



## *Quokkaraneus*, a new monotypic genus of Australian orb-weaving spider (Araneae, Araneidae)

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### Abstract

A new monotypic Australian genus in the orb-weaving spider family Araneidae Clerck, 1757 is described, *Quokkaraneus* **gen. nov.**, with *Q. necopinus* (Keyserling, 1887) **comb. nov.** as type species. Morphologically the new genus has affinities with the Australasian clade informally termed 'backobourkiines', due to the presence of a single patellar macroseta and the median apophysis forming an arch over the radix in the male pedipalp. It distinctly differs from other genera of this clade by somatic characters, such as a unique white cephalic and/or thoracic area and abdomen. Some genitalic characters are also diagnostic amongst the backobourkiines, such as a C-shaped median apophysis with pointed tip, triangular terminal apophysis and prominent concave conductor in males, and a very broad female epigyne scape. *Quokkaraneus necopinus* **comb. nov.** occurs in southern Australia, from western Victoria to south-western Western Australia.

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### Introduction

When Keyserling (1887) described the new Australian araneid orb-weaving spider *Araneus necopinus* (Keyserling, 1887) based on a female collected in south-western Western Australia, he noted a very unusual white colouration of parts of the carapace, mouthparts and abdomen (Keyserling 1887, p. 199). Despite this unusual appearance, *A. necopinus* has not been mentioned in the scientific or popular literature for over 100 years, with

the exception of its listing in Australian or world-wide spider catalogues (e.g., Rainbow 1911, Bonnet 1955, World Spider Catalog 2022).

*Araneus necopinus* was included in a multigene, molecular systematic study on world-wide Araneidae Clerck 1757 (Scharff et al. 2020). The phylogenetic placement of the species in that study, which included many other Australian terminals, appeared to reflect its unusual morphology. The species was placed by itself basal to

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all other araneids with the exception of ‘caerostrines’, Nephilinae Simon, 1894 and Zygellinae Wunderlich, 2004 (= Phonognathinae Simon, 1894) (Scharff et al. 2020; fig. 3A), albeit without statistical support. Based on this placement, the study suggested the species to represent a new genus (‘NGEN09’). This placement, however, was surprising with respect to other Australian araneids included in the analyses, particularly in relation to the informal ‘backobourkiines’ (*sensu* Scharff et al. 2020). *Araneus necopinus* clearly shows the proposed synapomorphies for this informally named clade in that study, i.e. a single patellar macroseta on the male pedipalp and the base of the median apophysis forming an arch over the radix (Scharff et al. 2020; p. 12).

A number of putative backobourkiine genera, such as *Hortophora* Framenau & Castanheira, 2021, *Socca* Framenau, Castanheira & Vink 2022, *Salsa* Framenau & Castanheira, 2022, *Leviana* Framenau & Kuntner, 2022 and others have recently been revised as part of an ongoing study to formalise the clade as a subfamily of the Araneidae based on morphological and molecular data (e.g., Framenau 2011, Joseph and Framenau 2012, Framenau and Castanheira 2021a, 2022, Framenau et al. 2010, 2022a, Framenau and Kuntner 2022). The aim of this study is to establish a new monotypic genus for Scharff et al.’s (2020) ‘NGEN09’ as a testable hypothesis for the systematic placement of its species in our systematic studies on the backobourkiine and related orb-weaving spiders.

## Methods

This study is based on the examination of all orb-weaving spider material in the major Australian museum collections and overseas collections where historical type material is lodged, totalling almost 12,000 records (= vials). No other species morphologically similar to *A. necopinus* that would justify an inclusion in this study was found.

Descriptions and terminology follow recent publications on Australian orb-weaving spiders (e.g., Framenau and Castanheira 2022; Framenau and Kuntner 2022; Framenau et al. 2022a, b). We separated the characters for the genus and species-level descriptions as in the studies on the monotypic *Lariniophora* Framenau, 2011 and *Courtaranus* Framenau, Vink, McQuillan & Simpson, 2022 (Framenau 2011; Framenau et al. 2022b), i.e. genus-level characters described here are those that were shown to be informative at that level by a previous morphological systematic study on the Araneidae (Scharff and Codrington 1997). The generic and species descriptions are based on recently collected specimens as the holotype female of *A. necopinus* from the Bradley Collection is considered lost (Framenau 2005). Colour patterns were described based on specimens preserved in ca. 75% ethanol.

The terminology of the views of the male pedipalp considers their position as a limb. The full view of the bulb

with the cymbium in the background is a retrolateral, not ventral, view as in Araneidae the pedipalp is twisted so that the cymbium is situated mesally. Consistent with our recent papers (e.g., Framenau and Castanheira 2022; Framenau and Kuntner 2022; Framenau et al. 2022a, b), ‘conductor lobe’ is used over ‘paramedian apophysis’ for a structure that arises at the base of the conductor in the male pedipalp (see also Framenau et al. 2010 and Framenau et al. 2021b for additional discussions on this sclerite). The male pedipalp was expanded by alternatively submerging it for around 10 min in 10% KOH and distilled water until fully expanded. The epigyne has two main parts, the base (encapsulating the internal genitalia) and the scape. We refer to the central part of the base in ventral view as an atrium which, in posterior view, becomes the central division.

Microscope photographs were taken with two different stereo-imaging systems. A setup at the Natural History Museum, Copenhagen (Denmark) was used to take images with a Nikon D300 digital SLR camera attached via a C-mount adapter to a Leica M16A stereomicroscope. Images of different focal planes 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 were edited with Photoshop CC 2020.

All measurements are given in millimetres. They were taken with an accuracy of 0.1 mm, with the exception of eye and labium measurements taken with an accuracy of 0.01 mm.

Maps were compiled in the software package QGIS v. 3.2.6 (<https://qgis.org/en/site/>; accessed 14 July 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 14 July 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

*Collections*: AM—Australian Museum, Sydney (Australia); NMV—Museums Victoria, Melbourne (Australia); SAM—South Australian Museum, Adelaide (Australia); WAM—Western Australian Museum, Perth (Australia)

## Discussion

The unique morphological characters of *Quokkaraneus necopinus* **comb. nov.**, including colouration and genital

morphology, and the absence of any synapomorphies of other backbourkiine genera (to which the new genus putatively belongs) justify the erection of a new monotypic genus for this species. No other species with similar morphological features has been found during our extensive examination of Australian orb-weaving spiders. Platnick (1976) and Wiley (1977) provided an interesting philosophical discussion on the existence of monotypy, but irrespective of their then opposing views, monotypic genera are not uncommon in orb-weaving spiders. Amongst recently revised Australian araneid taxa *Cyrtobill* Framenau & Scharff, 2009 and *Lariniophora* are monotypic (World Spider Catalog 2022).

The white colour pattern in *Q. necopinus* **comb. nov.** is unusual for spiders. White spiders occur in crab or flower spiders (Thomisidae Sundevall, 1833), for example *Zygometa xanthogaster* (L. Koch, 1875) and *Thomisus spectabilis* Doleschall, 1859 in Australia (see Framenau et al. 2014 for images of both species). The colouration in these spiders appears cryptic on white flowers, at least to the human eye and indigenous prey, but has been shown to increase foraging success at least in introduced prey (Heiling and Herberstein 2004, Heiling et al. 2003). Five species of rare trapdoor spiders with white carapace in males, colloquially termed 'white-headed trapdoor spiders', were recently described from mid-west Western Australia in the genus *Euoplos* Rainbow, 1914 (Rix et al. 2019). These are the only known trapdoor spiders with such a phenotype. The evolutionary significance of the white colouration in these spiders, which generally lead a cryptic life style in burrows, remains unknown, but it is possible that it increases the reflection of sunlight and aids in preventing desiccation when these males leave their burrow to find a mate. The colouration of females in these species is unknown. Predator avoidance, prey attraction and reduction of water loss may all play a part in the white colouration of *Q. necopinus* **comb. nov.**, but we do not know much about the habits and behaviours of this spider for a more detailed interpretation.

There is discordance between the systematic position of *Q. necopinus* **comb. nov.** as suggested by Scharff et al.'s (2020) molecular study and the genital morphology of the species as described here. Whilst molecular data suggest its basal position in the Araneidae, morphological evidence, i.e. the presence of only a single patellar macroseta and the basal arch of the median apophysis in the male pedipalp, places the genus in the more derived Australasian backbourkiine clade. The latter position is further supported by its biogeography. As a representative of the southern Australian fauna, the species is likely of Australian origin, as are all other known backbourkiines. Similar incongruence of molecular and morphological data is evident in the endemic Australian genus *Leviana*, which also displays the backbourkiine male genitalic traits (see Framenau & Kuntner 2022), but which was placed outside this clade in

Scharff et al. (2020). It is clear that there remain many unresolved problems in araneid systematics, in particular with respect to the Australian fauna. These can only be resolved by further studies, as already clearly stated by Scharff et al. (2020, p. 16): "Little can be concluded other than araneid phylogeny remains a work in progress to be pursued with more data and more taxa."

## Taxonomy

Order ARANEAE Clerck, 1757

Family ARANEIDAE Clerck, 1757

### *Quokkaraneus* gen. nov.

<https://zoobank.org/NomenclaturalActs/8CF06956-C6AC-468D-939C-4FFD9A541B7A>

**Type species.** *Epeira necopina* Keyserling, 1887; by monotypy.

**Etymology.** The genus-group name is a compound noun composed of 'Quokk-' in reference to the Quokka, *Setonix brachyurus* (Quoy & Gaimard 1830), an enigmatic south-west Western Australian marsupial currently listed as Vulnerable (IUCN Red List of Threatened Species), and '-araneus', a genus-group name for orb-weaving spiders. The type locality of *Q. necopinus* **comb. nov.** is Albany, which is within the historical and current range of the Quokka. The gender of the genus-group name *Quokkaraneus* is masculine.

**Diagnosis.** The following apomorphies can be used to diagnose *Quokkaraneus* **gen. nov.**: at least the cephalic area (but often other parts of the body) white (Figs 1A–C, 3A, B); median apophysis of the male pedipalp C-shaped with elongated and pointed tip (Figs 1D, E, 2A–D); terminal apophysis elongated triangular (Fig. 1D), conductor prominent with concave centre and basal elongate rectangular process (Figs 1E, 2A); female epigyne scape basally enlarged and rounded (Fig. 3C).

These characters clearly diagnose *Quokkaraneus* **gen. nov.** from all other orb-weaving spiders, in particular those of the backbourkiines with which it shares the presence of a single patellar macroseta on the male pedipalp and the basal arch of the median apophysis that extends over the radix (Fig. 1D). It lacks any of the synapomorphies of other putative backbourkiine genera, for example (and amongst others) the basal flange of the median apophysis in *Backbourkia* Framenau, Dupérré, Blackledge & Vink, 2010, the elongated abdomen of *Lariniophora* Framenau, 2011, the basally pointing median apophysis in *Novakiella* Court & Forster, 1993, the ventral abdominal Ü-shaped pattern in *Plebs* Joseph & Framenau, 2012, the transverse median apophysis with two apical tips in *Hortophora*, the spine in the basal arch of the median apophysis in *Leviana*, the five posterior abdominal humps in *Socca* and the pale spindle-shaped ventral marks on the abdomen in *Salsa*. Other putative backbourkiine gen-

era such as *Acroaspis* Karsch, 1878, *Carepalxis* L. Koch, 1872 and possibly *Singa* C.L. Koch, 1836 (see Scharff et al. 2020) have not been revised with modern taxonomic methods and a proper diagnosis between *Quokkaraneus gen. nov.* and these genera is not possible. However, the type specimens of these genera have been investigated (see Framenau 2019) and are clearly different to *Quokkaraneus gen. nov.*

**Description.** Medium-sized orb-weaving spiders, with males (ca. TL 5.4–6.0) of similar size as females (ca. TL 5.0 – 7.1). Carapace longer than wide, pear-shaped and with cephalic region slightly narrower in males than in females; cephalic area white to off-white, sometimes extending into thoracic area; thoracic area otherwise light brown to brown (Figs 1A, C, 3A). Fovea longitudinal in males and transverse in females (Figs 1A, C, 3A). Anterior median eyes largest in males, row of posterior eyes recurved, lateral eyes almost touching; posterior lateral eyes largest in females and apart from posterior median eyes by less than their diameter; anterior median eyes slightly protruding from the carapace in both sexes (Figs 1A, C, 3A). Sternum slightly longer than wide, brown with an irregular longitudinal pale median band and covered with sparse setae (Figs 1B, 3B). Labium wider than long, with anterior glabrous pale edge (Figs 1B, 3B). Maxillae with glabrous lighter antero-mesal section (Figs 1B, 3B). Chelicerae fangs with four (females) or three (males) promarginal teeth and three retromarginal teeth in both sexes. Leg formula I > II > IV > III; tibiae of leg II in males only slightly stronger than those of leg I. Abdomen sub-spherical, wider than long, without humeral or other humps; three pairs of small sigillae (median pair largest), abdomen otherwise without specialized setae, condyles or other specific structures; colour dorsally off-white with indistinct or distinct folium pattern and sometimes dark spots (Figs 1A, C, 3A). Venter with irregular brown patch (Figs 1B, 3B).

Male pedipalp patella with a single macroseta (Figs 1D, E, 2A–D); paracymbium hook-shaped (Figs 1E, 2A); median apophysis basally strongest and tapering to its tip, C-shaped with slightly curved and pointed tip, base forming an arch over radix (Figs 1D, 2A–D); radix elongate (Fig. 1A); terminal apophysis elongate triangular with a pointed tip (Fig. 1D); conductor prominent and centrally concave, basally with an elongate rectangular protrusion (Figs 1E, 2 A–D); basal conductor lobe small, spatulate without ventrally bent tip (Fig. 1D); embolus basally elongate rectangular, heavily sclerotized from its median portion, with a curved, uncapped tip (Figs 1D, 2A–C).

Epigyne base oval, wider than long, with narrow lateral borders encircling a wide and convex atrium (Fig. 3C); narrow central division (Fig. 3E); scape basally broadly rounded, sinuous in lateral view and without terminal pocket (Figs 3C–E); spermathecae small ovoid, copulatory ducts situated under the lateral atrium edges (Fig. 3G, H).

## *Quokkaraneus necopinus* (Keyserling, 1887) **comb. nov.**

Figs 1A–E, 2A–D, 3A–H, 4

*Epeira necopina* Keyserling 1887: 198–200, plate 17, figs 7, 7a.

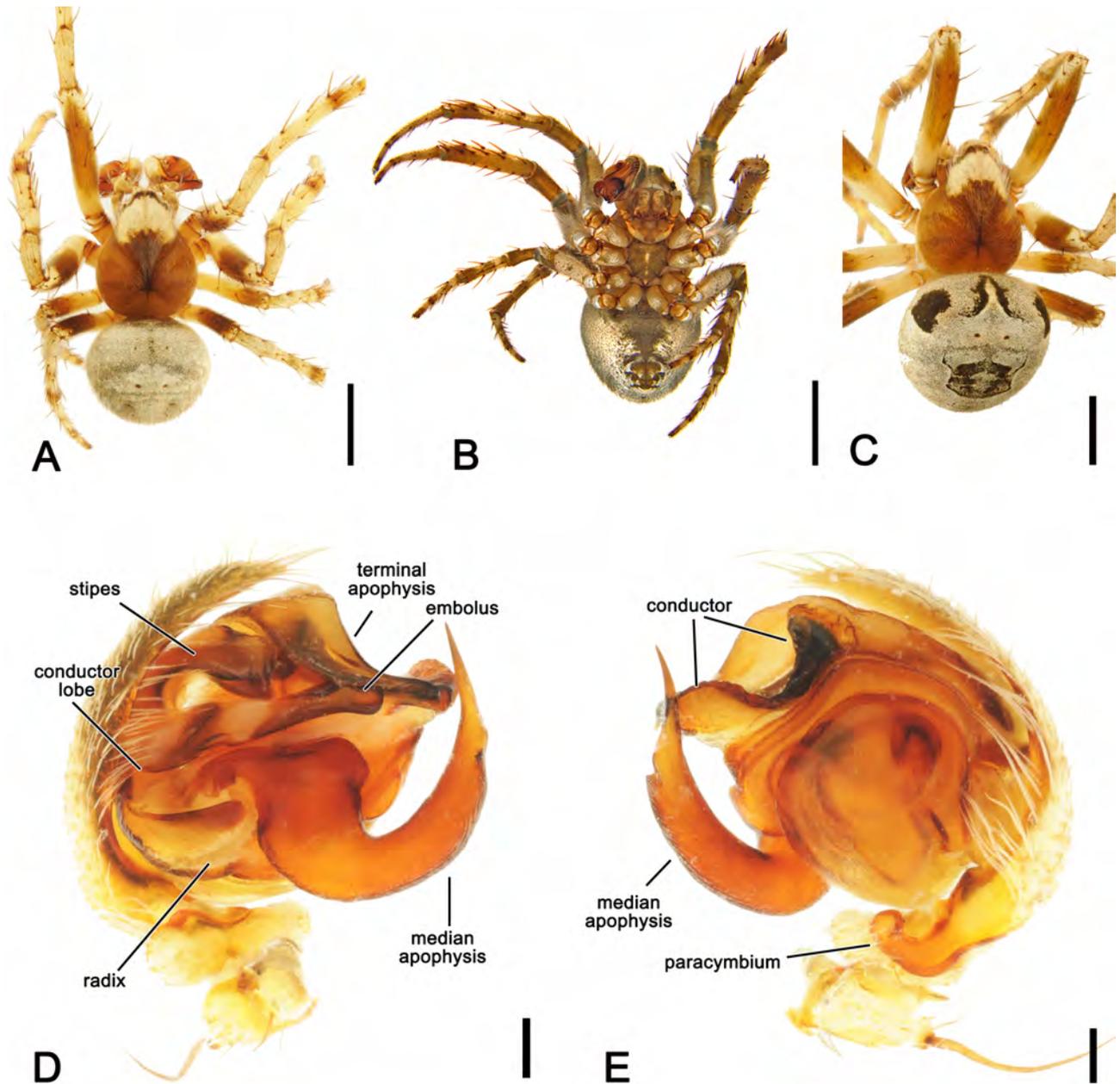
*Araneus neocopinus* (Keyserling, 1887).- Rainbow 1911: 190; Bonnet 1955: 548.

**Type specimen.** Holotype female, King George Sound (today Albany) (ca. 35°02'S, 117°53'E, Western Australia, AUSTRALIA), Bradley Collection (whereabouts unknown; see Framenau 2005). Not examined.

**Other material examined. AUSTRALIA: South Australia:** 1 female, Cape Gantheaume, 1 km N Point Tinline, Kangaroo Island, 35°59'S, 137°37'E, 10.xi.1987, D Hirst coll. (SAM NN30794); 1 male, 2 females, Ferris McDonald Conservation Park, adjacent Garwood Road, 35°13'26"S, 139°07'54"E, 02.x.1998 (SAM NN30795); 1 female, Flinders Chase National Park, Ranger Station, 220 m NW on Shakel Road, Kangaroo Island, 35°56'S, 136°37'E, 01.xii.1982 (SAM. NN30796); 2 females, Kelly Hill Caves camping area, Kangaroo Island, 35°59'S, 136°54'E, 09.xi.1987 (SAM NN30797); 1 female, Lincoln National Park, Woodcutters Beach camping area, 34°47'11"S, 135°44'04"E, 23.ii.2002, G Milledge and H Smith coll. (AM KS.76462); 1 female, Vivonne Bay, Kangaroo Island, 35°58'S, 137°10'E (SAM NN30799); 1 female, Vivonne Bay and Playford Highway, 35°58'S, 137°10'E, 02.xi.1990 (SAM NN30798); 1 female, Woodcutters Beach Campsite, Port Lincoln National Park, 34°47'15"S, 135°54'53"E, 28.xii.2007, VW Framenau and ML Thomas coll. (WAM T81460). **Victoria:** 1 male, 5 females, Broken Bucket Tank, 12.5 km N, 35°53'S, 141°24'E, 03.x.1994 (SAM NN30800); 1 female, Little Desert, 36°33'S, 141°50'E, 01.xi.1949, A Burns coll. (NMV). **Western Australia:** 3 females, near Dalyup, 33°42'S, 121°35'E, 25.viii.1989, AE de Jong coll. (WAM T75389); 1 male, 2 juveniles, Quaalup Homestead, 34°17'S, 119°26'E, 27.v.1994, MS Harvey and JM Waldock coll. (WAM T75386); 1 males, 2 subadult males, same data (WAM T75387); 1 male, same data (WAM T75388); 1 male, same data (WAM T157980); 1 female, same data (WAM T157981).

**Diagnosis.** As for genus; *Quokkaraneus gen. nov.* is monotypic.

**Description.** *Male* (based on WAM T157980): Total length 5.5. Carapace 3.0 long, 2.3 wide, brown, with darker fovea; cephalic area white (Fig. 1A). Eye diameter AME 0.14, ALE 0.10, PME 0.14, PLE 0.09; row of eyes: AME 0.48, PME 0.41, PLE 1.06. Chelicerae light brown, mottled olive grey (Fig. 1B); with three promarginal teeth of similar size and three small retromarginal teeth (apical largest). Sternum 1.3 long, 1.2 wide, olive brown with pale irregular median band (Fig. 1B). Leg femora brown, basally yellow brown; all other segments dorsally largely

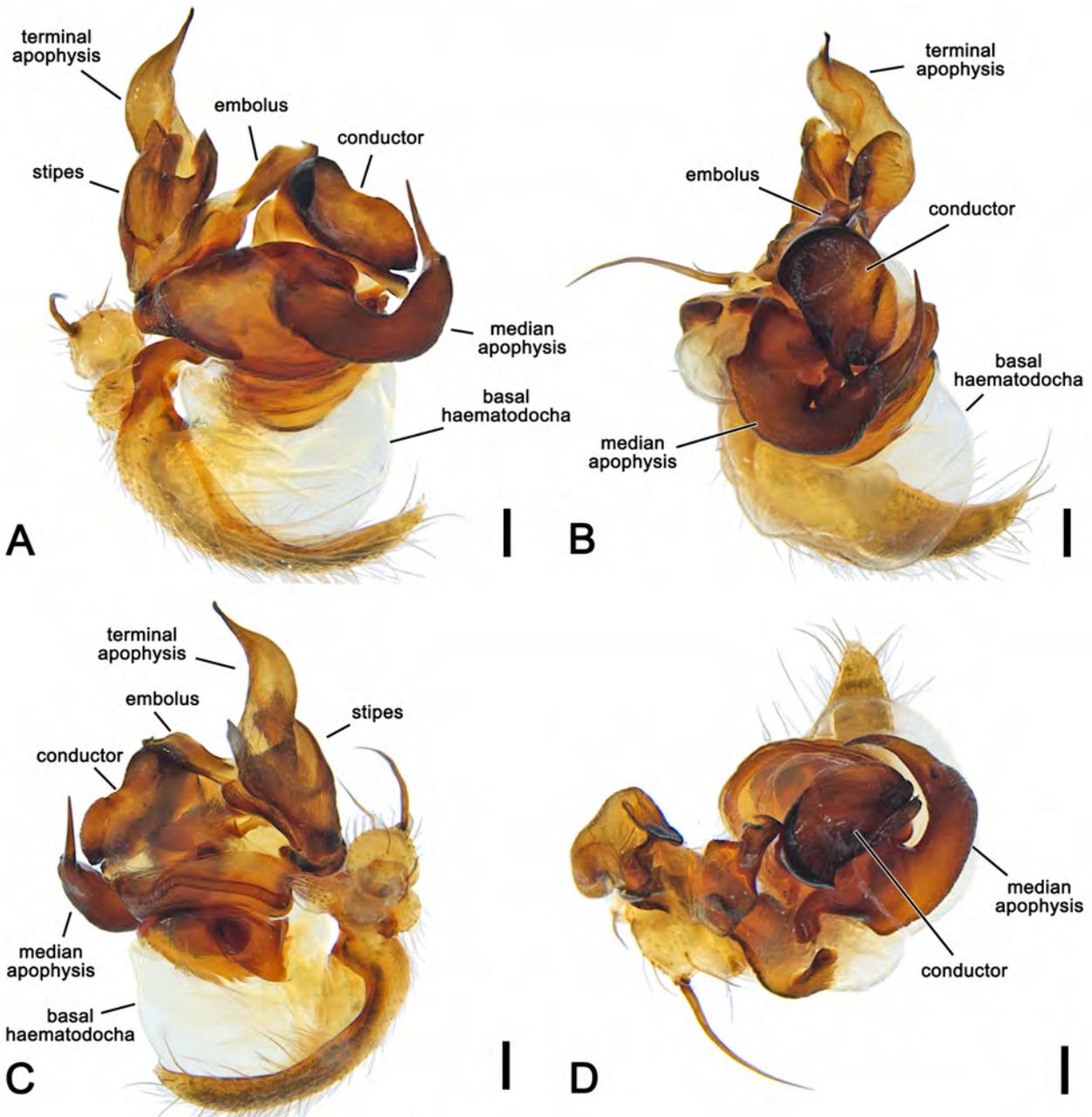


**Figure 1.** *Quokkaraneus necopinus* (Keyserling, 1887) **comb. nov.**, male, WAM T157890 (A, B, D, E) and WAM T75388 (C). A, C, dorsal habitus; B, ventral habitus; D, left pedipalp, ventral view; E, left pedipalp, dorsal view. Scale bars: A, B, C, 2 mm; D, E, 0.2 mm.

white, ventrally olive brown to brown (Fig. 1A, B); length of segments (femur + patella + tibia + metatarsus + tarsus = total length): I – 3.3 + 1.5 + 2.1 + 2.5 + 1.1 = 10.5, II – 2.7 + 1.2 + 1.8 + 1.7 + 0.9 = 8.3, III – 1.9 + 0.8 + 1.1 + 1.0 + 0.7 = 5.5, IV – 2.4 + 1.2 + 1.6 + 1.5 + 0.7 = 7.4. Labium 0.12 long, 0.45 wide, olive brown (Fig. 1B). Abdomen 2.5 long, 2.8 wide, dorsum off-white, with indistinct darker folium demarcations, scattered with small grey spots (Fig. 1A); venter brown, laterally irregular off-white (Fig. 1B). Pedipalp (Figs 1D, E, 2A–D): length of segments (femur + patella + tibia + cymbium = total length): 0.5 + 0.3 + 0.2 + 1.2 = 2.2; description as for genus.

**Female** (based on WAM T157981): Total length 6.5. Carapace 2.8 long, 2.3 wide; cephalic area and anterior and lateral thoracic area white, posterior thoracic area yel-

lowish brown, (Fig. 3A). Eye diameter AME 0.10, ALE 0.12, PME 0.11, PLE 0.14; row of eyes: AME 0.49, PME 0.46, PLE 1.20. Chelicerae off-white with reddish fangs, four promarginal teeth (third basalmost largest) and three small retromarginal teeth (basal largest). Legs dorsally white and covered by small brown spots and macrosetae, ventrally femora white, all other segments yellow-brown (Fig. 3A, B). Pedipalp length of segments (femur + patella + tibia + tarsus = total length): 1.1 + 0.4 + 0.5 + 1.2 = 3.2. Leg formula I > II > IV > III; length of segments (femur + patella + tibia + metatarsus + tarsus = total length): I – 3.3 + 1.6 + 2.6 + 2.4 + 1.6 = 11.5, II – 2.6 + 1.4 + 2.2 + 2.1 + 1.1 = 9.4, III – 1.7 + 0.7 + 1.2 + 1.2 + 0.8 = 5.6, IV – 1.9 + 1.1 + 1.6 + 1.7 + 0.8 = 7.1. Labium 0.21 long, 0.55 wide (Fig. 3B). Sternum 1.3 long, 1.2



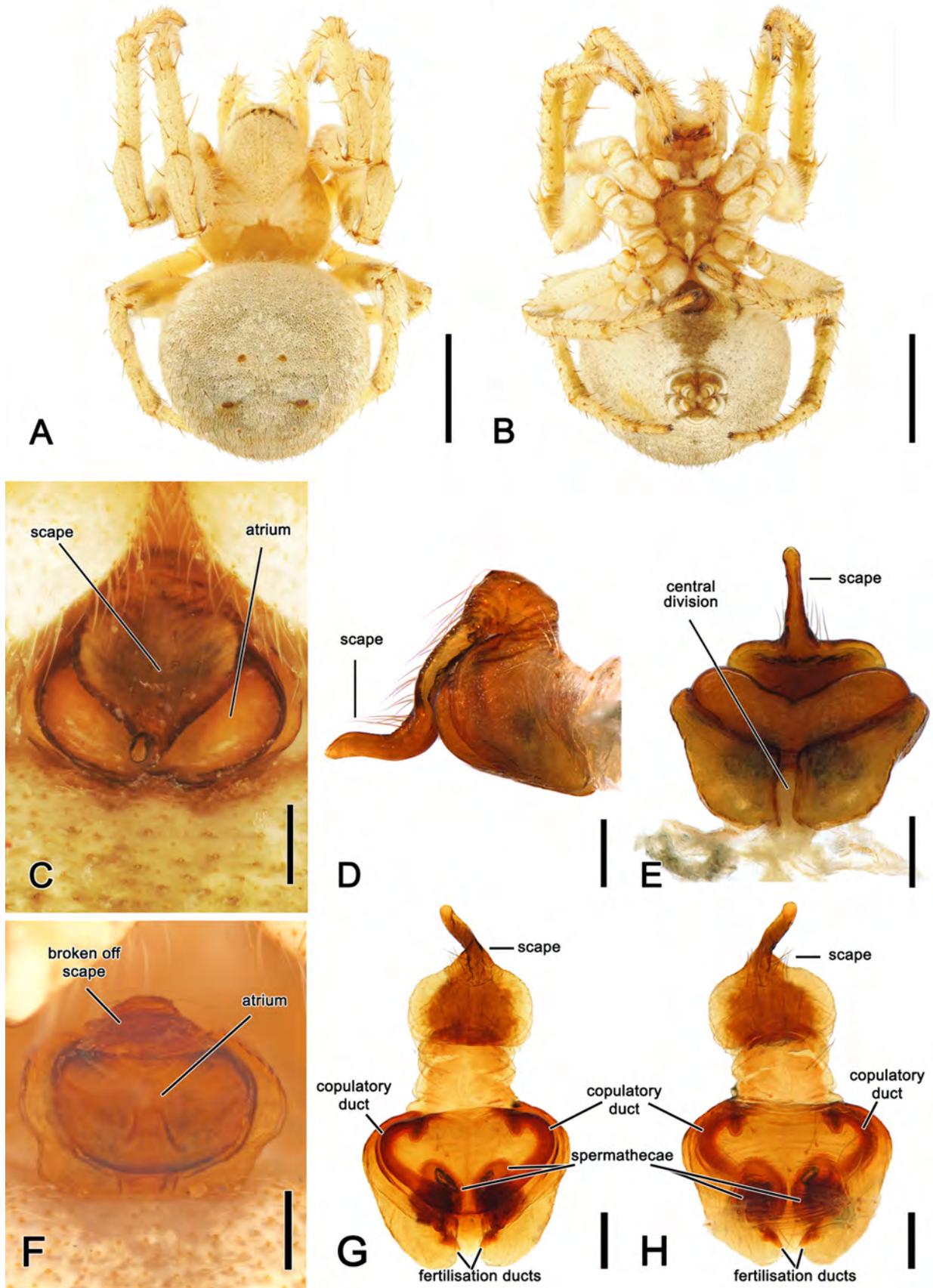
**Figure 2.** *Quokkaraneus necopinus* (Keyserling, 1887) **comb. nov.**, expanded left pedipalp (WAM T157980). A, ventral view; B, retrolateral view; C, dorsal view; D, apical view. Scale bars: 0.2 mm.

wide, similar colour as male (Fig. 3B). Abdomen 3.7 long, 4.1 wide, similar colour as male (Fig. 3A, B). Epigyne (Fig. 3C–H) descriptions as for genus.

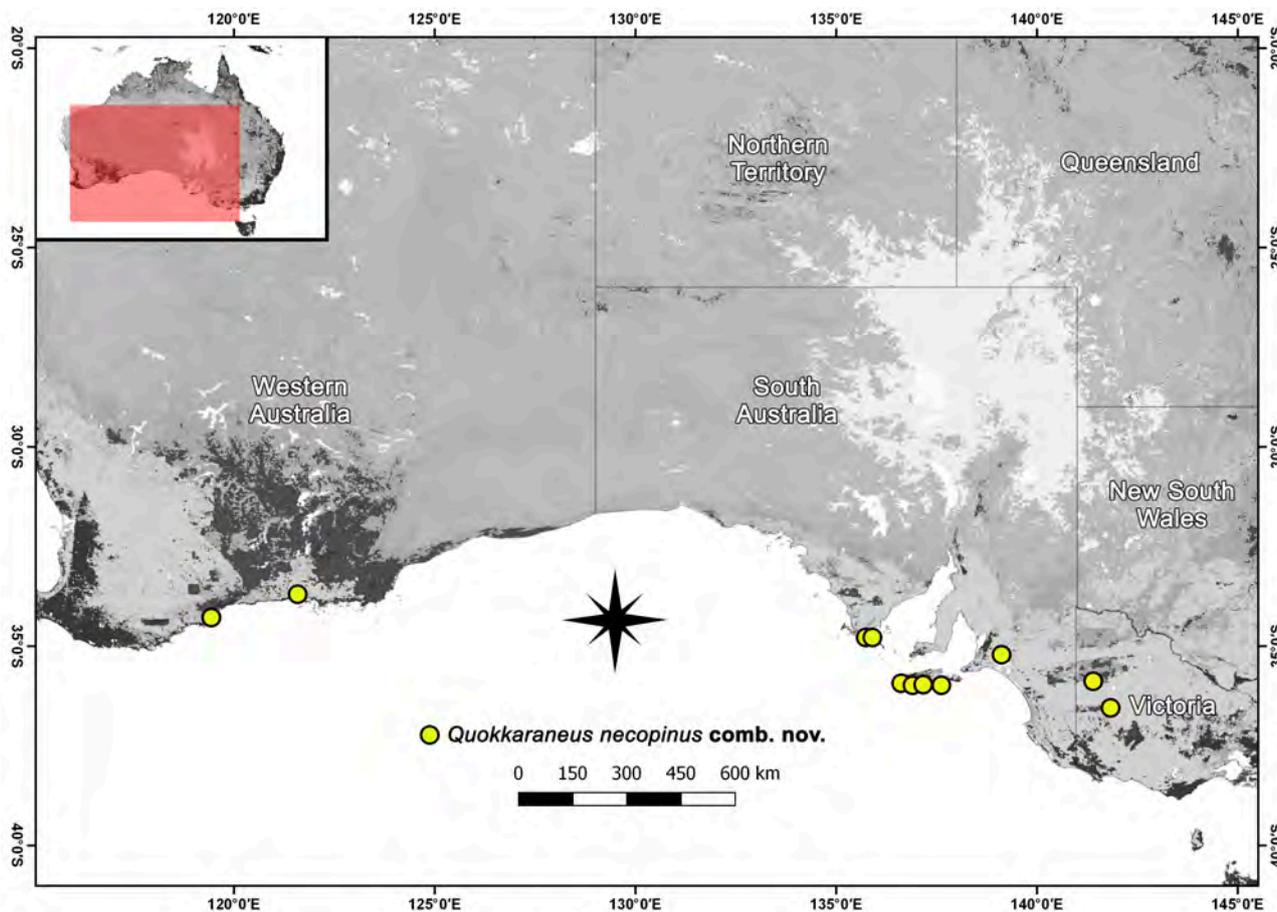
**Variation.** Total length males 5.4–6.0 (n= 4), females 5.0–7.1 (n= 5). As in many orb-weaving spiders, the colour pattern in *Q. necopinus comb. nov.* is variable. The white cephalic area was smaller in some females in comparison to the one illustrated here. There was overall some variation in males and females with respect to the distinctness of the abdominal folium, and males may have some additional black patches (Fig. 1C). The scape was broken off in 12 of 20 females (= 60%) we examined (e.g., Fig 3F).

**Remarks.** The holotype female of *Epeira necopina* Keyserling, 1887 was part of H.B.B. Bradley's collection, from which a number of early Australian spider species were described. The whereabouts of this collections is unknown (see Framenau 2005) and we here consider the holotype lost. However, the accurate descriptions and illustrations by Keyserling (1887) do not leave any doubt about the identity of this unusual spider and we do not consider it necessary to designate a neotype for this species.

**Life history and habitat preferences.** Mature males of *Q. necopinus comb. nov.* were collected in May and October; females in March, May, August, and in highest numbers between October and December. This points to an early spring/summer maturity, although so far no



**Figure 3.** *Quokkaraneus necopinus* (Keyserling, 1887) **comb. nov.**, female, WAM T157981 (A–E, G, H), SAM NN30795 (F) A, dorsal habitus; B, ventral habitus; C, epigyne, ventral view; D, epigyne, lateral view; E, epigyne, posterior view; F, epigyne ventral view with broken off scape; G, internal genitalia, ventral view H, internal genitalia, dorsal view. Scale bars: A, B, 2 mm; C–H, 0.2 mm.



**Figure 4.** Distribution records of *Quokkaraneus necopinus* (Keyserling, 1887) **comb. nov.**

mature spiders where collected in the generally hottest months of the year in southern Australia, January and February. There seems to be some plasticity in the life cycle of this species, as mature males were also found in autumn and females in autumn and winter.

No information about habitat preferences were given on the original collection labels with specimens of *Q. necopinus* **comb. nov.**

**Distribution.** The distribution of *Q. necopinus* **comb. nov.** encompasses south-western Victoria, southern South Australia (incl. Kangaroo Island), and south-western Western Australia (Fig. 4).

#### Disclosures

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