amblycyphus* comb. nov. by the epigyne scape completely covering the atrium (Figs 3C vs 8C).

Redescription. Male (based on WAM T64400). Total length 6.7. Carapace 3.0 long, 2.4 wide, light brown, centrally darker around fovea (Fig. 1A). Eye diameter AME 0.11, ALE 0.11, PME 0.12, PLE 0.07; row of eyes: AME 0.51, PME 0.42, PLE 1.12. Chelicerae light brown with four promarginal teeth (third largest) and three retromarginal teeth of similar size. Legs light brown mottled dark brown, base of femora lighter (Fig. 1A, B). Leg length of segments (femur + patella + tibia + metatarsus + tarsus = total length): I – 3.9+ 1.6 + 3.2 + 2.8 + 1.2 = 12.7, II – 3.1 + 1.5 + 2.4 + 2.3 + 1.0 = 10.3, III – 1.1 + 0.9 + 1.4 + 1.0 + 0.6 = 5.0, IV – 1.8 + 0.9 + 1.5 + 1.8 + 0.8 = 6.8. Labium 0.47 long, 0.35 wide, light brown; maxillae light brown, both beige anteriorly (Fig. 1B). Sternum 1.3 long, 1.0 wide, light brown with smooth darker radial shading (Fig. 1B). Abdomen 3.5 long, 3.6 wide, triangular with two conspicuous and pointed shoulder humps; dorsum with pale beige background, large olive-grey patch in cardiac area and irregular folium with olive-grey spots, laterally pale beige with dark streaks (Fig. 1A); venter same background colour as dorsum and with sparse guanine spots (Fig. 1B). Pedipalp (Figs 1C–E, 2A–D) length of segments (femur + patella + tibia + cymbium = total length): 0.6 + 0.4 + 0.2 + 1.0 = 2.2; paracymbium strong, hook-like and curved apically; median apophysis C-shaped, terminating in an acute tip, central protrusion small; radix strong; terminal apophysis elongated, membranous and lanceolate, bearing a large, sclerotised,

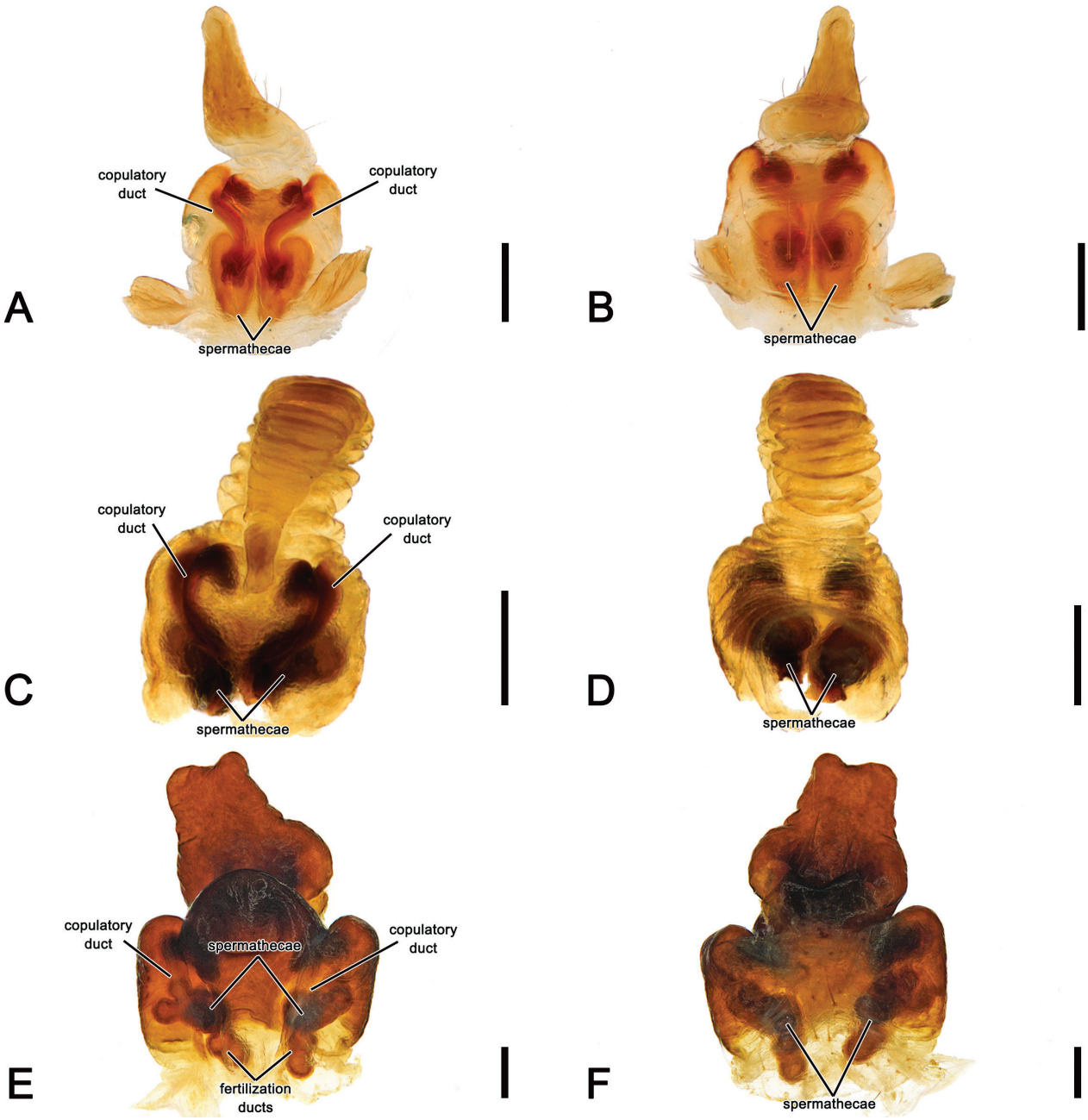

Figure 4. *Kangaraneus* gen. nov. female epigynes, cleared. **A.** *K. arenaceus* (Keyserling, 1886) comb. nov., ventral view (WAM T77221); **B.** *K. arenaceus* (Keyserling, 1886) comb. nov., dorsal view (WAM T77221); **C.** *K. amblycyphus* (Simon, 1908) comb. nov., ventral view (AM KS.131276); **D.** *K. amblycyphus* (Simon, 1908) comb. nov., dorsal view (AM KS. 131276); **E.** *K. farhani* sp. nov. ventral view (AM KS.131278); **F.** *K. farhani* sp. nov., dorsal view (AM KS. 131278). Scale bars: 0.2 mm.

round projection, ending in an acute tip; conductor large, round and laterally projected, bearing a hook-like apical protuberance and an elongated basal protrusion tapering to a bifid tip; basal conductor lobe inconspicuous; embolus prominent, elongate, heavily sclerotised with a curved tip.

Female (based on WAM T77221): Total length 5.6. Carapace 2.5 long, 2.4 wide; beige, cephalic area light brown (Fig. 3A). Eye diameter AME 0.11, ALE 0.10, PME 0.09, PLE 0.09; row of eyes: AME 0.46, PME 0.38, PLE 1.23. Chelicerae beige, with four promarginal teeth (apical and third largest) and three retromarginal teeth of similar size. Legs beige, patellae and tibiae apically slightly darker (Fig. 3A, B). Pedipalp length of segments (femur + patella + tibia + tarsus = total length): 0.6 + 0.4 + 0.4 + 1.2 = 2.6. Leg length of segments (femur + patella + tibia + metatarsus + tarsus = total length): I – 2.9 + 1.4 + 2.4 + 2.3 + 1.1 = 10.1, II – 2.4 +1.1 + 2.1 + 2.1 + 0.9 = 8.6, III – 1.4 + 0.9 + 1.0 + 1.0 + 0.8 = 5.1, IV – 1.8 + 1.0 + 1.5 + 1.7 + 1.0 = 7.0. Labium 0.25 long, 0.60 wide, beige; maxillae beige (Fig. 3B). Sternum 1.5 long, 1.2 wide, beige (Fig. 3B). Abdomen 3.5 long, 3.2 wide; dorsum of same colour background as male but almost completely covered greyish, laterally grey (Fig. 3A); venter grey with a few guanine

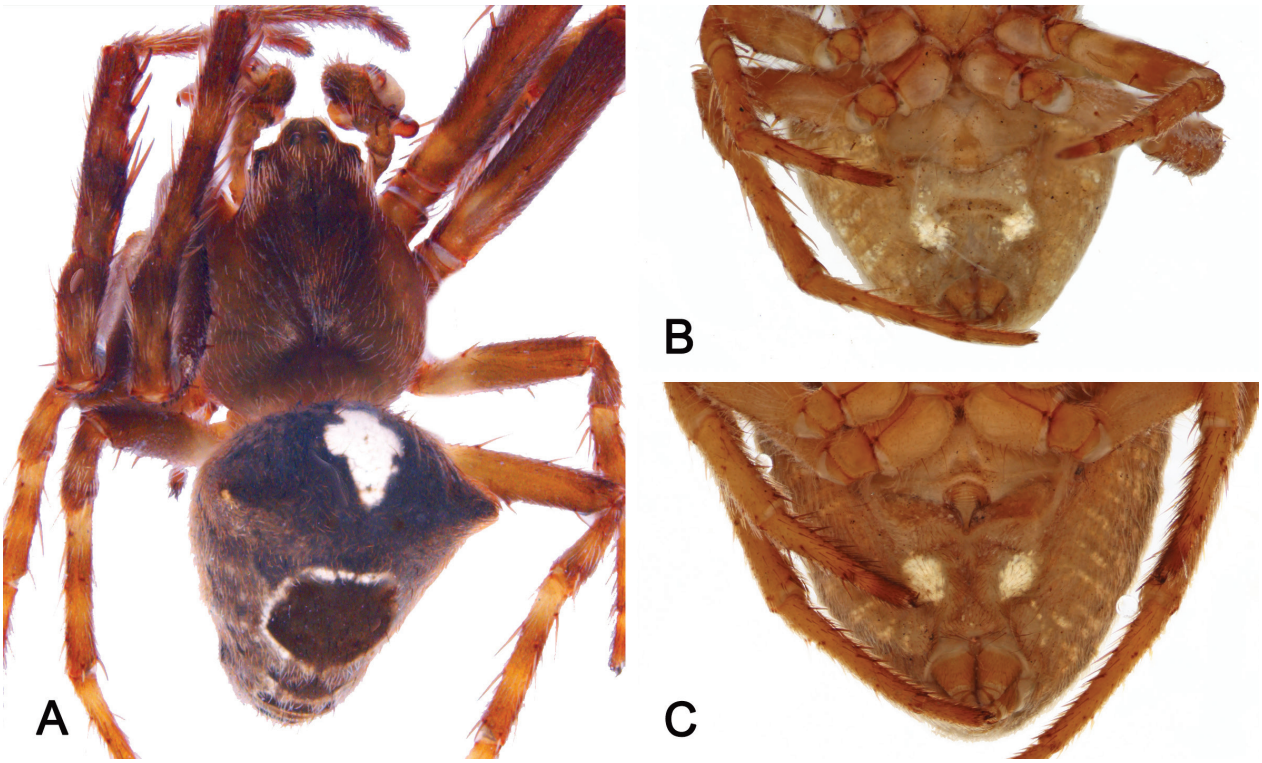

Figure 5. *Kangaraneus arenaceus* (Keyserling, 1886) comb. nov., variations. **A.** Male dorsal habitus (WAM T64598); **B.** Paralectotype male ventral abdomen (NHM 1890.7.1.4137); **C.** Lectotype female ventral abdomen (NHM 1890.7.1.4138).

spots (Fig. 3B). Epigyne base oval, wider than long, with wide lateral borders, atrium convex, barely visible in ventral view (Fig. 3C); central division narrow, baso-lateral flaps present (Figs 3E, 4A); scape elongate-triangular extending over the posterior epigyne border, basally broadly rounded and slightly wrinkled, almost straight in lateral view, tip flattened without terminal pocket (Fig. 3C, D); spermathecae elongate-ovoid, copulatory ducts sinuous and terminating at base of scape (Fig. 4A, B).

Variation. Males total length 4.5–6.7 (n = 6); females total length 5.6–8.7 (n = 6). The colouration of *K. arenaceus* comb. nov. males can vary considerably, with some specimens having a dark brown carapace and a black abdomen with a large white patch in the cardiac area (Fig. 5A). Examined females are less variable in colouration. Both males and females may have a pair of white spots ventrally on the abdomen, a character mentioned in the original description (see Keyserling 1886) (Fig. 5B, C).

Remarks. The syntypes of *Epeira arenacea* Keyserling, 1886 are deposited at the ZMH and NHM. A female paralectotype (NHM 1890.7.1.4139) was misidentified by Keysersing (1886); this is *K. amblycyphus* comb. nov. To unequivocally fix the species-group name of *K. arenaceus* comb. nov., we here designate a female collected in Sydney (NHM 1890.7.1.4138) as the lectotype of the species. We do not consider the specimens from Peak Downs (Queensland) at the ZMH syntypes of *K. arenaceus* comb. nov. as Keyserling's type locality is "Sydney. Museum Godeffroy".

Life history and habitat preferences. Specimens of *K. arenaceus* comb. nov. have mainly been found from October to January, with only a few specimens collected in the colder months like June and August. Therefore, the species seems to be largely spring to early summer mature.

Habitat descriptions on the collection labels include "cypress and brigalow" and "in low bush". Two labels indicated that the species falls prey to wasps ("in wasp nest" and "mud dauber wasp nest").

Distribution. *Kangaraneus arenaceus* comb. nov. has been found in eastern New South Wales and Queensland, the Fleurieu Peninsula and Kangaroo Island in South Australia, Victoria and south-western Western Australia (Fig. 12).

Kangaraneus amblycyphus (Simon, 1908), comb. nov.

Figs 6A–E, 7A–D, 8A–E, 12

Araneus amblycyphus Simon 1908: 427.

Araneus amblycyphus Simon, 1908.- Rainbow 1911: 182; Bonnet 1955: 432.

Type specimens. ***Lectotype*** of *Araneus amblycyphus* Simon, 1908 (designated here): 1 female Busselton (33°38'S, 115°20'E, Western Australia, AUSTRALIA) (MNHN 13309), **examined**. ***Paralectotype*:** 1 juvenile, same locality (ZMB 13485), **examined**.

Other material examined. AUSTRALIA – **Australian Capital Territory** • 1 female, Corin Dam, 57 km W of Canberra, 35°34'S, 148°50'E (AM KS.32942); **New South Wales** • 1 female, Brooklana, W of Dorrigo, 30°16'S, 152°51'E (AM KS.34050); • 1 male, Hornsby, Waitara

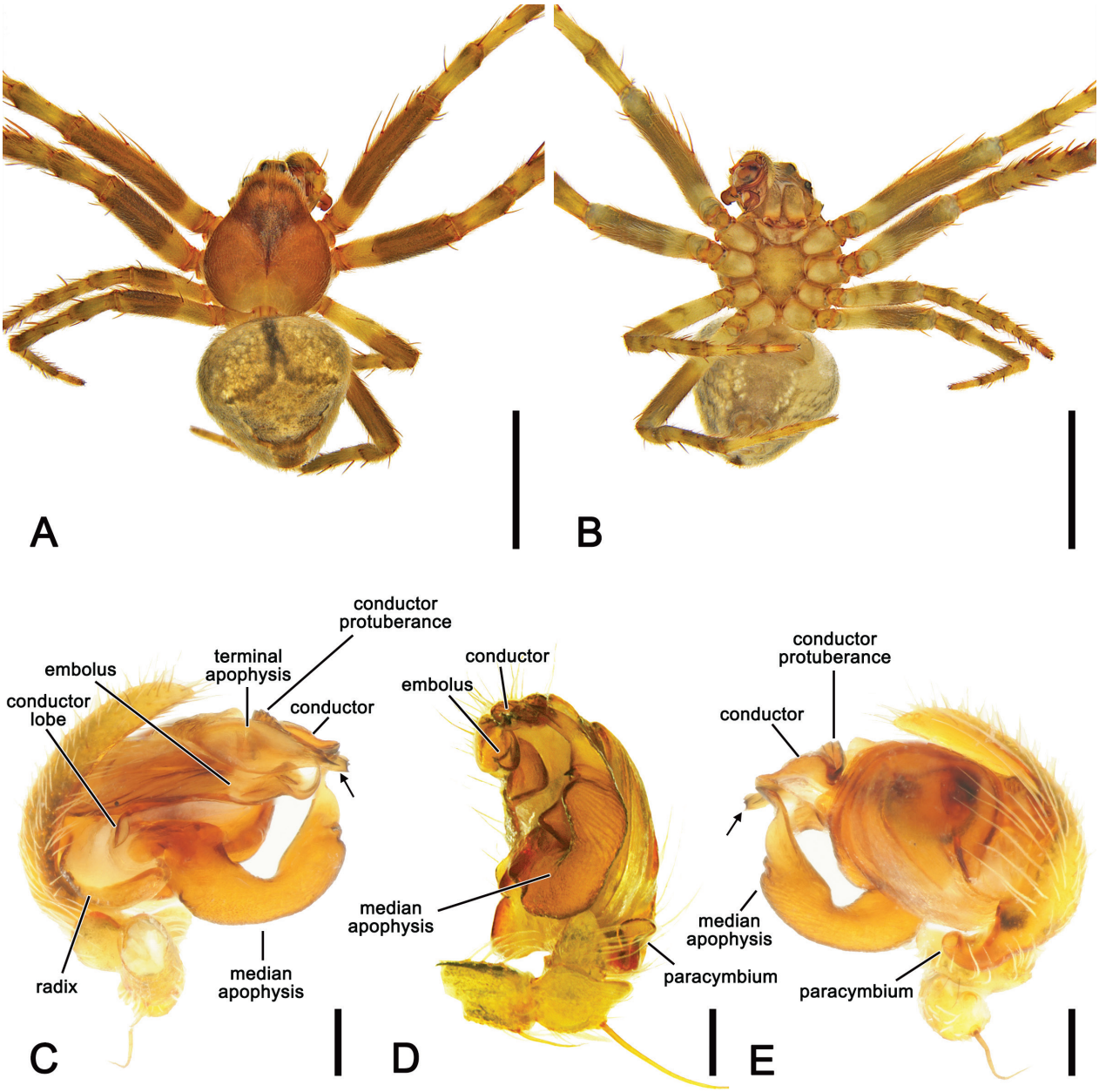

Figure 6. *Kangaraneus amblycyphus* (Simon, 1908) comb. nov., male (AM KS.131277). **A.** Dorsal habitus; **B.** Ventral habitus; **C.** Left pedipalp, ventral view; **D.** Left pedipalp, retrolateral view; **E.** Left pedipalp, dorsal view. Scale bars: 2 mm (**A, B**); 0.2 mm (**C–E**). Arrow points to the conductor basal protrusion.

Creek, 33°42'S, 151°05'E (AM KS.91125); • 1 female, same data (AM KS.91105); • 1 female, Howes Valley, 32°51'S, 150°51'E (AM KS.34043); • 1 male, Jamberoo Mountain, 34°40'S, 150°43'E (AM KS.54098); • 2 females, Scheyville, 33°36'S, 150°53'E (AM KS.98752); • 1 female, same data (AM KS.131276); • 1 female, Sydney, 33°53'S, 151°13'E (NHM 1890.7.1.4139; paralectotype of *K. arenaceus* comb. nov.); • 1 female, 3 juveniles, Wilson River Flora Reserve, Bellangry State Forest, 31°18'S, 152°29'E (AM KS.9666); **Queensland** • 1 female, Braemar State Forest, 27°13'S, 150°50'E (QM); • 1 male, same locality (QM); • 1 male, 6 juveniles, same locality (QM); • 1 female, 1 juvenile, Camira, 27°38'S, 152°55'E (QM S2462); • 5 females, same locality (QM); • 2 males, Malanda, SW, Lot 2, Meragallan Road, 17°25'S, 145°32'E (AM KS.86086); • 1 male, same data (AM KS.131277); • 1 male, Mt Lewis, 16°35'S, 145°17'E (QM); • 1 male, Mulgowie, 27°43'S, 152°22'E (QM); • 1 female, Tweed River, 28°18'S, 153°27'E (AM KS.32649); **South Australia** • 2 females, Dudley Conservation Park, Kangaroo Island, 35°48'S, 137°51'E, (SAM); **Victoria** • 1 female, German Creek, near Bright, 36°43'S, 147°02'E (QM); • 2 females, Snobs Creek, 37°15'S, 145°52'E (MV K-9440). **Western Australia:** • 2 males, 5 females, Stirling Range National Park, Moingup Spring, 34°24'S, 118°06'E (WAM T74424).

Diagnosis. Male *K. amblycyphus* comb. nov. can be distinguished from those of the very similar *K. arenaceus*

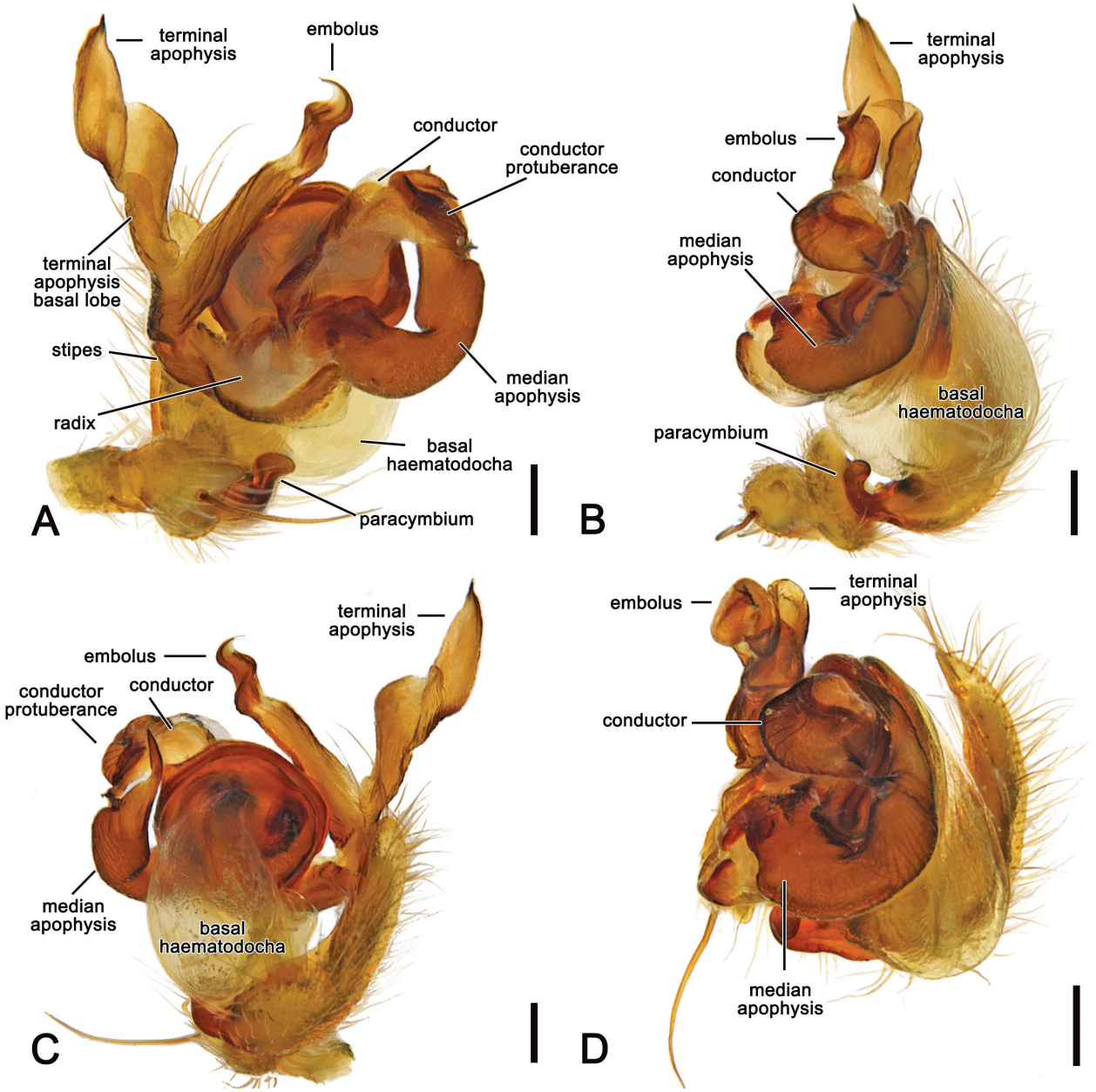

Figure 7. *Kangaraneus amblycyphus* (Simon, 1908) comb. nov., male expanded left pedipalp (AM KS.131277). **A.** Ventral view; **B.** Retrolateral view; **C.** Dorsal view; **D.** Apical view. Scale bars: 0.2 mm.

comb. nov. by the double central protrusion on the median apophysis, the bubble-shaped terminal apophysis, and the shorter and thicker basal protrusion of the conductor with a lamellar apical protuberance (Figs 6A–E, 7A–D). Females of *K. amblycyphus* comb. nov. can be differentiated from those of other *Kangaraneus* gen. nov. species by the epigyne scape not entirely covering the atrium (Fig. 8A, C).

Redescription. Male (based on AM KS.131277). Total length 5.8. Carapace 2.6 long, 2.4 wide, light brown, anteriorly darker (Fig. 6A). Eye diameter AME 0.12, ALE 0.11, PME 0.15, PLE 0.13; row of eyes: AME 0.54, PME 0.46, PLE 1.0. Chelicerae light brown, basally mottled dark brown; with four promarginal teeth (second from base largest) and three retromarginal teeth of similar size. Legs light brown, mottled in dark brown mainly on femora (Fig. 6A, B). Leg length of segments (femur + patella + tibia + metatarsus + tarsus = total length): I – 2.9 + 1.4 + 2.9 + 2.2 + 1.2 = 10.6, II – 1.9 + 1.2 + 2.3 + 1.8 + 1.1 = 8.3, III – 1.0 + 0.9 + 1.2 + 1.0 + 0.8 = 4.9, IV – 1.6 + 1.1 + 1.5 + 1.4 + 0.8 = 6.4. Labium 0.30 long, 0.43 wide, yellowish brown; maxillae yellowish brown (Fig. 6B). Sternum 1.0 long, 0.9 wide, light brown with black radial shading (Fig. 6B). Abdomen 2.8 long, 2.8 wide, oval with inconspicuous shoulder humps; dorsum with beige background and large olive-grey, irregular folium bordered anteriorly and posteriorly by brown bands, laterally beige with dark streaks (Fig. 6A); venter olive-grey, laterally with two pale bands (Fig. 6B). Pedipalp (Figs 6C–E, 7A–D) length of segments (femur + patella + tibia + cymbium

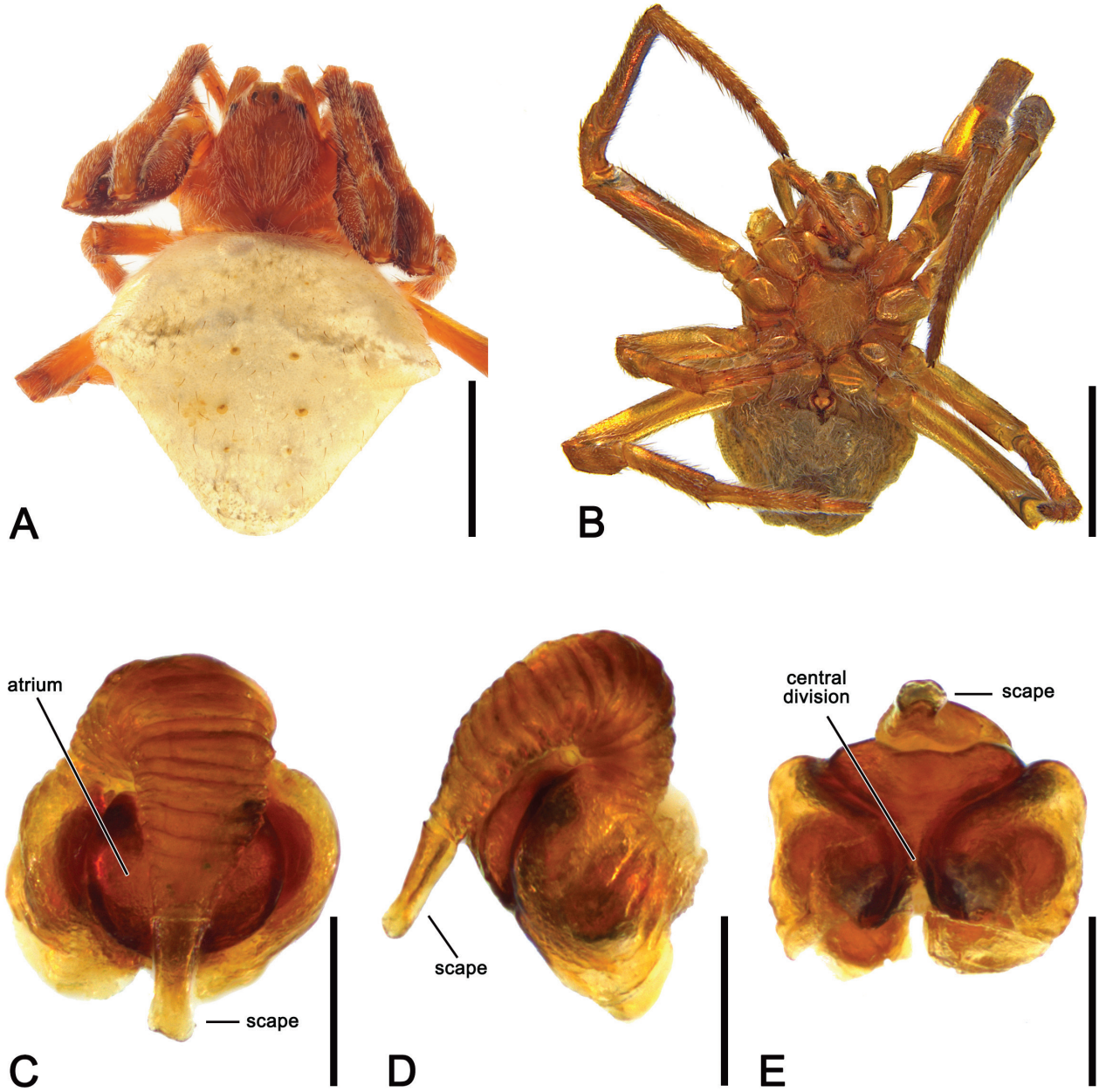

Figure 8. *Kangaraneus amblycyphus* (Simon, 1908) comb. nov., female, (AM KS.131276). **A.** Dorsal habitus; **B.** Ventral habitus; **C.** Epigyne, ventral view; **D.** Epigyne, lateral view; **E.** Epigyne, posterior view. Scale bars: 2 mm (**A, B**); 0.2 mm (**C–E**).

= total length): 0.7+ 0.2 + 0.3 + 1.1 = 2.3; paracymbium short, hook-like and slightly curved apically; median apophysis C-shaped, terminating in an acute tip, central protrusion accompanied by smaller bulge apically; radix comparatively slim; terminal apophysis elongate, slightly inflated and bubble-shaped, terminating in an acute spine-like tip; basal conductor lobe large; conductor prominent, bearing a strong protrusion tapering to a bifid tip; embolus short and elongate, heavily sclerotised with its tip curved apically.

Female (based on AM KS.131276): Total length 5.8. Carapace 2.7 long, 2.6 wide; dark brown, (Fig. 8A). Eye diameter AME 0.09, ALE 0.08, PME 0.10, PLE 0.07; row of eyes: AME 0.46, PME 0.41, PLE 1.15. Chelicerae dark brown, four promarginal teeth (second basal largest) and three retromarginal teeth of similar size. Legs brown with yellowish setae (Fig. 8A, B). Pedipalp length of segments (femur + patella + tibia + tarsus = total length): 0.9 + 0.5 + 0.7 + 0.8 = 2.9. Leg length of segments (femur + patella + tibia + metatarsus + tarsus = total length): I – 3.4 + 1.5 + 2.8 + 2.2 + 1.0 = 10.9, II – 3.4 + 1.4 + 2.7 + 2.2 + 1.1 = 10.8, III – 1.7 + 0.9 + 1.4 + 1.0 + 0.7 = 5.7, IV – 2.4 + 1.1 + 1.5 + 1.4 + 0.8 = 7.2. Labium 0.22 long, 0.49 wide, beige; maxillae beige (Fig. 8B). Sternum 1.3 long, 1.2 wide, dark brown, with yellow streaks (Fig. 8B). Abdomen 3.9 long, 5.4 wide; dorsum with two conspicuous shoulder humps, uniformly beige with indistinct darker line between humeral humps (Fig. 8A); venter dark olive grey (Fig. 8B). Epigyne base almost circular, slightly wider than long, with large and elevated borders (Fig. 8C); central division

narrow (Fig. 8E); scape elongate, longer than the epigyne base, with broad wrinkled base (Fig. 8C, D); spermathecae oval, almost as long as half of the epigyne length, copulatory ducts C-shaped and heavily sclerotised, copulatory openings near the base of scape (Fig. 4C, D).

Variation. Males total length 3.2–5.8 (n = 4); females total length 3.5–6.0 (n = 7). There was little colour variation in male *K. amblycyphus* comb. nov. Some female specimens had a large white patch completely covering the ventral part of abdomen and/or a rounded white patch in the cardiac area, similar to males of *K. arenaceus* comb. nov. and *K. farhani* sp. nov.

Remarks. There are only two syntypes for this species, one female deposited in Paris (MNHN 13309) and a juvenile deposited in Berlin (ZMB 13485), both from the type-locality of Busselton (Western Australia). We here designate the female as the lectotype of this species as the juvenile cannot be unequivocally identified and may be *K. arenaceus* comb. nov., which also occurs in Western Australia.

Life history and habitat preferences. Mature specimens of *K. amblycyphus* comb. nov. were mainly collected between September and December with few specimens collected in February and April; the species therefore appears to be spring to early summer mature.

Habitat descriptions on the labels include "cypress and brigalow" and "*Callitrus*"; the species was also found in a "wasp nest".

Distribution. The distribution of *K. amblycyphus* comb. nov. is very similar to that of *K. arenaceus* comb. nov. although it has been found much further north in Queensland. It occurs in all Australian states except Northern Territory and Tasmania (Fig. 12).

Kangaraneus farhani sp. nov.

https://zoobank.org/CD0DBA93-E176-468F-B6C0-238ED30A6FF0

Figs 9A–E, 10A–D, 11A–F, 12

Type-material. ***Holotype*** male, Frankston (38°09'S, 145°08'E, Victoria, AUSTRALIA), 25 September 1947 (MV K-9854).

Other material examined. AUSTRALIA – **Australian Capital Territory** • 2 females, Corin Dam, 35 km W Canberra, 35°34'S, 148°50'E (AM KS.33511). **New South Wales** • 1 female, Barrington Tops, 32°01'S, 151°29'E (MV K-9814); • 2 males, Jamberoo Mountain, 34°40'S, 150°43'E (AM KS.54090, KS.56902); • 2 females, same locality (AM KS.54096, KS.56898); • 1 female, Jenolan Caves, 33°49'S, 150°01'E (AM KS.32648); • 2 females, New England National Park, 30°29'S, 152°30'E (QM); • 1 female, Newnes State Forest, Sunnyside Road, 1.6 km from Blackfellows Hand Road, 33°22'S, 150°11'E (AM KS.93211). **South Australia** • 1 female, Mylor, 35°03'S, 138°46'E (SAM); • 1 female, Ravine des Casoars, Kangaroo Island, 35°48'S, 136°45'E (SAM). **Tasmania** • 1 female, King Island, 39°53'S, 143°54'E (MV K-9468); • 3 females, Launceston, 41°27'S, 147°10'E (AM KS.28590); • 1 female, same locality (AM KS.28697); • 1 male, 2 females, same locality (AM KS.28545); • 1 female, same locality (AM KS.131278); • 1 female, Lees Paddocks, 41°50'S, 146°06'E (QVMAG 13:0529); • 2 females, Lilydale, 41°15'S, 147°13'E (AM KS.8524); • 1 female, Maggs Mountain, 41°44'S, 146°10'E (QVMAG 13:0634); • 1 female, Picton area, 43°09'S, 146°38'E (MV K-10379); • 1 male, Ringarooma River, Gladstone, 40°57'S 148°01'E (QM S90595); • 1 female, Risdon, 42°49'S, 147°19'E (AM KS.28839); • 1 female, 2 juveniles, Southport, 43°25'S, 146°58'E (AM KS.28870); • 1 female, Stanley, 1 Ford St, 40°46'S, 145°17'E (QVMAG 13:0582); • 1 female, same locality (QVMAG 13:0584); • 1 female, Strahan, 42°09'S, 145°19'E (AM KS.34086). **Victoria** • 1 female, no exact locality (MV K-10377); • 1 female, Camberwell, 37°50'S, 145°4'E (MV K-10375); • 2 females, Frankston, 38°09'S, 145°08'E (MV K-10378); • 1 female, Macclesfield, 37°53'S, 145°29'E (MV K-10376); • 3 females, Narracan, 38°15'S, 146°13'E (MV K-10374).

Etymology. The specific name is a patronymic in honour of Farhan Bokhari, a colleague at the Harry Butler Institute (Murdoch University).

Diagnosis. Male *K. farhani* sp. nov. can be distinguished from the other two species of the genus by the central protrusion of the median apophysis being much longer, somewhat blade-like and heavily sclerotised (Figs 9C, D, 10A, B). Females can be differentiated from the other two *Kangaraneus* gen. nov. species by the truncated tip of the epigyne scape (tapering in the other two species) (Fig. 11D–F). *Kangaraneus farhani* sp. nov. is the only species in which females were found with a broken off scape exposing a distinct, shallowly V-shaped posterior edge of the atrium (Fig. 10C).

Description. Male (based on holotype MV K-9854). Total length 5.8. Carapace 3.6 long, 3.1 wide, light brown, slightly lighter in cephalic area (Fig. 9A). Eye diameter AME 0.23, ALE 0.18, PME 0.18, PLE 0.16; row of eyes: AME 0.64, PME 0.43, PLE 1.17. Chelicerae light brown, basally mottled dark; with three promarginal teeth (median largest) and two retromarginal teeth of similar size. Legs light brown, patched in beige on the base of femur (Fig. 9A, B). Leg length of segments (femur + patella + tibia + metatarsus + tarsus = total length): I – 3.9 + 1.3 + 2.6 + 2.9 + 1.2 = 11.9, II – 3.7 + 1.3 + 3.2 + 2.2 + 1.0 = 11.4, III – 2.2 + 0.8 + 1.6 + 1.0 + 0.5 = 6.1, IV – 3.2 + 0.7 + 1.8 + 2.0 + 1.0 = 8.7. Labium 0.39 long, 0.52 wide, light brown; maxillae light brown (Fig. 9B). Sternum 1.6 long, 1.2 wide, light brown with black contour (Fig. 9B). Abdomen 3.1 long, 3.1 wide, with conspicuous humeral humps; dorsum olive-grey, with short, pale longitudinal patch anteriorly and a dark, heart-shaped patch posteriorly, demarcated by a pale line (Fig. 9A); venter olive-brown with irregular light streaks (Fig. 9B). Pedipalp (Figs 9C–E, 10A–D) length of segments (femur + patella + tibia + cymbium = total length): 0.7+ 0.4 + 0.6 + 1.3 = 3.0; paracymbium strong and hook-like, curved apically; median apophysis C-shaped, tapering to an acute

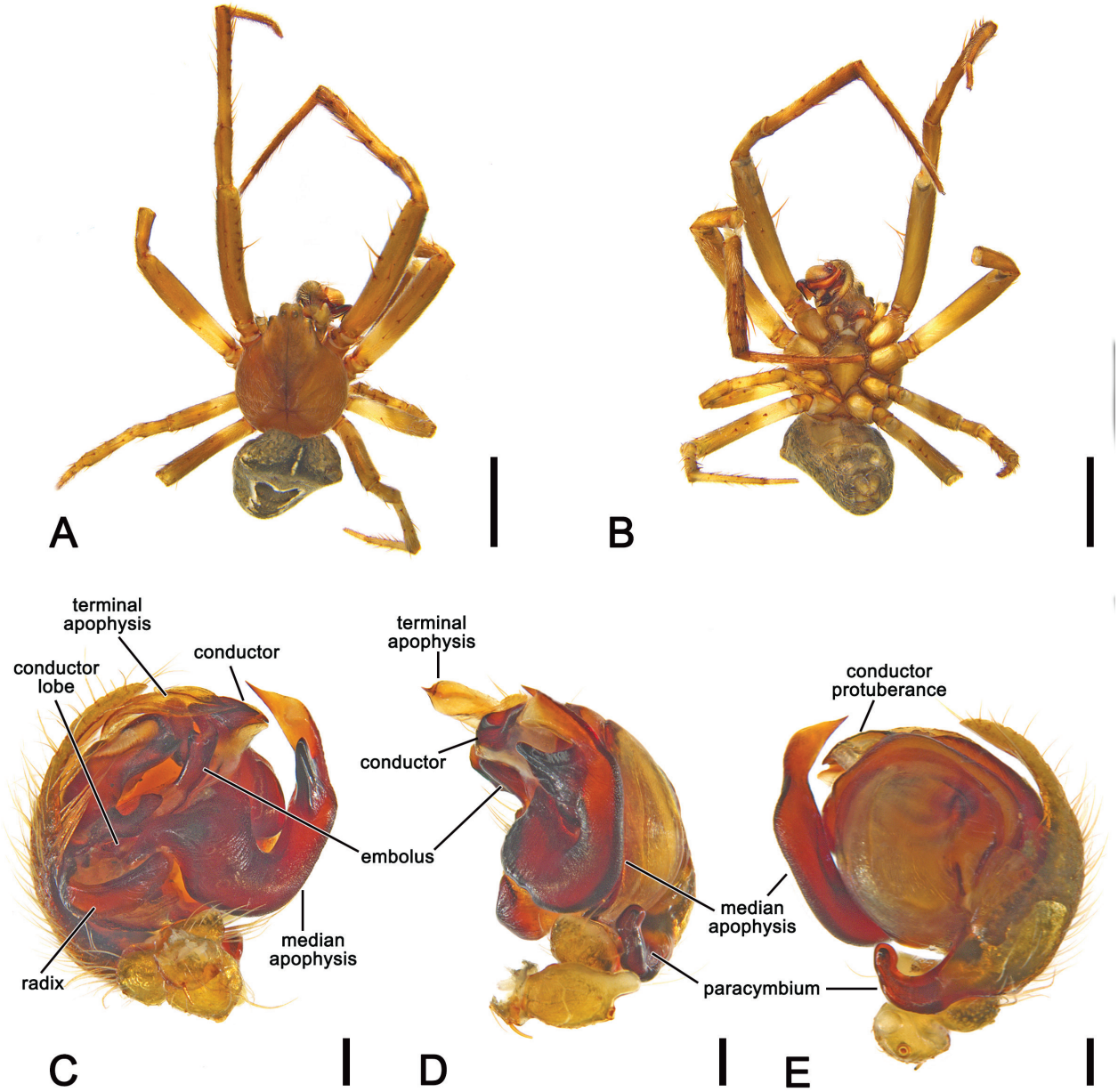

Figure 9. *Kangaraneus farhani* sp. nov., male holotype (MV K-9854). **A.** Dorsal habitus; **B.** Ventral habitus; **C.** Left pedipalp, ventral view; **D.** Left pedipalp, retrolateral view; **E.** Left pedipalp, dorsal view. Scale bars: 2 mm (**A, B**); 0.2 mm (**C–E**).

tip, central protrusion elongate, heavily sclerotised; radix canoe-shaped; terminal apophysis elongate, lanceolate, tapering to an acute tip; basal conductor lobe conspicuous, heavily sclerotised; conductor triangular, bearing a membranous apical protuberance and a short basal protrusion with a bifid tip; embolus heavily sclerotised with its tip curved apically.

Female (based on AM KS.54096): Total length 10.4. Carapace 3.7 long, 3.6 wide; colouration as in male (Fig. 11A). Eye diameter AME 0.13, ALE 0.11, PME 0.12, PLE 0.10; row of eyes: AME 0.51, PME 0.43, PLE 1.28. Chelicerae brown, four promarginal teeth (apical and third largest) and three retromarginal teeth of similar size. Legs light brown with covered in setae (Fig. 11A, B). Pedipalp length of segments (femur + patella + tibia + tarsus = total length): 1.3 + 0.5 + 0.8 + 1.7 = 4.3. Leg length of segments (femur + patella + tibia + metatarsus + tarsus = total length): I – 4.4 + 2.0 + 3.8 + 3.0 + 1.7 = 14.9, II – 3.9 + 1.8 + 3.3 + 2.6 + 1.4 = 13.0, III – 2.5 + 1.1 + 1.6 + 1.5 + 1.0 = 7.7, IV – 3.8 + 1.3 + 2.2 + 2.3 + 1.2 = 10.8. Labium 0.56 long, 0.89 wide, light brown; maxillae light brown (Fig. 11B). Sternum 2.0 long, 1.8 wide, colouration as in male (Fig. 11B). Abdomen 7.9 long, 6.7 wide; dorsum with two conspicuous humeral humps, golden brown with brown band between humeral humps (Fig. 11A); venter olive-grey with indistinct pale lateral bands (Fig. 11B). Epigyne base rounded, wider than long, with large and elevated borders including a V-shaped posterior rim (Fig. 11C, D); atrium convex (Fig. 11C, E, F); central division wide (Fig. 11F); scape slightly longer than wide, longer than the epigyne base, with rounded bulged base,

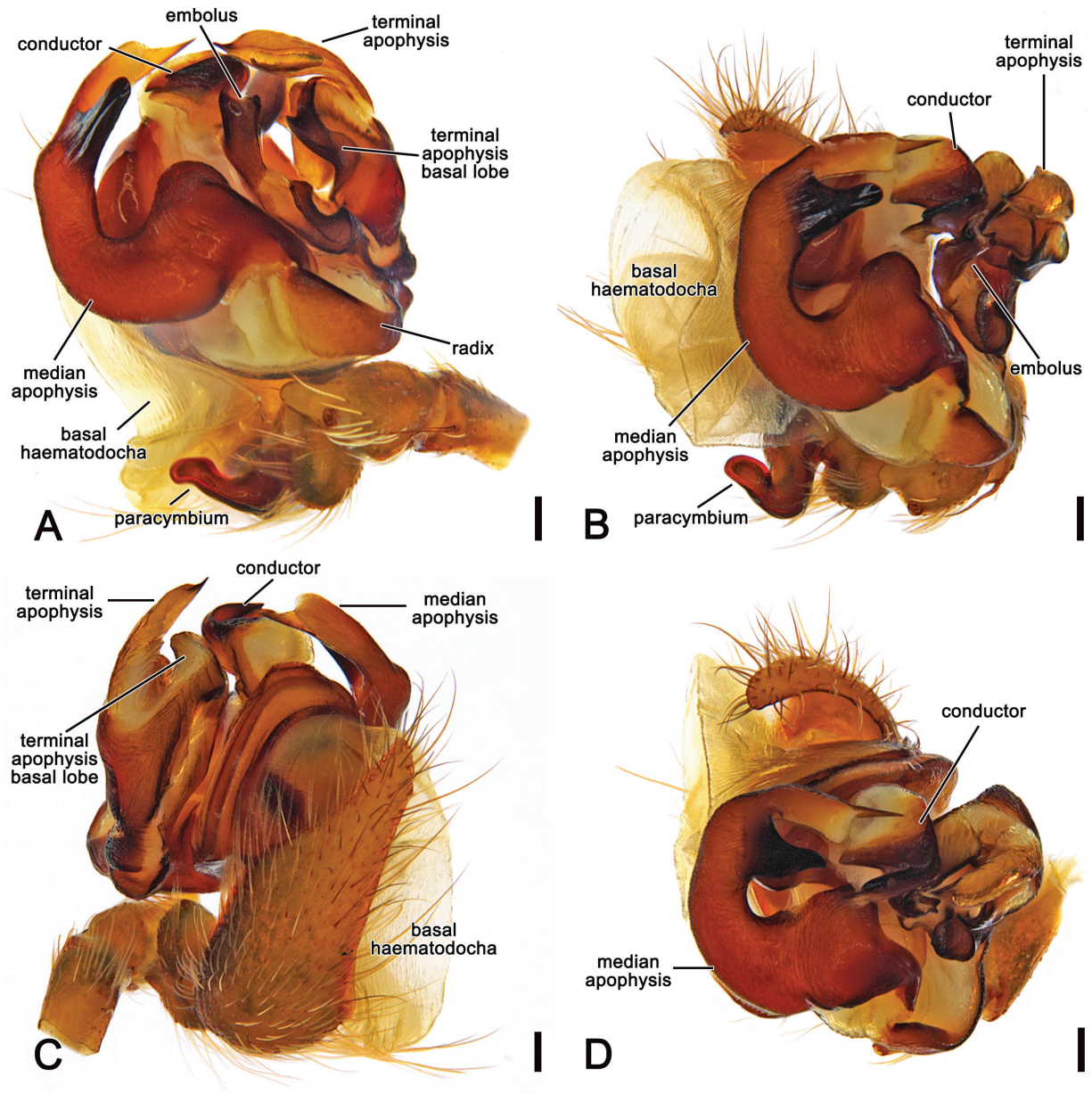

Figure 10. *Kangaraneus farhani* sp. nov., male expanded right pedipalp (AM KS.56902). **A.** Ventral view; **B.** Retrolateral view; **C.** Dorsal view; **D.** Apical view. Scale bars: 0.2 mm.

apically truncated (Fig. 11D, E); spermathecae oval, located basally on the genital plate, copulatory ducts short (Fig. 4E, F).

Variation. Males total length 5.6–5.8 (n = 2); females total length 6.3–10.4 (n = 8). Males display similar colour variations to *K. arenaceus* comb. nov. with one specimen having a large white patch in the cardiac area. Females do not display much colour variation, but half had the epigyne scape broken off.

Life history and habitat preferences. Mature specimens of *K. farhani* sp. nov. were collected between July and early December, except for one female collected in February. The species therefore seems to be largely winter- to spring mature.

Kangaraneus farhani sp. nov. generally appears to build its web low in grass, with original labels reading "among grass in garden", "garden", "orb-web near ground", "in grass at side of creek".

Distribution. *Kangaraneus farhani* sp. nov. occurs in south-eastern mainland Australia (Australian Capital Territory, New South Wales, South Australia, Victoria) and Tasmania (Fig. 12).

Discussion

We here consider *Kangaraneus* gen. nov. to be the twelfth genus within the backobourkiines sensu Scharff et al. (2020) due to the presence of a single patellar macroseta and the median apophysis forming an arch of the radix (Table 1). However, this placement remains ambiguous. Genital morphology, in particular that of the male pedi-

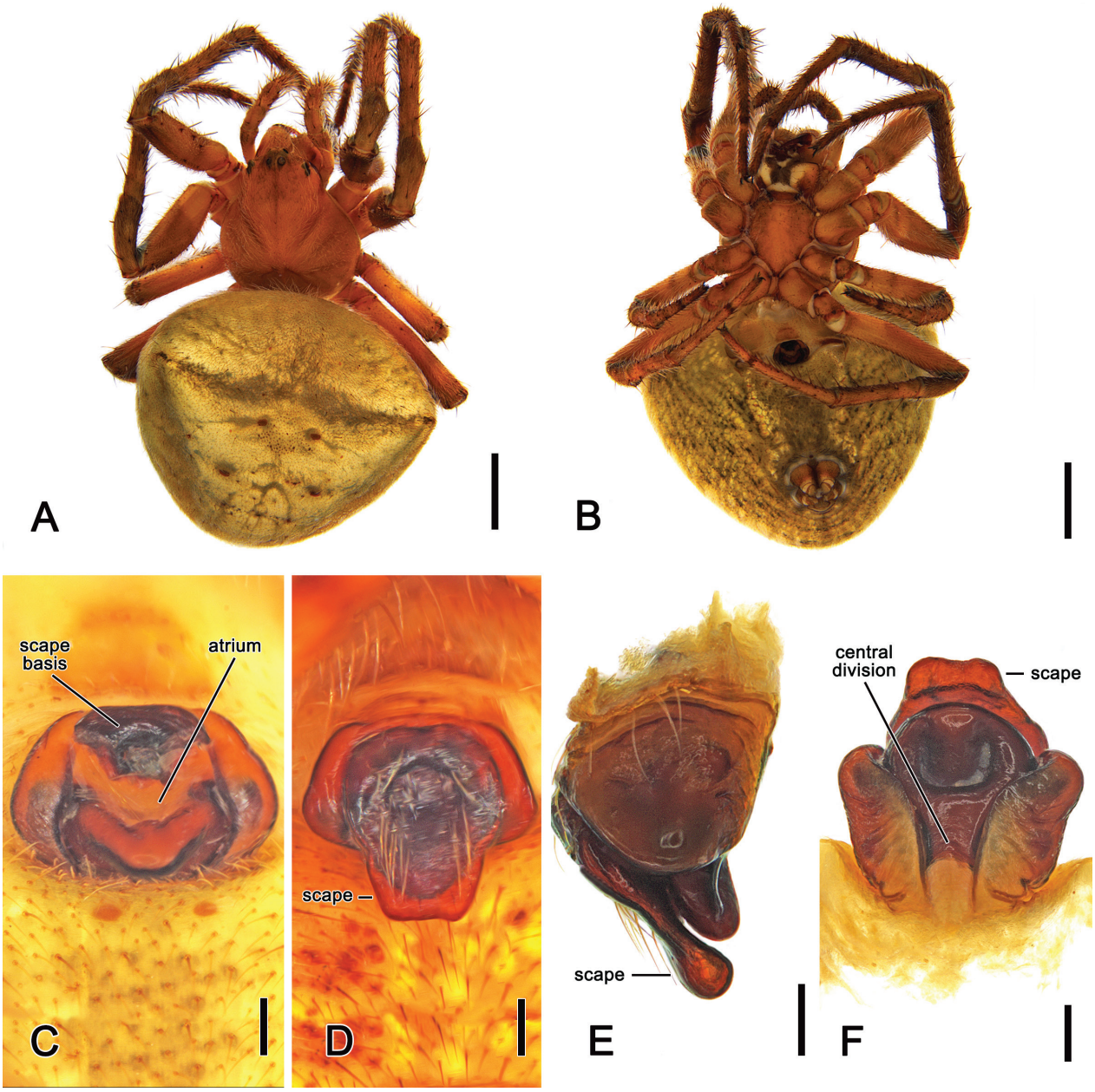

Figure 11. *Kangaraneus farhani* sp. nov., female. **A.** Dorsal habitus (AM KS.54096); **B.** Ventral habitus (AM KS.54096); **C.** Broken epigyne, ventral view (AM KS.54096); **D.** Epigyne, with scape, ventral view (AM KS. 131278); **E.** Epigyne, lateral view (AM KS.131278); **F.** Epigyne posterior view (AM KS. 131278). Scale bars: 2 mm (**A, B**); 0.2 mm (**C–F**).

palp, is most similar to that of *Quokkaraneus necopinus* (Keyserling, 1887), but that species was not recovered in the backobourkiines in Scharff et al. (2020); it was basal in their ARA-clade with the exception of 'caerostrines', phylogenetically far removed from the backobourkiines. However, Scharff et al. (2020; p. 16) stressed the preliminary aspect of their phylogenetic hypothesis: "*Little can be concluded other than araneid phylogeny remains a work in progress to be pursued with more data and more taxa.*" The same is true for the backobourkiines and their putative members (Table 1). More comprehensive phylogenetic analyses are required to elucidate their relationships and interpret the evolution of morphological characters, including genitalia.

The distribution patterns of *K. arenaceus* comb. nov. and *K. amblycyphus* comb. nov. are very similar, and there are several localities where both species were found together, even simultaneously (Busselton, Western Australia; Braemar State Forest, Queensland; Dudley Conservation Park, South Australia; Sydney, New South Wales). This made initial matching of sexes difficult. However, as multiple males and females of each species as diagnosed here were found together in several localities (Shannon and Sterling Range National Parks, Western Australia; Hornsby, Waitara Creek, New South Wales; Braemar State Forest, Queensland), we consider the results of our taxonomic revision the most likely match for males and females of *K. arenaceus* comb. nov. and *K. amblycyphus*

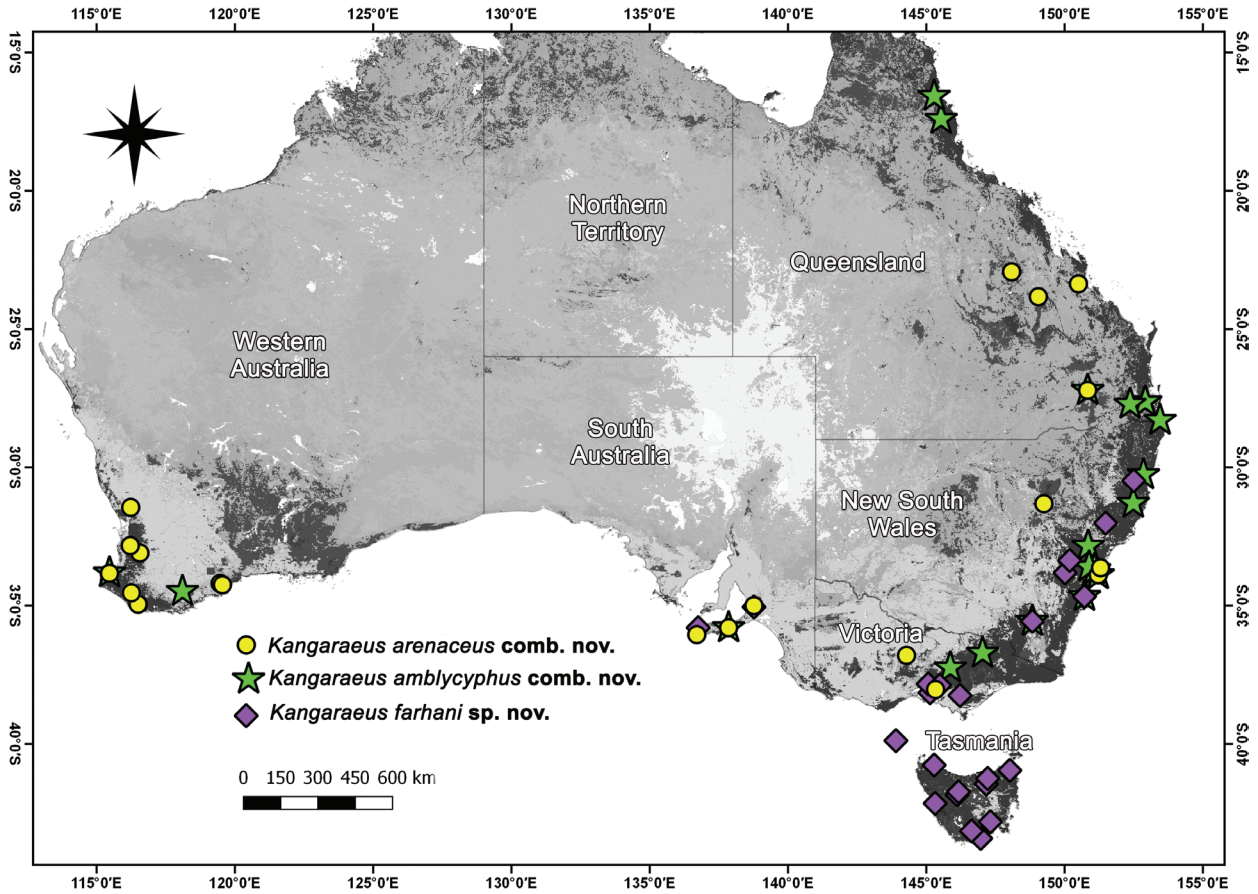

Figure 12. Distribution records of *Kangaraneus* comb. nov. species.

comb. nov. Our species diagnoses have been compiled based on best evidence and by arachnologists highly experienced in araneoid taxonomy. However, there remains the remote possibility that either males and females are matched incorrectly or, alternatively and even less likely, that male and female genitalia in these species are highly variable and both represent the same species. Future molecular analyses could confirm the matching and therefore the distribution patterns of these species.

Acknowledgements

We thank (in no particular order) Peter Lillywhite, Joseph Schubert, Catriona McPhee, Ken Walker, Richard Marchant, Simon Hinkley (NMV), Robert Raven (retired), Owen Seeman, Jeremy Wilson, Michael Rix (QM), John Douglas (retired) (QVMAG), David Hirst (retired), Matthew Shaw (SAM), Graham Milledge (retired), Helen Smith (AM), and Mark Harvey and Julianne Waldock (WAM), for the loan of specimens in their care and/or assistance when visiting their respective institutions. We also thank Christine Rollard and Yvan Montardi for sharing images of the *K. amblycyphus* comb. nov. lectotype. Janet Beccaloni and Nikolaj Scharff hosted both authors at a number of occasions in London and Copenhagen, respectively. Nikolaj also provided in-depth insights into araneid phylogeny and systematics.

Funding for revisions of the Australian Araneidae was provided by the Australian Biological Resources Study (ABRS) (grant no. 205-24 [2005–2008] to VWF and N. Scharff and grant number 4-EHPVRMK [2021–2023] to VWF, PSC, N. Scharff, D. Dimitrov, A. Chopra and R. Baptista). Additional funding was provided by a Synthesis project grant (GB-TAF-TA3-008) to PdSC to visit the NHMUK in London.

References

Bonnet P (1955) Bibliographia araneorum. Analyse méthodique de toute la littérature aranéologique jusqu'en 1939. Tome II. Systématique des araignées (Étude par ordre alphabétique) [1re partie: A–B]. Douladoure, Toulouse, 1–918.

Castanheira P de S, Framenau VW (2022) *Quokkaraneus*, a new monotypic genus of Australian orb-weaving spider (Araneae, Araneidae). Australian Journal of Taxonomy 10: 1–9. https://doi.org/10.54102/ajt.a7oq2

Castanheira P de S, Framenau VW (2023) *Abba*, a new monotypic genus of orb-weaving spiders (Araneae, Araneidae) from Australia. Evolutionary Systematics 7(1): 73–81. https://doi.org/10.3897/evolsyst.7.98015

Ferreira-Sousa L, Motta PC (2022) Diagnostic notes on the spider orb-weaving genera *Carepalxis* and *Ocrepeira* (Araneae: Araneidae), with description of three new species from Central Brazil. Zootaxa 5087(2): 389–399. https://doi.org/10.11646/zootaxa.5087.2.9

Framenau VW (2011) *Lariniophora*, a new monotypic orb-weaving spider genus from Australia (Araneae: Araneidae: Araneinae). Records of the Western Australian Museum 26(2): 191–201. https://doi.org/10.18195/issn.0312-3162.26(2).2011.191-201

Framenau VW, Castanheira P de S (2022) Revision of the new Australasian orb-weaving spider genus *Salsa* (Araneae, Araneidae). ZooKeys 1102: 107–148. https://doi.org/10.3897/zookeys.1102.82388

Framenau VW, Kuntner M (2022) The new Australian leaf-curling orb-weaving spider genus *Leviana* (Araneae, Araneidae). Evolutionary Systematics 6(2): 103–133. https://doi.org/10.3897/evolsyst.6.83573

Framenau VW, Dupérré N, Blackledge TA, Vink CJ (2010) Systematics of the new Australasian orb-weaving spider genus *Backobourkia* (Araneae: Araneidae: Araneinae). Arthropod Systematics & Phylogeny 68: 79–111.

Framenau VW, Baptista RLC, Oliveira FSM, Castanheira P de S (2021a) Taxonomic revision of the new spider genus *Hortophora*, the Australasian Garden Orb-weavers (Araneae, Araneidae). Evolutionary Systematics 5(2): 275–334. https://doi.org/10.3897/evolsyst.5.72474

Framenau VW, Vink CJ, Scharff N, Baptista RLC, Castanheira P de S (2021b) Review of the Australian and New Zealand orb-weaving spider genus *Novakiella* (Araneae, Araneidae). Zoosystematics and Evolution 97(2): 393–405. https://doi.org/10.3897/zse.97.67788

Framenau VW, Castanheira P de S, Vink CJ (2022) Taxonomy and systematics of the new Australo-Pacific orb-weaving spider genus *Socca* (Araneae: Araneidae). New Zealand Journal of Zoology 49: 263–334. https://doi.org/10.1080/03014223.2021.2014899

Joseph MM, Framenau VW (2012) Systematic review of a new orb-weaving spider genus (Araneae: Araneidae), with special reference to the Australasian-Pacific and South-East Asian fauna. Zoological Journal of the Linnean Society 166(2): 279–341. https://doi.org/10.1111/j.1096-3642.2012.00845.x

Kallal RJ, Hormiga G (2018) Systematics, phylogeny and biogeography of the Australasian leaf-curling orb-weaving spiders (Araneae: Araneidae: Zygiellinae), with a comparative analysis of retreat evolution. Zoological Journal of the Linnean Society 184(4): 1055–1141. https://doi.org/10.1093/zoolinnean/zly014

Keyserling E (1886) Die Arachniden Australiens nach der Natur beschrieben und abgebildet. Bauer & Raspe, Nürnberg.

Levi HW (1992) The American species of the orb-weaver genus *Carepalxis* and the new genus *Rubrepeira* (Araneae: Araneidae). Psyche, Cambridge 98(2–3): 251–264. https://doi.org/10.1155/1991/26493

Rack G (1961) Die Entomologischen Sammlungen des Zoologischen Staatsinstituts und Zoologischen Museums Hamburg. 2. Teil, Chelicerata 11: Araneae. Mitteilungen aus dem Hamburgischen Zoologischen Museum und Institut 59: 1–60.

Rainbow WJ (1911) A census of Australian Araneidae. Records of the Australian Museum 9(2): 107–319. https://doi.org/10.3853/j.0067-1975.9.1911.928

Scharff N, Coddington JA (1997) A phylogenetic analysis of the orb-weaving spider family Araneidae (Arachnida, Araneae). Zoological Journal of the Linnean Society 120(4): 355–434. https://doi.org/10.1111/j.1096-3642.1997.tb01281.x

Scharff N, Coddington JA, Blackledge TA, Agnarsson I, Framenau VW, Szűts T, Hayashi CY, Dimitrov D (2020) Phylogeny of the orb-weaving spider family Araneidae (Araneae: Araneoidea). Cladistics 36(1): 1–21. https://doi.org/10.1111/cla.12382

Simon E (1908) Araneae, 1re partie. In: Die Fauna Südwest-Australiens. Ergebnisse der Hamburger südwest-australischen Forschungsreise 1905 (ed. W. Michaelsen, R. Hartmeyer). Verlag von Gustav Fischer, Jena, 359–446.

World Spider Catalog (2023) World Spider Catalog Version 23.5. [Available from:] http://wsc.nmbe.ch [21 April 2023]

Yin CM, Wang JF, Zhu MS, Xie LP, Peng XJ, Bao YH (1997) Fauna Sinica: Arachnida: Araneae: Araneidae. Science Press, Beijing, 460 pp.