

The male of the orb-weaving spider *Cyrtophora unicolor* (Araneae, Araneidae)

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Abstract. Males of the araneid genus *Cyrtophora* Simon 1864 are comparatively rare in collections, possibly because they are much smaller and less conspicuous than their female counterparts and are expected to have a much shorter lifespan. Field work on Christmas Island (Indian Ocean) revealed a male of *Cyrtophora unicolor* (Doleschall 1857) copulating with a female. Both male and female are described here. The known distribution of *C. unicolor* is updated to include southern parts of China, Taiwan and Japan in the North, the Philippines and Papua New Guinea to the south-east, Indonesia and Christmas Island to the South, and Thailand, Myanmar, and Sri Lanka to the East. *Cyrtophora acrobalia* (Thorell 1895), described from a juvenile from Myanmar, is considered a *nomen dubium*.

Keywords: Cyrtophorinae, red tent spider, pedipalp morphology, Christmas Island, Australia

The araneid spider genus *Cyrtophora* Simon 1864 is known for the construction of large, tightly woven, horizontal orb-webs with a network of supporting threads above (e.g., Fig. 1). It currently includes 38 species and nine subspecies of which only ten species are known from both males and females. Thirty-one species or subspecies have been described based on females only and the remaining six from juveniles (Platnick 2007). *Cyrtophora* mainly occurs in the Indo-Australasian region, with some species described from Africa (Platnick 2007). The type species of the genus, *C. citricola* (Forsskål 1775), is the only representative of *Cyrtophora* that has been introduced to the New World (e.g., Levi 1997; Álvares & de Maria 2004).

The pronounced sexual dimorphism with males generally being much smaller and therefore less conspicuous than females and an expected shorter lifespan seems to be one reason for the rarity of males of *Cyrtophora* in museum collections. In addition, due to the pronounced sexual dimorphism, males present in collections may not have been correctly associated with conspecific females. However, systematic research in spiders relies heavily on an analysis of the morphology of the male pedipalp (e.g., in araneoids: Scharff and Coddington 1997; Griswold et al. 1998), and resolving the phylogenetic relationships in the diverse genus *Cyrtophora* remains difficult without knowledge of males. Here, I report on the male of the conspicuous *C. unicolor* (Doleschall 1857) (commonly known as “Red Tent Spider”), to date unknown. This male was collected during a recent trip to Christmas Island (Indian Ocean) courting a female which had left the curled leaf retreat in the center of its large web where she usually hides (Fig. 2).

Descriptions are based on specimens preserved in 70% ethanol. The epigynum of a female was prepared for examination by submersion in 10% KOH for 30 min. For clarity, the illustrations of the male pedipalp and female epigynum omit the setae. The morphological nomenclature follows Levi (1997). All measurements are given in millimeters (mm).

Images of a male and a female were taken with a digital camera (G6; Canon Inc., Japan) that was connected to the optical tube of a stereo microscope (MZ6; Leica Microsystems GmbH, Wetzlar, Germany) with an optical adapter set

(MaxView™ Plus; Scopetronix, Cape Coral, Florida, USA). Six to 10 photographs were taken in different focal planes and combined with the software package Helicon Focus 4.16 (Khmelik & Kozub 2007).

Abbreviations.—*Morphology:* TL, total length; CL, CW, CH cephalothorax length, width and height; AL, AW, abdomen length and width; AE, PE anterior and posterior eyes; AME, ALE, anterior median and lateral eyes; PME, PLE, posterior median and lateral eyes; MOQ, median ocular quadrangle. *Institutions:* BMNH, Natural History Museum, London, England; NHMV, Naturhistorisches Museum, Vienna, Austria; RMNH, National Museum of Natural History Naturalis, Leiden, The Netherlands; WAM, Western Australian Museum, Perth; ZMB, Museum für Naturkunde, Zentralinstitut der Humboldt-Universität, Berlin, Germany; ZMUC, Zoological Museum, Natural History Museum of Denmark, Copenhagen, Denmark.

SYSTEMATICS

Family Araneidae Simon 1895
Subfamily Cyrtophorinae Simon 1895
Cyrtophora Simon 1864

Cyrtophora Simon 1864:261.

Euetria Thorell 1890:109 (synonymy established in Simon 1895).

Suzumia Nakatsudi 1943:184 (synonymy established in Yaginuma 1958).

Type species.—*Cyrtophora: Aranea citricola* Forsskål 1775, by subsequent designation of Simon (1895).

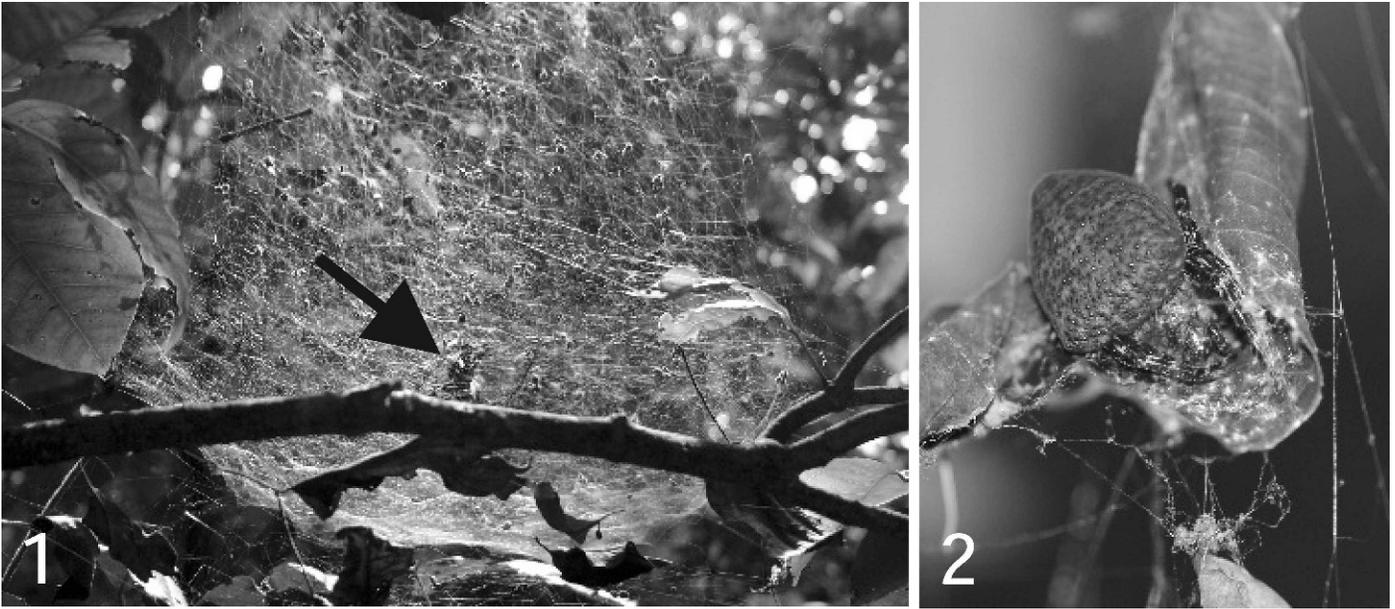
Cyrtophora unicolor (Doleschall 1857)
(Figs. 1–10)

Epeira unicolor Doleschall 1857:419; Doleschall 1859:plate 2, fig. 1; Workman & Workman 1894:20, plate 20.

Epeira stigmatisata Karsch 1878:326–327, plate 9, figs. 3, 3a–b.

Epeira stigmatisata var. *serrata* Hasselt 1882:21–22, plate 2, fig. 1, plate 4, fig. 5.- Thorell 1890:33 (synonymy established in Thorell 1895).

Epeira (Cyrtophora?) unicolor Doleschall: Thorell 1895:171.



Figures 1–2.—*Cyrtophora unicolor* female from Australia, Christmas Island (Indian Ocean): 1. Tent-web. The arrow points to the curled leaf that the spider places as a retreat in the center of the web; 2. Spider in her curled leaf retreat.

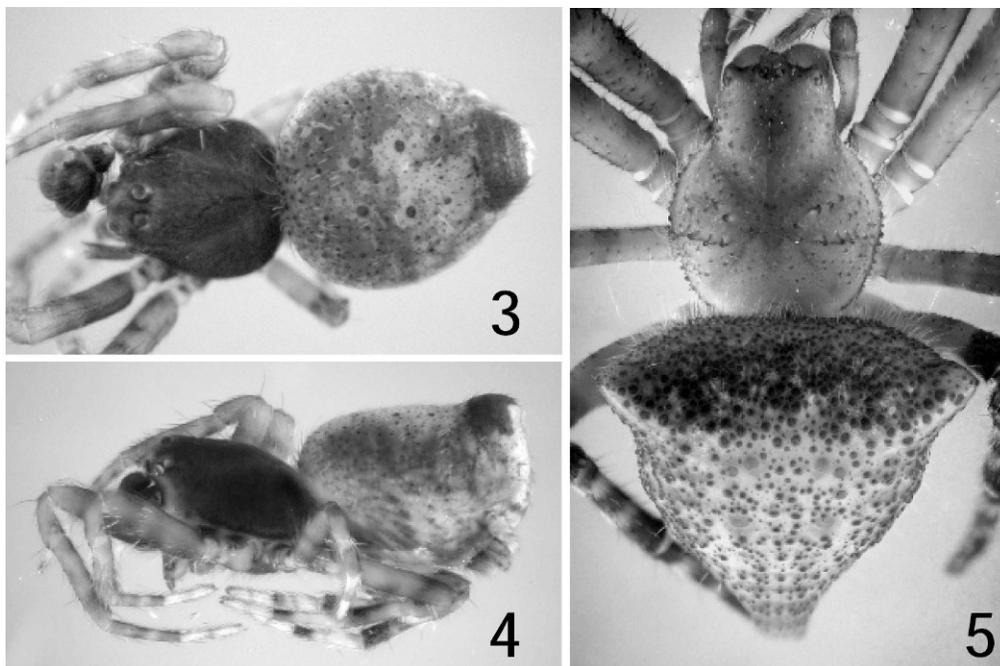
Araneus unicolor (Doleschall): Pocock 1897:600, plate 25, fig. 10; Pocock 1900:225.

Cyrtophora unicolor (Doleschall): Simon 1895:771; Roewer 1942:750; Bonnet 1956:1368–9; Chrysanthus 1959:201, figs. 3, 7, 26; Yaginuma 1968:36, figs. 8–9; Yaginuma 1986:117, fig. 32.4; Platnick 1989:335; Barrion & Litsinger 1995:587–590, figs. 366a–j; Yin et al. 1997:287, figs. 196a–c; Platnick 1998:499; Song et al. 1999:280, figs. 164m–n, 165g.

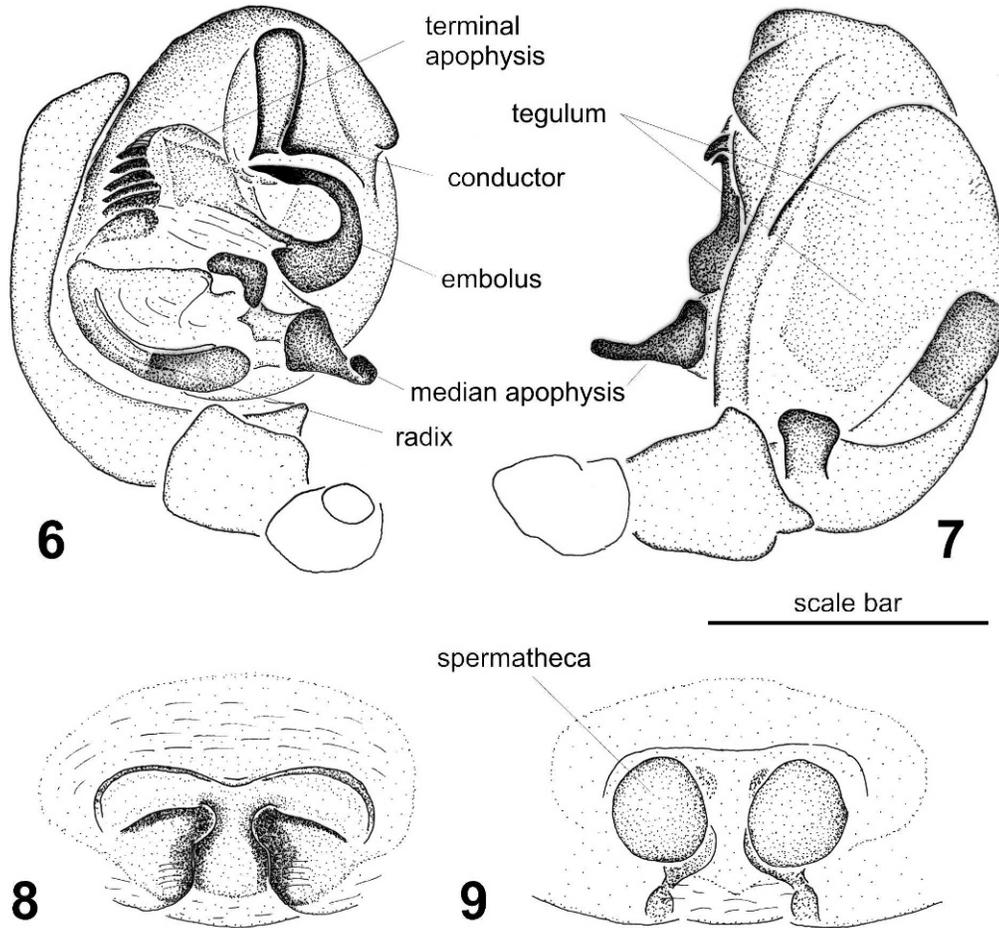
Types.—Syntypes of *Epeira unicolor* Doleschall: 1 female, Ambon, Indonesia, 3°42'S, 128°10'E (RMNH ARA05571); 1 immature, same locality (NHMV 20.596/1858.I.7) (not examined).

Holotype of *Epeira stigmatisata* Karsch: female, Thailand (no exact locality), F. Jagor (ZMB 2877) (not examined).

Holotype of *Epeira stigmatisata* var. *serrata* Hasselt: female, Agam district, Sumatra, Indonesia (no exact locality) (currently cannot be located in RMNH, where Hasselt's material is housed; E. v. Nieukerken, pers. comm.) (not examined).



Figures 3–5.—*Cyrtophora unicolor* (Doleschall). 3, 4. Male from Australia, Christmas Island (Indian Ocean) (WAM T65625): 3. Dorsal view; 4. Lateral view (total length 2.91 mm). 5. Female from Singapore (WAM 90/1964): dorsal view (total length 13.75 mm).



Figures 6–9.—*Cyrtophora unicolor* (Doleschall). Male and female from Australia, Christmas Island (Indian Ocean) (WAM T65625): 6. Left male pedipalp, mesal view; 7. Left male pedipalp, dorsal view; 8. Epigynum, postero-ventral view; 9. Epigynum, antero-dorsal view. Scale bar: (6, 7) 0.33 mm, (8, 9) 0.77 mm.

Material examined.—AUSTRALIA: *Western Australia*: 1 ♀, Christmas Island (Indian Ocean), 10°25'S, 105°40'E, 20 May 2005, V.W. Framenau (WAM T65699); 1 ♀, 1 juvenile, same locality, September 1897, C.W. Andrews (BMNH

1898.10.14.11.24); 2 ♀, same locality, 1897, C.W. Andrews (BMNH 1898.10.14.11.24); 1 ♀, Christmas Island (Indian Ocean), Central Plateau, 10°25'S, 105°40'E, 1897, C.W. Andrews (BMNH 1898.10.14.11.24); 1 ♀, Christmas Island (Indian Ocean), east coast, 10°25'S, 105°40'E, October 1897, C.W. Andrews (BMNH 1898.10.14.11.24); 4 ♀, 1 juvenile, Christmas Island (Indian Ocean), east of Flying Fish Cove, 10°25'S., 105°40'E., 12 August 1897, C.W. Andrews (BMNH 1898.10.14.11.24); 1 ♂, 1 ♀, Christmas Island (Indian Ocean), N of Drumsite, 10°27'20"S, 105°40'10"E, 26 September 2005, V.W. Framenau, M.L. Thomas (WAM T65625); 1 ♀ with eggsac, Christmas Island (Indian Ocean), The Dales, 10°29'S, 105°33'E, 4–5 October 1969, Christmas Island Scouts (via S. Slack-Smith) (WAM T77421); 1 ♀, Christmas Island (Indian Ocean), 1 km W of Jane Up Cave (cave CI-6), 10°29'24"S, 105°37'54"E, 28 March 1998, W.F. Humphreys, in curled leaf (WAM T67960). INDIA: 1 ♀, eastern India (no exact locality), from dry collection (BMNH). INDONESIA: 1 ♀, 1 juvenile, Java (no exact locality), H.J. Jensen (ZMUC); 2 ♀, Bogor (Java), 6°35'S, 106°47'E, 1904, H.J. Jensen (ZMUC). MYANMAR (BURMA): 1 ♀, Tharawaddy, 17°19'N, 95°48'E, E.W. Oates (BMNH 1895.9.21.539). SINGAPORE: 1 ♀, Sungei Boleh, 1°18'N, 103°51'E, J.M. Waldock, J. Koh, swamp (WAM 90/1964); 1 ♀, Singapore, 1°18'N, 103°51'E,

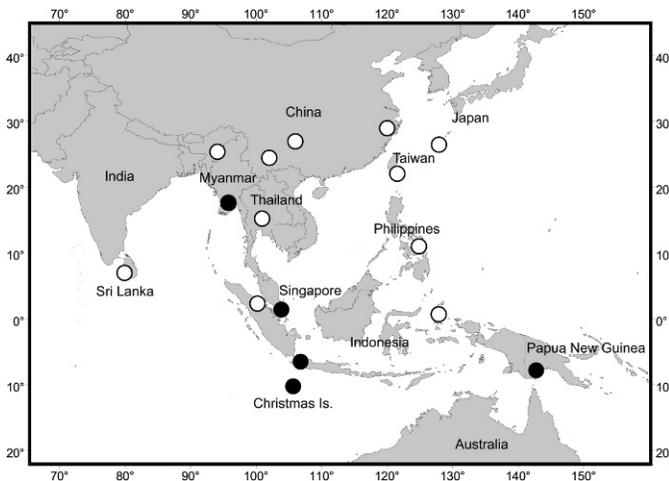


Figure 10.—Distribution records of *Cyrtophora unicolor* (Doleschall). (●) material examined, (○) records from the literature.

H.N. Ridley (BMNH 1894.12.22.12). PAPUA NEW GUINEA: 2 ♀, labelled "Pauneata, British New Guinea" (not listed in gazetteers) (QM S75510).

Diagnosis.—Male similar to *C. citricola* as illustrated in Levi (1997, figs. 154–156), but terminal apophysis with distinct longitudinal ridges instead of tubercles and median apophysis much stouter. Female, in contrast to other members of *Cyrtophora*, with numerous small sclerotized plates on the abdomen and numerous tubercles dorsally on cephalothorax (Fig. 5).

Description.—Male (based on WAM T65625 from Christmas Island, Indian Ocean): carapace: cephalic area protruding over clypeus (Fig. 4), its profile horizontal in lateral view; clypeus ca. twice as high as AME diameter; dark brown with some black pigmentation; fovea indistinct, longitudinal; sparse black setae, very few light setae posteriorly and silvery setae between eyes. Eyes: AE and PE rows recurved; row of AME wider than row PME; MOQ wider than long. Sternum: wider than long, orange-brown with dense black pigmentation; covered with few black macrosetae. Labium: ca. twice as wide as long, dark brown, front end rounded and with white rim. Chelicerae: orange-brown with black pigmentation some of which forms longitudinal stripes laterally; three very small retromarginal teeth, with the basal largest; four promarginal teeth, with the third (from apical) largest and the second smallest. Pedipalp (Figs. 6–7): median apophysis a mesally directed hook; embolus sickle-shaped with a very broad base; terminal apophysis with distinct sclerotized ridges. Abdomen: oval in dorsal view (Fig. 3), posterior end elevated above the spinnerets into a distinct tip (Fig. 4); milky-gray with light discoloration centrally, posterior tip very dark olive-gray; covered with few silverfish setae, setal sockets dark brown; venter milky-gray with two large lighter patches; spinnerets orange-brown with some dark pigmentation. Legs: leg length I > II > IV > III; orange-brown, with dark annulations.

Measurements. WAM T65625: TL 2.91, CL 1.39, CW 1.05, CH 0.61. Eyes: AME 0.12, ALE 0.08, PME 0.10, PLE 0.10. Row of eyes: AME 0.36, ALE 0.61, PME 0.28, PLE 0.63, MOQ length 0.26. Clypeus height 0.21. Sternum (length/width) 0.58/0.64. Labium (length/width) 0.13/0.25. AL 1.67, AW 1.42. Legs: lengths of segments (femur, patella, tibia, metatarsus, tarsus = total length): Pedipalp 0.97, 0.17, 0.17, -, 0.61 = 1.93; leg I 2.27, 1.15, 2.09, 1.91, 0.55 = 7.97; leg II 2.06, 1.18, 1.61, 1.48, 0.45 = 6.79; leg III 1.61, 0.70, 0.97, 0.88, 0.39 = 4.55; leg IV 1.94, 0.97, 1.48, 1.61, 0.42 = 6.42.

Female (based on WAM T65625 from Christmas Island, Indian Ocean): carapace: profile highest at fovea in lateral view; fovea a roundish pit; lateral and median eyes distinctly elevated from carapace; clypeus ca. as high as AME diameter; carapace laterally covered with large tubercles (Fig. 5); orange-brown; sparse black setae, few white setae in anterior half. Eyes: AE and PE rows recurved; row of AME wider than row PME; ME quadrangle wider than long. Sternum: wider than long, orange-brown with black pigmentation; covered with black macrosetae. Labium: ca. twice as wide as long; orange-brown; front end rounded and with white rim. Chelicerae: orange, apically somewhat darker; dentition as male. Epigynum (Figs. 8, 9): postero-ventral view: anterior rim sinuous, median sclerotized part pentagonal (Fig. 8); antero-dorsal view: large, round spermathecae (Fig. 9).

Abdomen: longer than wide, with distinct and pointed humeral humps at anterior margin (Fig. 5); uniformly olive-brown with numerous small orange-brown sclerotized plates. Legs: leg length I > II > IV > III; femora orange-brown with indistinct dark annulations and very dark brown apically, patellae very dark brown, tibiae dark brown with light annulations which are accentuated by white setae, metatarsi and tarsi brown.

Measurements. WAM T65625: TL 18.75, CL 8.13, CW 6.75, CH 2.50 (without tubercles). Eyes: AME 0.30, ALE 0.21, PME 0.24, PLE 0.24. Row of eyes: AME 0.91, ALE 2.88, PME 0.79, PLE 2.94, MOQ length 0.76. Clypeus height 0.38. Sternum (length/width) 3.25/3.38. Labium (length/width) 1.00/1.45. AL 14.38, AW 12.75. Legs: Pedipalp 2.38, 1.13, 1.63, -, 2.63 = 7.75; leg I 7.63, 3.13, 5.38, 5.75, 2.13 = 24.00; leg II 7.38, 3.13, 4.75, 5.38, 2.13 = 22.75; leg III 4.50, 2.00, 2.50, 2.75, 1.88 = 13.63; leg IV 6.63, 2.88, 3.88, 4.88, 1.88 = 20.13).

Variation. ♀ (range, mean ± SD): TL 13.75–10.00, 17.00 ± 3.15; CL 6.25–8.13, 7.03 ± 0.79; CW 5.38–6.63, 5.78 ± 0.57; *n* = 4.

Remarks.—The embolus tip of the left pedipalp of the male described here was broken off and the illustration of the pedipalp (Fig. 6) shows a complete embolus reconstructed from the intact right pedipalp.

Pocock (1900, pg. 225) reported that *Cyrtophora acrobalia* (Thorell 1895), described based on a juvenile spider from Tonghoo (Myanmar), was "closely allied to this [= *C. unicolor*] species." Although the jar of the type specimen, originally described from the E.W. Oates collection (now housed in the BMNH), is present in London, it only contains the original label but no spider (pers. obs., 14 August 2007). Therefore the holotype must be regarded as lost. It remains impossible to ascertain the identity of this species based on Thorell's (1895) description alone and I consider *C. acrobalia* to be a *nomen dubium*. Thorell's (1895) original description of *C. acrobalia* includes a reference to the apparently similar *Cyrtophora diazoma* (Thorell 1890), described from a juvenile female from Sumatra. A synonymy of this species with *C. unicolor* remains possible pending an examination of the type material.

Distribution (Fig. 9).—*Cyrtophora unicolor* is known from China (Zhejiang, Yunnan, Guizhou) (Song et al. 1999), southern Taiwan (Chen & Tso 2004) and Japan (Miyashita 2002) in the north, the Philippines (Barrion & Litsinger 1995) and Papua New Guinea (this study) as its eastern border, Indonesia (Hasselt 1882; Pocock 1897; Chrysanthus 1959) and Christmas Island (this study) to the South, and Sri Lanka (Pocock 1900), Thailand (Karsch 1878), Myanmar (Thorell 1895; Pocock 1900) and northeastern India (Pocock 1900) in the East. However, the species was not listed for India by Tikader (1982). Roewer (1942) firstly catalogued Australia as part of the distribution of *C. unicolor* but, with the exception of the offshore territory of Christmas Island, I could not find an original record listing mainland Australia. The species is not present in the collection of the Queensland Museum which holds large numbers of tropical araneids from Australia (O. Seeman, pers. comm.; pers. obs.).

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