Redescription of five *Parasteatoda* species and one *Campanicola* (Araneae: Theridiidae) species from Taiwan

臺灣產五種擬肥腹蛛屬（*Parasteatoda*）和一種吊鐘姬蛛屬（*Campanicola*）之重新描述

Yu-Ming Huang[1], Yin-Yuan Lo[2,3,*] and Ren-Chung Cheng[1,*]

黃俞銘[1] 羅英元[2,3,*] 鄭任鈞[1,*]

[1] Department of Life Sciences, National Chung Hsing University, Taichung, Taiwan

[2] Taiwan Biodiversity Research Institute, Nantou, Taiwan

[3] Department of Life Science, National Taiwan Normal University, Taipei, Taiwan

[1] 國立中興大學生命科學系 402202 臺中市南區興大路 145 號

[2] 農業部生物多樣性研究所 552005 南投縣集集鎮民生東路 1 號

[3] 國立臺灣師範大學生命科學系 116059 臺北市文山區汀州路四段 88 號

*Corresponding authors: bolasargiope@email.nchu.edu.tw; yylo.robert@gmail.com

* 通訊作者：bolasargiope@email.nchu.edu.tw; yylo.robert@gmail.com

Abstract

This paper redescribes five species of *Parasteatoda* Archer, 1946 and one species of *Campanicola* Yoshida, 2015 from Taiwan. Among these species, four *Parasteatoda* species are reported in Taiwan for the first time, namely *P. asiatica* (Bösenberg and Strand 1906), *P. culicivora* (Bösenberg and Strand 1906), *P. ducta* (Zhu 1998), and *P. transipora* (Zhu and Zhang 1992). Furthermore, the male of *P. quadrimaculata* (Yoshida *et al.* 2000) is described for the first time. On the other hand, we report the rediscovery of *Campanicola ferrumequina* (Bösenberg and Strand 1906). Both sexes of the aforementioned species are redescribed and photographed in order to facilitate future taxonomic studies of Taiwanese spiders.

Key words: *Parasteatoda*, *Campanicola*, Theridiidae, new record, Taiwan

摘要

本文重新描述臺灣產五種擬肥腹蛛 (*Parasteatoda*) 和一種吊鐘姬蛛 (*Campanicola*)。其中，四種擬肥腹蛛屬為臺灣的新紀錄種：*Parasteatoda asiatica* (Bösenberg and Strand 1906)、*Parasteatoda culicivora* (Bösenberg and Strand 1906)、*Parasteatoda ducta* (Zhu 1998) 和 *Parasteatoda transipora* (Zhu and Zhang 1992)。另外，我們提供了四斑擬肥腹蛛 *Parasteatoda quadrimaculata* (Yoshida *et al.* 2000) 的雄性個體的首次形態描述。而另外一方面，我們重新紀錄 *Campanicola ferrumequina* (Bösenberg and Strand 1906) 存在於臺灣。上述所有物種之雄性與雌性皆重新描述及提供標本影像以促進未來臺灣產蜘蛛之分類學研究。

關鍵詞：擬肥腹蛛屬、吊鐘姬蛛屬、姬蛛科、新紀錄、臺灣

Received: November 6, 2023 收件日期：2023 年 11 月 6 日
Accepted: August 22, 2024 接受日期：2024 年 8 月 22 日

Introduction

The genus *Parasteatoda* Archer, 1946 represents a group of comb-footed spiders with 43 species distributed across Asia, Europe, and New Guinea (World Spider Catalog 2023). Yoshida (2015) reclassified some species from *Parasteatoda* into a new genus, *Campanicola*, predominantly occurring in Taiwan and China (World Spider Catalog 2023). Currently, six *Parasteatoda* species and three *Campanicola* species are recorded in Taiwan (Yoshida 2015). Through our collection and examination of specimens of these genera, we discovered four new records of *Parasteatoda* in Taiwan, namely *P. asiatica* (Bösenberg and Strand 1906), *P. culicivora* (Bösenberg and Strand 1906), *P. ducta* (Zhu 1998), and *P. transipora* (Zhu and Zhang 1992). Additionally, the male of *P. quadrimaculata* (Yoshida *et al.* 2000) is described for the first time. Chu and Okuma (1974) and Chen (1996) documented the occurrence of *C. ferrumequina* (Bösenberg and Strand 1906) in Taiwan, but Yoshida (2015) contended that these records were cases of misidentification, thus dismissing the species' existence on the island. Recently, we managed to re-discover Taiwanese populations of *C. ferrumequina*, confirming its occurrence in Taiwan. In summary, five *Parasteatoda* species and one *Campanicola* species from Taiwan are discussed, and both sexes of the aforementioned species were redescribed in this paper.

Materials and methods

The specimens were collected by sweep nets or through visual searches in their habitats (rock walls, trees, grasses

and artificial structures) in Taiwan. All specimens were preserved in 70% ethanol and deposited at National Chung Hsing University. Specimens were examined, measured, and photographed using a Nikon SMZ800N microscope with SAGE VISION SGview (SAGE VISION Co., Ltd.). Genital photos of the specimens were taken by a Leica M205C microscope with the Focus Stacking Automatic Microphotograph System (TORI FOCUS). Multifocal plane images were stacked using Helicon Focus version 7.5.1 (Helicon Soft Ltd.). The epigynum of females was dissected and cleaned in a warm 10% KOH solution to examine its inner genital structure.

All measurements are given in millimeters (mm). The measurements of the legs were shown as: total length (femur, patella and tibia, metatarsus, tarsus). Abbreviations used in this paper were: ALE, anterior lateral eye; AME, anterior median eye; PLE, posterior lateral eye; PME, posterior median eye; C, conductor; CD, copulatory duct; CP, copulatory pore; Cy, cymbium; E, embolus; FD, fertilization duct; S, spermatheca; St, subtegulum; T, tegulum; Ti, tibia.

Results

Campanicola ferrumequina (Bösenberg and Strand 1906)

(Fig. 1)

Theridion ferrum-equinum: Bösenberg and Strand, 1906, p. 139, pl. 12, f. 261.

Theridion ferrumequinum: Saito, 1959, p. 70, f. 65A–C; Chu and Okuma, 1974, p. 39.

Achaearanea ferrumequina: Yoshida, 1983, p. 40 (Transferred from *Theridion*); Yaginuma, 1986, p. 34, f. 19.8; Chen, 1996, p. 126; Zhu, 1998, p. 99, f. 56A–C; Song, Zhu and Chen, 1999, p. 90, f. 39G–H; Yoshida, 2000, p. 140, f. 4–7; Namkung, 2003, p. 87, f. 13.3a–b; Yoshida, 2003, p. 102, f. 250–253, 574; Yin *et al.*, 2012, p. 255, f. 84a–e.`

Parasteatoda ferrumequina: Yoshida, 2008, p. 39 (Transferred from *Achaeara-*

nea); Yoshida, 2009, p. 382, f. 258–259. *Campanicola ferrumequina*: Yoshida, 2015, p. 33 (Transferred from *Parasteatoda*); Li *et al*., 2021, p. 101, f. 4A–H, 5A–F, 6A–C. Kim, 2021, p. 29.

Specimens examined. 1♂, 2♀♀ (ABARA_03587–03589), 20 Jan. 2022, Chang-Lin Chung leg., Nanan Waterfall, Zhuoxi Township, Hualien County; 4♀♀ (ABARA_04310–04313), 23 Jul. 2022, Kuang-Ping Yu leg., Fuyuan National Forest Recreation Area, Ruisui Township, Hualien County.

Diagnosis. This species is similar to *C. tanakai* Yoshida, 2015 in body shape, coloration and shape of palp organ. *C. ferrumequina* can be distinguished from the latter by a horseshoe-shaped epigynum (in contrast to the two brackets-like structures in *C. tanakai*), shorter and doubly twisted copulatory ducts (longer and twisted four times in *C. tanakai*), and conductor of male palp organ moderately curved (largely curved in *C. tanakai*).

Description Female (ABARA_04310). Body length 2.32. Carapace length 1.04, width 0.87. Abdomen length 1.47, width 1.30, height 1.19. Leg formula: I, IV, II, III. Leg I 4.16 (1.33, 1.29, 0.96, 0.58). Leg II 3.12 (1.02, 0.96, 0.63, 0.51). Leg III 2.42 (0.78, 0.72, 0.50, 0.42). Leg IV 3.54 (1.11, 1.07, 0.81, 0.55). Diameters of eyes: AME 0.10, ALE 0.10, PME 0.10, PLE 0.10. Interdistances of eyes: AME-AME 0.02, AME-ALE 0.04, PME-PME 0.08, PME-PLE 0.03. Clypeus height 0.16. Carapace oval, yellowish brown, with a circular thoracic groove. Chelicerae, maxillae and labium yellowish brown. Sternum yellowish brown with marginal black flecks. Legs yellowish brown with indistinct dusky rings. Dorsum of abdomen black with circular and lineate white pigments. Venter of abdomen grayish brown with blackish flecks and white pigments. Spinnerets surrounded with blackish ring (Fig. 1a–c).

Epigynum horseshoe-shaped. Copulatory ducts thin and long, twisted twice (Fig. 1d–e).

Male (ABARA_03589). Body length 2.30. Carapace length 1.10, width 1.01. Abdomen length 1.54, width 1.15, height 1.19. Leg formula: I, II, IV, III. Leg I 5.06 (1.62, 1.60, 1.16, 0.68). Leg II 3.69 (1.20, 1.17, 0.78, 0.54). Leg III 2.62 (0.86, 0.78, 0.54, 0.44). Leg IV 3.60 (1.26, 1.23, 0.70, 0.41). Diameters of eyes: AME 0.10, ALE 0.10, PME 0.10, PLE 0.10. Interdistances of eyes: AME-AME 0.03, AME-ALE 0.04, PME-PME 0.07, PME-PLE 0.04. Clypeus height 0.17. Coloration similar to female (Fig. 1f–h). Conductor tip long and curved, with helical lines (Fig. 1i–k).

Distribution. Taiwan (Hualien), China, Japan, Korea.

Remarks. *C. ferrumequina* was previously recorded in Taiwan by Chu and Okuma (1974) and Chen (1996). However, Yoshida (2015) suggested that these records seem to be cases of misidentification. He regarded specimens from Taiwan as belonging to other *Campanicola* species, leading to the conclusion that *C. ferrumequina* is not distributed in Taiwan. Contrary to this, we rediscovered this species in Hualien County.

Parasteatoda asiatica (Bösenberg and Strand 1906)

(Fig. 2)

Achaea asiatica: Bösenberg and Strand, 1906, p. 148, pl. 12, f. 278.

Achaearanea asiatica: Yaginuma, 1986, p. 33, f. 19.7; Zhu, 1998, p. 96, f. 56A–E; Yoshida, 2000, p. 143, f. 14–16; Namkung, 2003, p. 92, f. 13.8a–b; Yoshida, 2003, p. 105, f. 260–262; Yin *et al*., 2012, p. 246, f. 77a–g.

Achaearanea asiaticus: Song, Zhu and Chen, 1999, p. 86, f. 38C–D, K–L.

Parasteatoda asiatica: Yoshida, 2008, p. 39 (Transferred from *Achaearanea*);

Yoshida, 2009, p. 382, f. 250–251; Kim, 2021, p. 99, f. 41A–I.

Specimens examined. 1♀ (ABARA_04653), 02 Sep. 2022, 2♂♂, 2♀♀ (ABARA_04701–04704), 01 Nov. 2022, Yu-Ming Huang leg., Tianzi Village, Zhushan Township, Nantou County.

Diagnosis. This species is similar to males of *Nihonhimea japonica* (Bösenberg and Strand 1906) in body shape and coloration. *P. asiatica* can be distinguished from the latter by the S-shaped copulatory ducts of females (larger copulatory pore and curved copulatory ducts in *N. japonica*), and the conductor tip of the male palp organ has a twist (without a twist in *N. japonica*).

Description. Female (ABARA_04653). Body length 2.06. Carapace length 0.84, width 0.71. Abdomen length 1.35, width 1.19, height 1.25. Leg formula: I, IV, II, III. Leg I 3.35 (1.01, 0.99, 0.86, 0.49). Leg II 2.91 (1.03, 0.82, 0.64, 0.42). Leg III 2.09 (0.63, 0.56, 0.50, 0.40). Leg IV 3.19 (0.98, 0.96, 0.78, 0.47). Diameters of eyes: AME 0.08, ALE 0.08, PME 0.08, PLE 0.08. Interdistances of eyes: AME-AME 0.08, AME-ALE 0.03, PME-PME 0.09, PME-PLE 0.03. Clypeus height 0.11. Carapace oval, orange; eye region black. Chelicerae, maxillae, labium and sternum orange. Pedipalps orange; tibia, metatarsi and tarsi brown. Legs orange; patella, tibia, metatarsi and tarsi brown. Abdomen yellow, with blackish and whitish flecks. Spinnerets surrounded with two blackish spots (Fig. a–c). Epigynum orange. Copulatory ducts S-shaped (Fig. 2d–e).

Male (ABARA_04701). Body length 1.69. Carapace length 0.85, width 0.69. Abdomen length 0.98, width 0.72, height 0.77. Leg formula: I, II, IV, III. Leg I 3.93 (1.22, 1.19, 1.01, 0.51). Leg II 2.64 (0.82, 0.80, 0.62, 0.40). Leg III 1.98 (0.65, 0.55, 0.42, 0.36). Leg IV 2.71

(0.87, 0.81, 0.63, 0.40). Diameters of eyes: AME 0.08, ALE 0.08, PME 0.08, PLE 0.08. Interdistances of eyes: AME-AME 0.07, AME-ALE 0.03, PME-PME 0.08, PME-PLE 0.04. Clypeus height 0.11. Coloration similar to female (Fig. 2f–h). Conductor tapering to tip (Fig. 2i–k).

Distribution. Taiwan (Nantou), China, Japan, Korea.

Parasteatoda culicivora (Bösenberg and Strand 1906)

(Fig. 3)

Theridion culicivorum: Bösenberg and Strand, 1906, p. 143, pl. 12, f. 297.

Achaearanea culicivorum: Yoshida, 1983, p. 40 (Transferred male from *Theridion*).

Achaearanea culicivora: Yaginuma, 1986, p. 33, f. 19.4; Yoshida, 2000, p. 146, f. 32–36; Yoshida, 2003, p. 111, f. 278–282, 580.

Parasteatoda culicivora: Yoshida, 2008, p. 39 (Transferred from *Achaearanea*); Yoshida, 2009, p. 380, f. 234–235; Yoshida, 2016, p. 18; Kim, 2021, p. 101, f. 42A–F, pl. 19

Specimens examined. 2♀♀ (ABARA_00609, 00617), 22 Jul. 2019, Wei-Zhe Tseng leg., 1♂, 2♀♀ (ABARA_03579–03580, 03592), 11 Dec. 2011, Yu-Ming Huang leg., Cingtonglin, Wufeng District, Taichung City; 1♀ (ABARA_00660), 11 Jul. 2019, Anansi Brigade leg., Lovers Lake Park, Anle District, Keelung City; 1♂(ABARA_00663), 25 Jul. 2019, 1♂, 1♀ (ABARA_01235, 01243), 19–20 Oct. 2019, Anansi Brigade leg., Bogongkeng, Sanyi Township, Miaoli County; 1♀ (ABARA_01681), 15 Aug. 2019, Hsiu-Chou Chung leg., Chinan National Forest Recreation Area, Shoufeng Township, Hualien County; 1♂, 1♀ (ABARA_03607, 03675), 03 Feb. 2022, Pin-Huang Hsu leg., Denggong Road, Tamsui Distinct, New Taipei City; 1♀ (ABARA_03619),

28 Feb. 2022, Yu-Ming Huang leg., Dacun 5-1 trail, Peitung District, Taichung City; 1♂, 1♀ (ABARA_03621, 04513), 19 Feb. 2022, Yu-Ming Huang leg., Xinhua Experimental Forest Station, Xinhua District, Tainan City; 1♂ (ABARA_3868), 07 May 2022, Ting-Kuan Lin leg., Duona, Liouguei District, Kaohsiung City; 2♂, 4♀♀ (ABARA_03751–03752, 03897–03900), 25 Mar. 2022, Anansi Brigade leg., Beipu Village, Beipu Township, Hsinchu County; 2♀♀ (ABARA_03939–03940), 25 Mar. 2022, Anansi Brigade leg., Matai trail, Jianshi Township, Hsinchu County; 5♂♂, 7♀♀ (ABARA_04177, 04250–04251, 04287–04291, 04298–04301), 06–07 Jul. 2022, Anansi Brigade leg., 2♀♀ (ABARA_04775–04776), 12 Jan. 2023, Yu-Chun Hsiao leg., Shuangliu Forest Recreation Area, Shizi Township, Pingtung County; 1♂, 1♀ (ABARA_04294–04295), 25 Jan. 2018, Kuang-Ping Yu leg., Changshou Road, Gushan District, Kaohsiung City; 1♂ (ABARA_04351), 03 Aug. 2022, 1♂, 2♀♀ (ABARA_04678–04679, 04693), 28 Sep. 2022, Yu-Ming Huang leg., Metropolitan Park, Xitung District, Taichung City; 2♀♀ (TESRI_Ar1411–1412), 22 Jul. 2015, Ying-Yuan Lo leg., Paoma trail, Jiaoxi Township, Yilan County; 5♀♀ (TESRI_LT042–046), 17 Mar 2018, Ying-Yuan Lo leg., Lantan trail, East District, Chiayi County.

Diagnosis. This species is similar to *P. kentingensis* (Yoshida 2015) and *P. ryukyu* (Yoshida 2000) in body shape and coloration. *P. culicivora* and *P. kentingensis* have longer copulatory ducts and larger copulatory pores in females, while *P. ryukyu* with shorter copulatory ducts and smaller copulatory pores. The turning of copulatory ducts is angular in *P. culicivora* and *P. kentingensis*, while a round and large curve is in *P. ryukyu*. The ducts of *P. kentingensis* are more curved under the posterior edge than *P. culicivora*. The basal part of the male

embolus is not segmented in *P. culicivora* (segmented in *P. kentingensis* and *P. ryukyu*).

Description. Female (ABARA_04693). Body length 4.80. Carapace length 1.78, width 1.41. Abdomen length 3.51, width 2.96, height 3.21. Leg formula: I, IV, II, III. Leg I 9.06 (2.80, 2.51, 2.76, 0.99). Leg II 5.89 (1.84, 1.72, 1.63, 0.70). Leg III 4.04 (1.26, 1.17, 1.00, 0.61). Leg IV 6.58 (2.33, 1.88, 1.64, 0.73). Diameters of eyes: AME 0.12, ALE 0.11, PME 0.12, PLE 0.12. Interdistances of eyes: AME-AME 0.05, AME-ALE 0.04, PME-PME 1.00, PME-PLE 0.05. Clypeus height 0.29. Carapace oval, with a circular thoracic groove, dusky brown. Chelicerae, maxillae and labium brown with dusky flecks. Sternum yellowish brown. Legs brown with distal dusky rings. Abdomen dusky brown with white pigments, black flecks. Spinnerets surrounded with a circular blackish ring (Fig. 3a–c). Epigynum brown with large copulatory pore and conspicuous sclerotized posterior edge. Copulatory ducts with largely curved under the posterior edge, the turning of copulatory ducts angular (Fig. 3d–e).

Male (ABARA_04679). Body length 2.44. Carapace length 1.25, width 1.04. Abdomen length 1.23, width 1.19, height 1.36. Leg formula: I, II, IV, III. Leg I 5.38 (1.58, 1.55, 1.62, 0.63). Leg II 3.50 (1.02, 1.01, 0.96, 0.51). Leg III 2.56 (0.80, 0.70, 0.66, 0.40). Leg IV 3.21 (1.02, 0.99, 0.77, 0.43). Diameters of eyes: AME 0.10, ALE 0.09, PME 0.10, PLE 0.10. Interdistances of eyes: AME-AME 0.06, AME-ALE 0.03, PME-PME 1.00, PME-PLE 0.05. Clypeus height 0.19. Coloration similar to female (Fig. 3f–h). The upper part of conductor bulging and bending into nearly right angle form in retrolateral view (Fig. 3k). Embolus thin and long, the basal part of embolus not segmented (Fig. 3i–k).

Distribution. Taiwan (widespread in low-altitude mountains), China, Japan, Korea.

Parasteatoda ducta (Zhu 1998)

(Fig. 4)

Achaearanea ducta: Zhu, 1998, p. 107, f. 64A–C; Song, Zhu and Chen, 1999, p. 90, f. 39E–F.

Parasteatoda ducta: Yoshida, 2008, p. 39 (Transferred from *Achaearanea*); Li *et al*., 2021, p. 112, f. 12–14, 15C, D.

Specimens examined. 2♀♀ (ABARA_03437, 03454), 31 Jan. 2021, 2♀♀ (ABARA_03608–03609), 08 Nov. 2021, Chang-Lin Chung leg., 2♂♂ (ABARA_04178, 04249), 07 Jul. 2022, Yu-Ming Huang, Li Liu and Li-Ping Wang leg., Shuangliu Forest Recreation Area, Shizi Township, Pingtung County; 2♀♀ (ABARA_03893–03894), 16 Mar. 2022, Li Liu leg., Lover's Gorge Waterfall, Maolin District, Kaohsiung City; 1♀ (ABARA_04093), 20 Jun. 2022, Yu-Ming Huang leg., Dingbenzai, Zhuqi Township, Chiayi County; 3♀♀ (ABARA_04507–04509), 23 Aug. 2022, Ting-Kuan Lin leg., Wujie reservoir, Renai Township, Nantou County; 2♀♀ (ABARA_04768–04769), 22 Jan. 2023, Yu-Ming Huang leg., White Deer Suspension Bridge, Heping District, Taichung City; 2♀♀ (ABARA_04833–04834), 13 Apr. 2023, Yu-Ming Huang leg., Fenqihu, Zhuqi Township, Chiayi County.

Diagnosis. This species is similar to *P. transipora* in the body shape and shape of the palp organ. *P. ducta* can be distinguished from the latter by the twisted-roll-shaped copulatory ducts (two copulatory ducts overlapping in *P. transipora*), and the conductor of the male palp organ slender with a sharp tip (wider in *P. transipora*).

Description. Female (ABARA_04709). Body length 2.01. Carapace length 0.82, width 0.69. Abdomen length 1.23, width

1.17, height 1.09. Leg formula: I, IV, II, III. Leg I 2.71 (0.91, 0.80, 0.58, 0.42). Leg II 2.01 (0.62, 0.61, 0.40, 0.38). Leg III 1.62 (0.50, 0.45, 0.37, 0.30). Leg IV 2.47 (0.83, 0.74, 0.48, 0.42). Diameters of eyes: AME 0.08, ALE 0.08, PME 0.08, PLE 0.08. Interdistances of eyes: AME-AME 0.04, AME-ALE 0.03, PME-PME 0.05, PME-PLE 0.04. Clypeus height 0.12. Carapace oval, yellowish brown. Chelicerae, maxillae, labium and sternum yellowish brown. Leg white to light yellow, patella, tibia, metatarsus and tarsus yellow with dark brown ring. Abdomen brownish black, dorsum of abdomen with a discontinuous white band near the midpoint and contains occasional white spots. Spinnerets yellow surrounded with blackish ring (Fig. 4a–c). Copulatory ducts long, twisted-roll-shaped, surround spermathecae. Fertilization ducts long and thin (Fig. 4d–e).

Male (ABARA_04178). Body length 1.32. Carapace length 0.73, width 0.61. Abdomen length 0.91, width 0.63, height 0.61. Leg formula: I, IV, II, III. Leg I 2.65 (0.87, 0.83, 0.59, 0.36). Leg II 1.90 (0.59, 0.57, 0.44, 0.30). Leg III 1.52 (0.51, 0.45, 0.29, 0.27). Leg IV 2.03 (0.67, 0.65, 0.40, 0.31). Diameters of eyes: AME 0.08, ALE 0.08, PME 0.08, PLE 0.08. Interdistances of eyes: AME-AME 0.05, AME-ALE 0.03, PME-PME 0.07, PME-PLE 0.04. Clypeus height 0.12. Coloration of males is lighter than females. Other characteristics are similar to female (Fig. 4f–h). Palps scoop-shaped, embolus long and bends more than one round, distal part thin. Conductor long and tapering (Fig. 4i–k).

Distribution. Taiwan (Taichung, Nantou, Chiayi, Kaohsiung and Pingtung), China.

Parasteatoda transipora (Zhu and Zhang 1992)

(Fig. 5)

Theridion transiporum: Zhu and Zhang, 1992, p. 27, f. 7A–C.

Achaearanea transipora: Zhu, 1998, p. 91, f. 52A–E (Transferred from *Theridion*); Song, Zhu and Chen, 1999, p. 95, f. 44A–D.

Parasteatoda transipora: Yoshida, 2008, p. 39 (Transferred from *Achaearanea*).

Specimens examined. 3♀♀ (ABARA_03473, 03477–03478), 15 Nov. 2021, Yu-Ming Huang and Pin-Huang Hsu leg., Shichuan Village, Caotun Township, Nantou County; 1♀ (ABARA_03575), 29 Oct. 2021, Yu-Ming Huang and Pin-Huang Hsu leg., Giaokeng, Taiping District, Taichung City; 1♀ (ABARA_03590), 03 Oct. 2020, Li-Jing Huang leg., Sapodang, Xiulin Township, Hualien County; 1♀ (ABARA_04675), 08 Nov. 2021, Chang-Lin Chung leg., 2♀♀ (ABARA_03617–03618), 23 Dec. 2021, Yu-Ming Huang leg., 1♀ (ABARA_04292), 06 Jul. 2022, Yu-Ming Huang, Li Liu and Li-Ping Wang leg., 1♀ (ABARA_04777), 12 Jan. 2022, Yu-Chun Hsiao leg., Shuangliu Forest Recreation Area, Shizi Township, Pingtung County; 1♀ (ABARA_03622), 19 Feb. 2022, Yu-Ming Huang leg., Xinhua Experimental Forest Station , Xinhua District, Tainan City; 1♀ (ABARA_03629), 09 Jul. 2020, Pin-Huang Hsu leg., Shixiangshan Farm, Wufeng District, Taichung city; 3♀♀ (ABARA_03748–03750), 25 Mar. 2022, Anansi Brigade leg., Beipu Village, Beipu Township, Hsinchu County; 1♀ (ABARA_04176), 08 Apr. 2022, Yu-Ming Huang leg., Dabaisha, Lyudao Township, Taitung County; 2♀♀ (ABARA_04500–04501), 09 Apr. 2022, Yu-Ming Huang leg., Lyudao Lighthouse, Lyudao Township, Taitung County; 1♂, 1♀ (ABARA_04709–04710), 19 Sep. 2022, Yu-Ming Huang leg., Toushe Reservoir, Yuchi Township, Nantou County; 1♀ (TESRI_Ar2378), 23 Jun. 2017, Chung-Sheng Huang leg., Jufenershan, Guoxing Township, Nantou County; 1♂ (TESRI_Ar5174), 13 May 2020, Chi-Chun Liao leg., Sun Moon Lake Antique

Assam Tea Farm, Yuchi Township, Nantou County; 1♂ (TESRI_ Ar8101), 11 Aug. 2021, Chi Wei leg., Dongyue, Nanao Township, Yilan County.

Diagnosis. This species is similar to *P. cingulata* (Zhu 1998) in body shape and coloration. *P. transipora* can be distinguished from the latter by the overlap of two copulatory ducts in females (separated in *P. cingulata*). The shape of male palp organs of *P. transipora* are oval (round in *P. cingulata*), and conductor wide and long (longer in *P. cingulata*).

Description. Female (ABARA_04709). Body length 2.85. Carapace length 1.24, width 0.98. Abdomen length 2.24, width 1.99, height 1.73. Leg formula: I, IV, II, III. Leg I 5.31 (1.75, 1.57, 1.38, 0.61). Leg II 3.44 (1.10, 1.00, 0.84, 0.50). Leg III 2.44 (0.72, 0.71, 0.58, 0.43). Leg IV 4.07 (1.44, 1.26, 0.93, 0.44). Diameters of eyes: AME 0.09, ALE 0.09, PME 0.09, PLE 0.09. Interdistances of eyes: AME-AME 0.07, AME-ALE 0.03, PME-PME 0.09, PME-PLE 0.06. Clypeus height 0.20. Carapace oval, with a circular thoracic groove; clypeus concave. Carapace, chelicerae, maxillae, labium and sternum blackish brown. Legs white to yellow with black rings. Abdomen yellowish brown to blackish brown, with white pigments. Spinnerets brown surrounded with black ring (Fig. 5a–c). Epigynum yellowish brown, copulatory pore large, with a protrusion at the posterior middle of copulatory pore. Copulatory ducts from wide to narrow, curved as circular shape at the base, circular part of two copulatory ducts overlap together (Fig. 5d–e).

Male (ABARA_04710). Body length 0.93. Carapace length 0.73, width 0.39. Abdomen length 0.89, width 0.41, height 0.47. Leg formula: I, II, IV, III. Leg I 2.42 (0.76, 0.75, 0.54, 0.37). Leg II 1.68 (0.52, 0.52, 0.33, 031). Leg III 1.29 (0.44, 0.35, 0.26, 0.24). Leg IV 1.64

(0.52, 0.51, 0.32, 0.29). Diameters of eyes: AME 0.08, ALE 0.08, PME 0.08, PLE 0.08. Interdistances of eyes: AME-AME 0.03, AME-ALE 0.02, PME-PME 0.07, PME-PLE 0.04. Clypeus height 0.19. Coloration similar to female (Fig. 5f–h). Embolus long and bends more than one round, distal part thin. Conductor long, distal part flat (Fig. 5i–k).

Distribution. Taiwan (Hsinchu, Taichung, Nantou, Tainan, Pingtung, Yilan, Hualien and Taitung), China.

Parasteatoda quadrimaculata (Yoshida *et al.* 2000)

(Fig. 6)

Achaearanea quadrimaculata: *Yoshida et al. 2000*, p. 130, f. 32–35.

Parasteatoda quadrimaculata: Yoshida, 2008, p. 39 (Transferred from *Achaearanea*); Yoshida, 2015, p. 33

Specimens examined. 1♀ (ABARA_03476), 16 Nov. 2021, Yu-Ming Huang and Pin-Huang Hsu leg., Kengkou Village, Wufeng District, Taichung City; 1♀ (ABARA_03824), 06 Apr. 2022, Yu-Ming Hung leg., Chunghai Bridge, Lanyu Island, Taitung County; 1♂ (ABARA_ 04187), 03 Apr. 2021, Chang-Lin Chung leg., Matai trail, Jianshi Township, Hsinchu County; 1♀ (ABARA_04341), 06 Jul. 2022, Yu-Ming Huang, Li Liu and Li-Ping Wang leg., Shuangliu Forest Recreation Area, Shizi Township, Pingtung County; 1♂, 1♀ (ABARA_04612–04613), 02 Dec. 2017, Han-Po Chang leg., Zhishan Yan, Shilin District, Taipei City; 1♀ (ABARA_04614), 18 Feb. 2018, Kuang-Ping Yu leg., Tzaishan, Gushan District, Kaohsiung City; 2♀♀ (TESRI_Ar0047–0048), 12 Jul. 2012, Yin-Yuan Lo leg., Wushikeng, Heping District, Taichung City.

Diagnosis. This species is similar to other *Parasteatoda* species in body shape. *P. quadrimaculata* can be distinguished

from congeneric species by the thick and short female copulatory ducts (longer in other *Parasteatoda* species) and male embolus embedded within the conductor (embolus embedded within the conductor in other *Parasteatoda* species).

Description. Female (ABARA_04341). Body length 3.26. Carapace length 1.46, width 1.28. Abdomen length 2.08, width 1.87, height 1.72. Leg formula: I, IV, II, III. Leg I 7.02 (2.11, 2.32, 1.84, 0.75). Leg II 5.16 (1.67, 1.66, 1.22, 0.61). Leg III 3.82 (1.24, 1.09, 0.99, 0.50). Leg IV 5.26 (1.69, 1.73, 1.23, 0.61). Diameters of eyes: AME 0.09, ALE 0.09, PME 0.10, PLE 0.10. Interdistances of eyes: AME-AME 0.08, AME-ALE 0.05, PME-PME 0.10, PME-PLE 0.07. Clypeus height 0.23. Carapace oval, with a circular thoracic groove; clypeus concave. Carapace, chelicerae, maxillae, labium and sternum yellowish brown. Legs yellowish brown; patella, tibia, metatarsi and tarsi dusky brown. Dorsum of abdomen blackish brown, with four white spots in the front, back, left, and right; Venter of abdomen yellowish white (Fig. 6a–c). Epigynum brown. Copulatory ducts thick and short. Spermathecae relatively large, ellipse shaped (Fig. 6d–e).

Male (ABARA_04187). Body length 2.52. Carapace length 1.10, width 1.02. Abdomen length 1.57, width 1.16, height 1.22. Leg formula: I, II, IV, III. Leg I 7.16 (2.18, 2.30, 1.93, 0.75). Leg II 5.60 (1.75, 1.72, 1.43, 0.70). Leg III 3.7 (1.18, 1.07, 0.93, 0.52). Leg IV 4.73 (1.49, 1.41, 1.13, 0.54). Diameters of eyes: AME 0.11, ALE 0.11, PME 0.11, PLE 0.11. Interdistances of eyes: AME-AME 0.05, AME-ALE 0.03, PME-PME 0.07, PME-PLE 0.05. Clypeus height 0.15. Coloration similar to female (Fig. 6f–h). Embolus black, short, with sharp tip. Conductor translucent, spoon shaped. Embolus not embedded within conductor (Fig. 6i–k).

Distribution. Taiwan (Taipei, Hsinchu, Taichung, Kaohsiung and Pingtung, Lanyu Island)

Remarks. This species differs from other *Parasteatoda* species in terms of coloration and genital organs. Our molecular data (unpublished) confirmed that the female and male specimens belong to the same species and also suggest that it may not belong to the genus *Parasteatoda*. However, given the uncertainty surrounding its accurate generic classification, we have chosen to retain its current taxonomic status to maintain stability.

Discussion

In this study, we redescribe six theridiid species from Taiwan, including four newly recorded *Parasteatoda* species, the first morphological description of male *P. quadrimaculata*, as well as the rediscovered *Campanicola ferrumequina*. Detailed morphological descriptions and photographs are provided for each species.

C. ferrumequina and *P. asiatica* have been recorded in China, Japan, and Korea, while *P. ducta* and *P. transipora* are only known from China. Although we did not examine specimens from other countries, the specimens from Taiwan can be easily identified based on previous morphological descriptions (Zhu and Zhang 1992; Zhu 1998; Song *et al.* 1999; Namkung 2003; Yoshida 2000, 2003, 2009; Yin *et al.* 2012; Kim 2021; Li *et al.* 2021). Furthermore, their ecological behaviors are consistent with previous studies. *P. asiatica* is typically found inhabiting the undersides of leaves, where it constructs irregular webs (Zhu 1998; Namkung 2003; Yin *et al.* 2012). Meanwhile, *C. ferrumequina*, *P. ducta,* and *P. transipora*, are known to inhabit rock walls, where they construct bell-shaped retreats on their webs (Bösenberg and Strand 1906; Zhu 1998: Namkung 2003; Yoshida 1983, 2015; Li *et al.* 2021).

The specimens of *P. culicivora* from

Taiwan correspond well with the descriptions in previous literature. However, another species in Taiwan, *P. kentingensis*, could be confused with *P. culicivora*. *P. kentingensis* is differentiated from *P. culicivora* by the female copulatory ducts largely curved under the posterior edge, and the male palpus conductor is relatively thin, lacking a downward swelling (Yoshida 2015). From our observations, it is difficult to distinguish between the females of *P. culicivora* and *P. kentingensis* based on Yoshida's description. When examining the genital organs, they can be easily misjudged depending on the viewing angle.

Nevertheless, the distinction between these two species is attainable through the characteristics of the male palp organs. However, the male of *P. kentingensis* is similar to the *P. tepidariorum* (C. L. Koch, 1841) based on Yoshida's illustration. Apparently, it's quite difficult to distinguish these species based on morphological characteristics. Resolving the problems of these species may require a detailed comparison with type specimens and conducting the DNA-based species delimitation.

This paper provides the first description of male *P. quadrimaculata*. Based on our examination, we believe that *P. quadrimaculata* is very different from other *Parasteatoda* species in its morphological characteristics, suggesting *P. quadrimaculata* may not belong to *Parasteatoda*. However, we are currently uncertain about the appropriate genus for *P. quadrimaculata*. Therefore, we have decided to temporarily retain its current genus name without change.

This study identified four new record species and one re-discovered species in Taiwan. Additionally, it provided the first description of male *P. quadrimaculata*. These findings would serve as a valuable reference for future research on the taxonomy of the family Theridiidae.

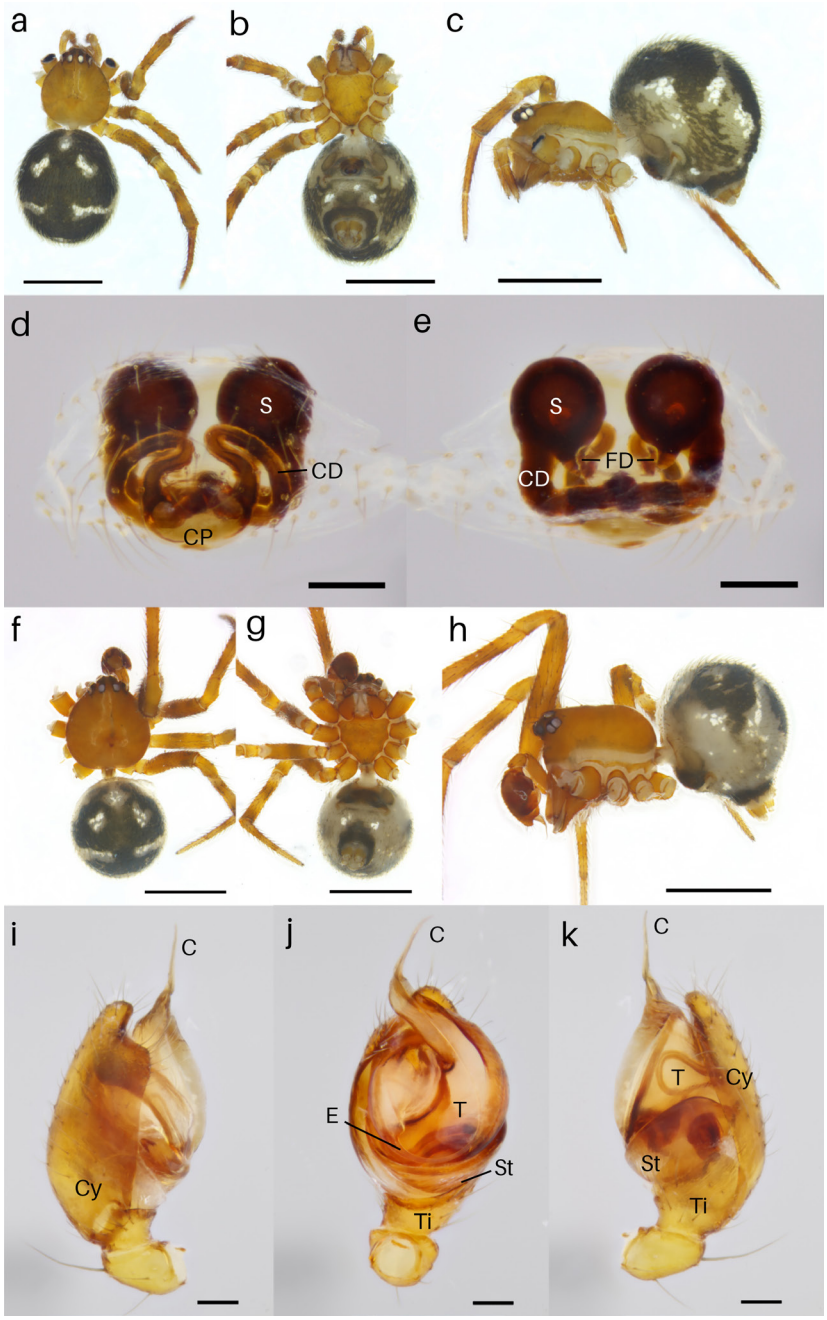

Fig. 1 *Campanicola ferrumequina* a–c, female habitus (a: dorsal view, b: ventral view, c: lateral view); d: female epigynum, e: vulva. f–h, male habitus (f: dorsal view, g: ventral view, h: lateral view). i–k, male left palp (i: prolateral view, j: ventral view, k: retrolateral view). Scale bars: 1 mm (a–c, f–h); 0.1 mm (d–e, i–k).

圖 1 *Campanicola ferrumequina* a–c, 雌蛛 (a: 背面觀 , b: 腹面觀 , c: 側面觀); d: 外雌器腹面觀 , e: 外雌器背面觀 . f–h, 雄蛛 (f: 背面觀 , g: 腹面觀 , h: 側面觀). i–k, 雄蛛左觸肢 (i: 前側面觀 , j: 腹面觀 , k: 後側面觀). 比例尺 : 1 mm (a–c, f–h); 0.1 mm (d–e, i–k).

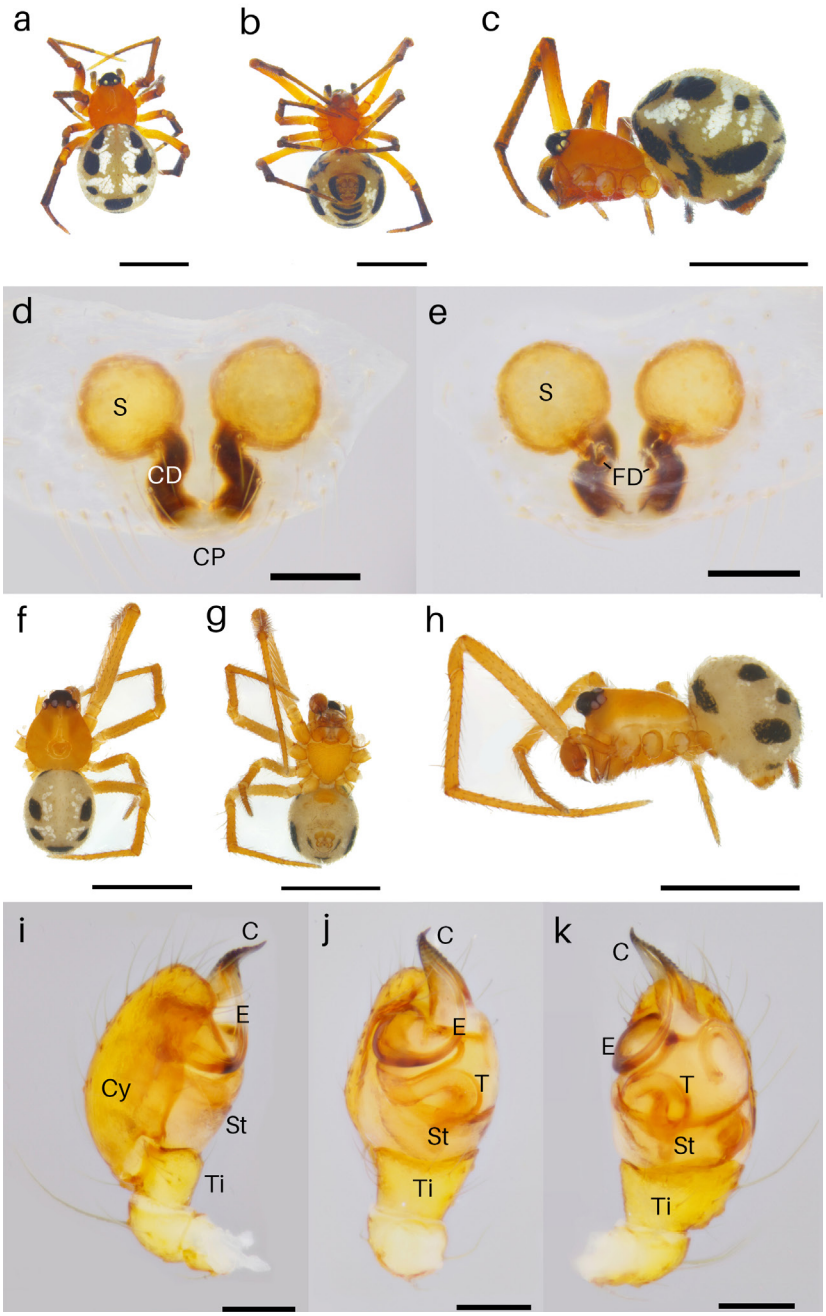

Fig. 2 *Parasteatoda asiatica* a–c, female habitus (a: dorsal view, b: ventral view, c: lateral view); d: female epigynum, e: vulva. f–h, male habitus (f: dorsal view, g: ventral view, h: lateral view). i–k, male left palp (i: prolateral view, j: ventral view, k: retrolateral view). Scale bars: 1 mm (a–c, f–h); 0.1 mm (d–e, i–k).

圖 2 *Parasteatoda asiatica* a–c, 雌蛛 (a: 背面觀 , b: 腹面觀 , c: 側面觀); d: 外雌器腹面觀 , e: 外雌器背面觀 . f–h, 雄蛛 (f: 背面觀 , g: 腹面觀 , h: 側面觀). i–k, 雄蛛左觸肢 (i: 前側面觀 , j: 腹面觀 , k: 後側面觀). 比例尺 : 1 mm (a–c, f–h); 0.1 mm (d–e, i–k).

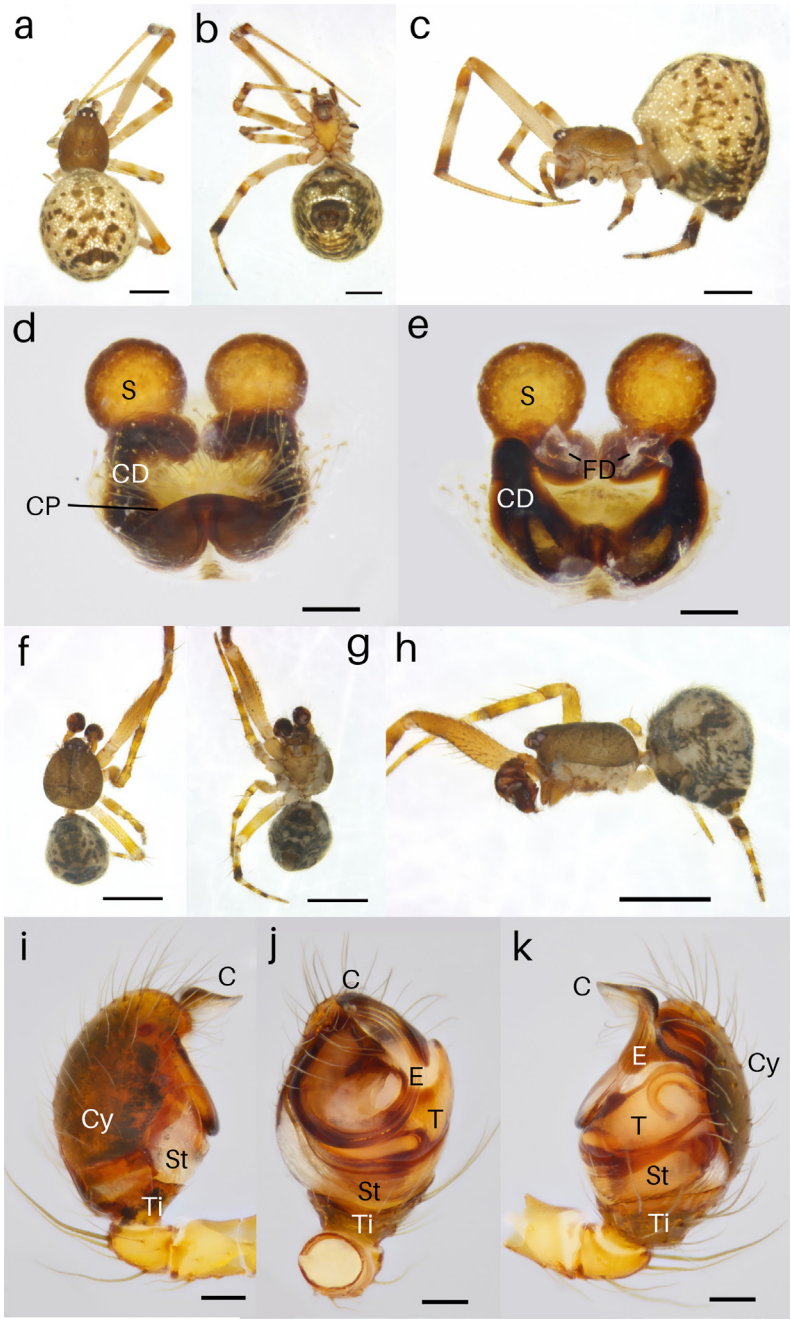

Fig. 3 *Parasteatoda culicivora* a–c, female habitus (a: dorsal view, b: ventral view, c: lateral view); d: female epigynum, e: vulva. f–h, male habitus (f: dorsal view, g: ventral view, h: lateral view). i–k, male left palp (i: prolateral view, j: ventral view, k: retrolateral view). Scale bars: 1 mm (a–c, f–h); 0.1 mm (d–e, i–k).

圖 3 *Parasteatoda culicivora* a–c, 雌蛛 (a: 背面觀 , b: 腹面觀 , c: 側面觀); d: 外雌器腹面觀 , e: 外雌器背面觀 . f–h, 雄蛛 (f: 背面觀 , g: 腹面觀 , h: 側面觀). i–k, 雄蛛左觸肢 (i: 前側面觀 , j: 腹面觀 , k: 後側面觀). 比例尺 : 1 mm (a–c, f–h); 0.1 mm (d–e, i–k).

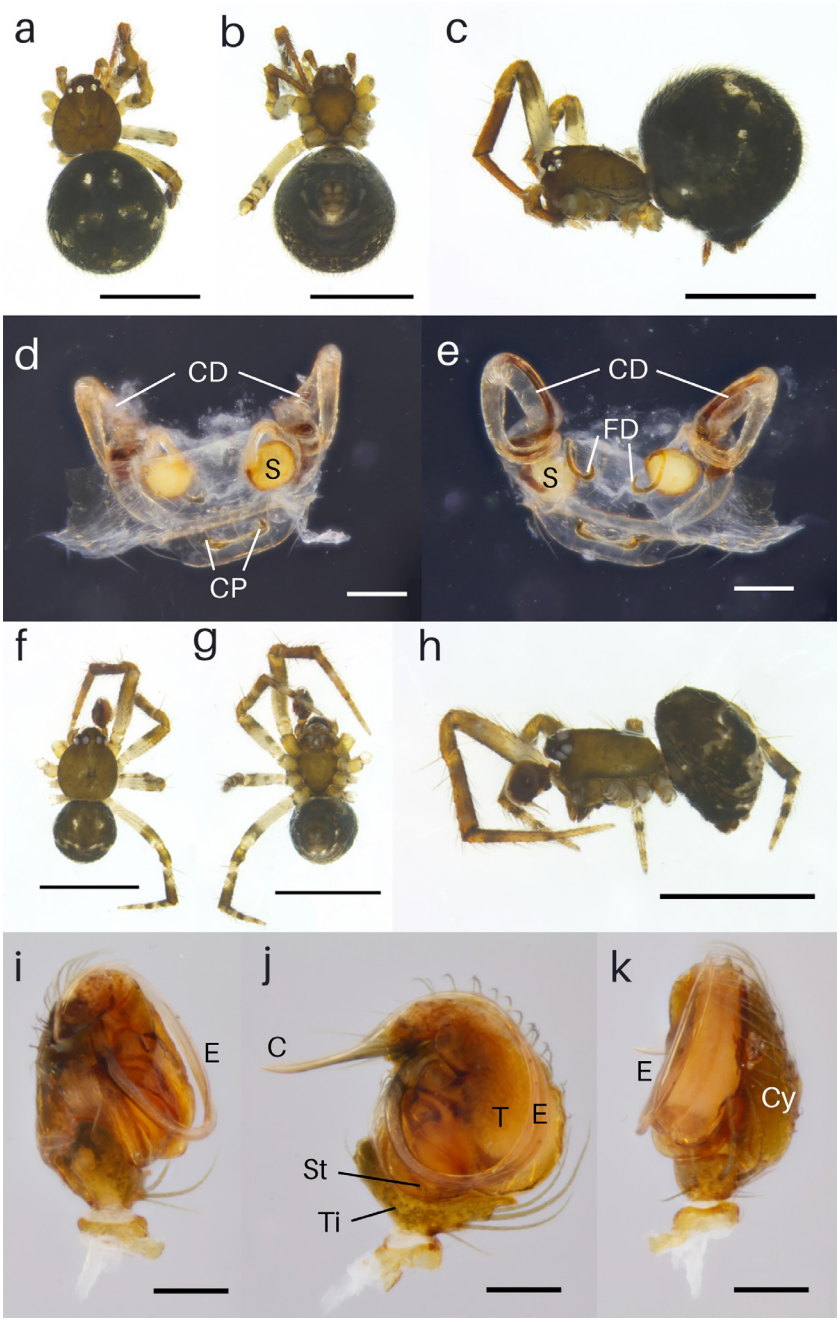

Fig. 4 *Parasteatoda ducta* a–c, female habitus (a: dorsal view, b: ventral view, c: lateral view); d: female epigynum, e: vulva. f–h, male habitus (f: dorsal view, g: ventral view, h: lateral view). i–k, male left palp (i: prolateral view, j: ventral view, k: retrolateral view). Scale bars: 1 mm (a–c, f–h); 0.1 mm (d–e, i–k).

圖 4 *Parasteatoda ducta* a–c, 雌蛛 (a: 背面觀 , b: 腹面觀 , c: 側面觀); d: 外雌器腹面觀 , e: 外雌器背面觀 . f–h, 雄蛛 (f: 背面觀 , g: 腹面觀 , h: 側面觀). i–k, 雄蛛左觸肢 (i: 前側面觀 , j: 腹面觀 , k: 後側面觀). 比例尺 : 1 mm (a–c, f–h); 0.1 mm (d–e, i–k).

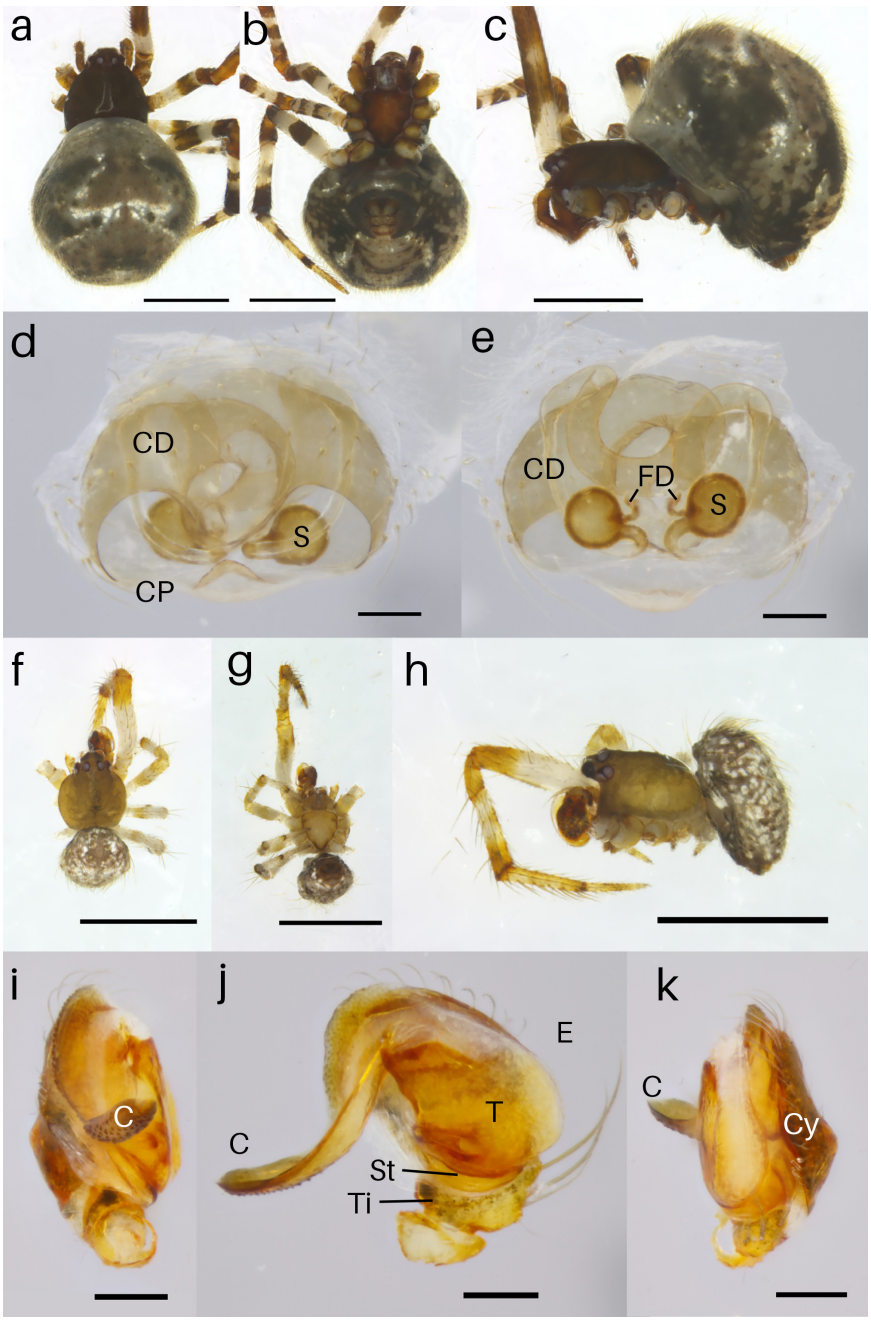

Fig. 5 *Parasteatoda transipora* a–c, female habitus (a: dorsal view, b: ventral view, c: lateral view); d: female epigynum, e: vulva. f–h, male habitus (f: dorsal view, g: ventral view, h: lateral view). i–k, male left palp (i: prolateral view, j: ventral view, k: retrolateral view). Scale bars: 1 mm (a–c, f–h); 0.1 mm (d–e, i–k).

圖 5 *Parasteatoda transipora* a–c, 雌蛛 (a: 背面觀 , b: 腹面觀 , c: 側面觀); d: 外雌器腹面觀 , e: 外雌器背面觀 . f–h, 雄蛛 (f: 背面觀 , g: 腹面觀 , h: 側面觀). i–k, 雄蛛左觸肢 (i: 前側面觀 , j: 腹面觀 , k: 後側面觀). 比例尺 : 1 mm (a–c, f–h); 0.1 mm (d–e, i–k).

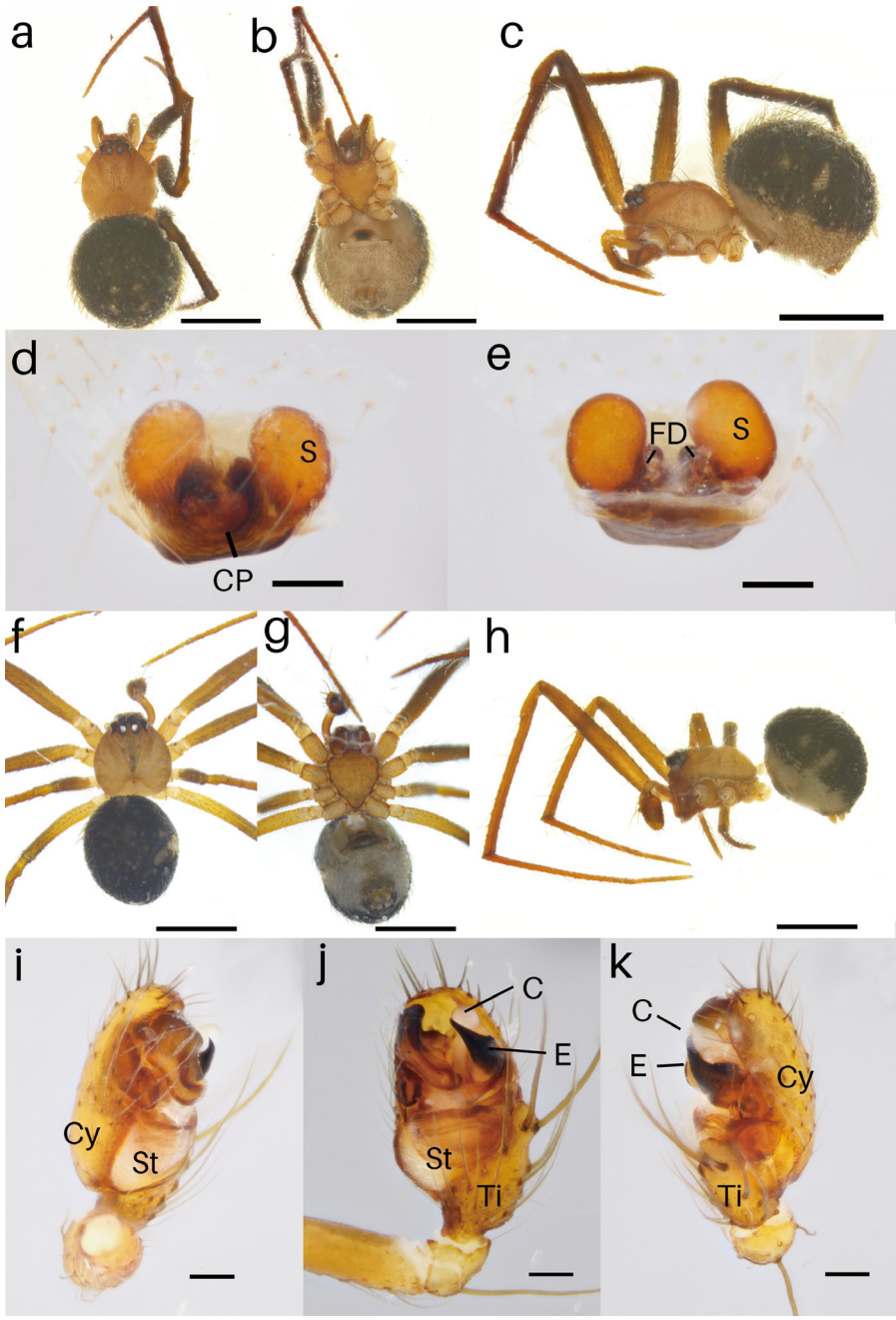

Fig. 6 *Parasteatoda quadrimaculata* a–c, female habitus (a: dorsal view, b: ventral view, c: lateral view); d: female epigynum, e: vulva. f–h, male habitus (f: dorsal view, g: ventral view, h: lateral view). i–k, male left palp (i: prolateral view, j: ventral view, k: retrolateral view). Scale bars: 1 mm (a–c, f–h); 0.1 mm (d–e, i–k).

圖 6 *Parasteatoda quadrimaculata* a–c, 雌蛛 (a: 背面觀 , b: 腹面觀 , c: 側面觀); d: 外雌器腹面觀 , e: 外雌器背面觀 . f–h, 雄蛛 (f: 背面觀 , g: 腹面觀 , h: 側面觀). i–k, 雄蛛左觸肢 (i: 前側面觀 , j: 腹面觀 , k: 後側面觀). 比例尺 : 1 mm (a–c, f–h); 0.1 mm (d–e, i–k).

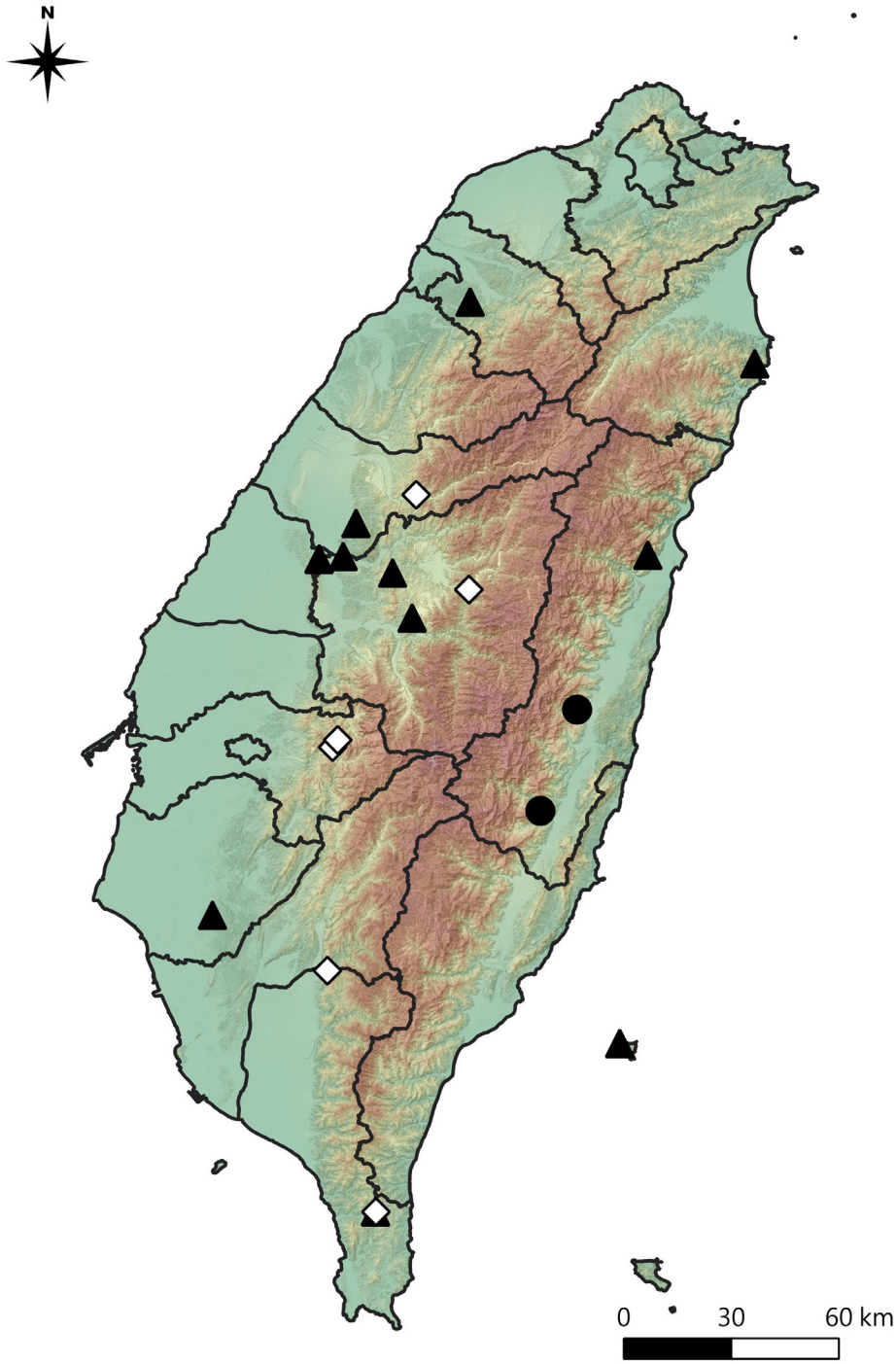

Fig. 7 Distribution of *Campanicola ferrumequina*, *Parasteatoda ducta*, and *Parasteatoda transipora* in Taiwan. ●: *Campanicola ferrumequina*; ◇ : *Parasteatoda ducta*; ▲: *Parasteatoda transipora*.

圖 7 *Campanicola ferrumequina*, *Parasteatoda ducta* 以及 *Parasteatoda transipora* 在臺灣之分布 ●: *Campanicola ferrumequina*; ◇ : *Parasteatoda ducta*; ▲: *Parasteatoda transipora.*

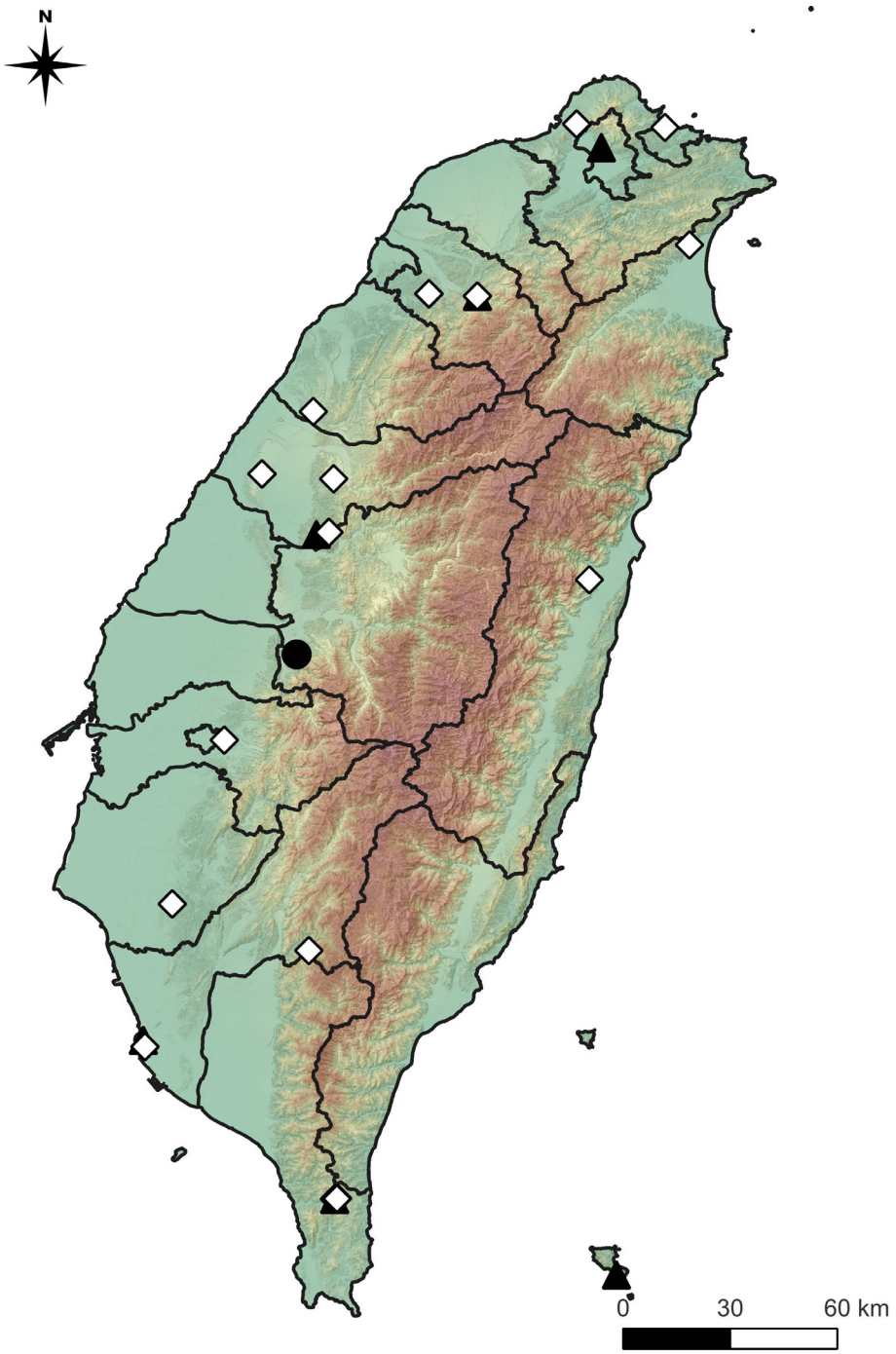

Fig. 8 Distribution of *Parasteatoda asiatica*, *Parasteatoda culicivora*, and *Parasteatoda quadrimaculata* in Taiwan. ●: *Parasteatoda asiatica*; ◇ : *Parasteatoda culicivora*; ▲: *Parasteatoda quadrimaculata.*

圖 8 *Parasteatoda asiatica*, *Parasteatoda culicivora* 以及 *Parasteatoda quadrimaculata* 在臺灣之分布 ●: *Parasteatoda asiatica*; ◇ : *Parasteatoda culicivora*; ▲: *Parasteatoda quadrimaculata.*

Literature Cited

Archer, A. F. 1946. The Theridiidae or comb-footed spiders of Alabama. Museum Paper, Alabama Museum of Natural History 22: 1-67.

Bösenberg, W. and E. Strand. 1906. Japanische Spinnen. Abhandlungen der Senckenbergischen Naturforschenden Gesellschaft 30: 93-422.

Chen, S. H. 1996. A checklist of spiders in Taiwan. Annual of the Taiwan Museum 39: 123-155.

Chu, Y. I. and C. Okuma. 1974. A checklist of spiders in Taiwan. Annual of the Taiwan Museum 17: 29-49.

Kim, S. T. 2021. Spiders V. Arthropoda: Arachnida: Araneae: Theridiidae, Amaurobiidae, Eresidae, Zoropsidae, Anyphaenidae. Invertebrate Fauna of Korea 21(47): 1-230.

Koch, C. L. 1841. Die Arachniden. C. H. Zeh'sche Buchhandlung, Nürnberg, Achter Band, pp. 41-131, pl. 265-288 (f. 621-694); Neunter Band, pp. 1-56, pl. 289-306 (f. 695-726).

Li, Z. C., I. Agnarsson, Y. Peng and J. Liu. 2021. Eight cobweb spider species from China building detritus-based, bell-shaped retreats (Araneae, Theridiidae). ZooKeys 1055: 95-121.

Namkung, J. 2003. The spiders of Korea. Kyo-Hak Publishing Co., Seoul.

Saito, S. 1959. The Spider Book Illustrated in Colours. Hokuryukan, Tokyo.

Song, D. X., M. S. Zhu and J. Chen. 1999. The spiders of China. Hebei Science and Technology Publishing House, Shijiazhuang.

World Spider Catalog. 2023. World Spider Catalog. Version 24. Natural History Museum Bern, Retrieved from http://wsc.nmbe.ch.

Yaginuma, T. 1986. Spiders of Japan in

color (new ed.) Hoikusha Publishing Co., Osaka.

Yin, C. M., X. J. Peng, H. M. Yan, Y. H. Bao, X. Xu, G. Tang, Q. S. Zhou and P. Liu. 2012. Fauna Hunan: Araneae in Hunan, China. Hunan Science and Technology Press, Changsha.

Yoshida, H. 1983. A new species of the genus *Achaearanea* (Araneae: Theridiidae) from Japan. Acta Arachnologica 32: 37-42.

Yoshida, H. 2000. The spider genus *Achaearanea* (Araneae: Theridiidae) from Japan. Acta Arachnologica 49: 137-153.

Yoshida, H. 2003. The spider family Theridiidae (Arachnida: Araneae). Arachnological Society of Japan, 224 pp.

Yoshida, H. 2008. A revision of the genus *Achaearanea* (Araneae: Theridiidae). Acta Arachnologica 57: 37-40.

Yoshida, H. 2009. Uloboridae, Theridiidae, Ctenidae. pp. 142-147, 356-393, 467-468. *In*: Ono, H. (ed.). The spiders of Japan with keys to the families and genera and illustrations of the species. Tokai University Press, Kanagawa.

Yoshida, H. 2015. *Parasteatoda* and a new genus *Campanicola* (Araneae: Theridiidae) from Taiwan. Bulletin of the Yamagata Prefectural Museum 33: 25-38.

Yoshida, H. 2016. *Parasteatoda, Campanicola*, Cryptachaea and two new genera (Araneae: Theridiidae) from Japan. Bulletin of the Yamagata Prefectural Museum 34: 13-30.

Yoshida, H., I. M. Tso and L. L. Severinghaus. 2000. The spider family Theridiidae (Arachnida: Araneae) from Orchid Island, Taiwan: Descriptions of six new and one newly recorded species. Zoological Studies 39: 123-132.

Zhu, M. S. 1998. Fauna Sinica: Arachni-

da: Araneae: Theridiidae. Science Press, Beijing.

Zhu, M. S. and Y. Q. Zhang. 1992. Notes of some species of Theridiidae in Guangxi (Arachnida: Araneae). Journal of the Guangxi Agricultural College 11(1): 20-29.