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Article in *Zootaxa* · March 2013

DOI: 10.11646/zootaxa.3635.1.7

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On the crab spider genus *Angaeus* Thorell, 1881 and its junior synonym *Paraborboropactus* Tang and Li, 2009 (Araneae: Thomisidae)

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Abstract

Morphological comparison of the genera *Angaeus* Thorell, 1881 and *Paraborboropactus* Tang and Li, 2009 (Araneae: Thomisidae) shows that the latter should be relegated to a junior synonym of the former. Further, I propose the following new synonyms: *Angaeus leucomenus* (Thorell, 1895), *Stephanopsis weyersi* Simon, 1899 and *Paraborboropactus leguminaceus* Tang and Li, 2009 = *Angaeus rhombifer* Thorell, 1890 **syn. nov.**, *Paraborboropactus oblatulus* Tang and Li, 2010 = *Angaeus lenticulosus* Simon, 1903 **syn. nov.** The following species are transferred from *Paraborboropactus*: *Angaeus canalis* (Tang & Li, 2010) **comb. nov.**, *Angaeus liangweii* (Tang & Li, 2010) **comb. nov.**, *Angaeus rhombus* (Tang & Li, 2009) **comb. nov.** and *Angaeus zhengi* (Tang & Li, 2009) **comb. nov.** The holotype of *Angaeus pudicus* (type species of the genus) is illustrated, and the male and female of *Angaeus rhombifer* are redescribed and illustrated based partly on fresh material from Singapore. A new species, *Angaeus christae* **sp. nov.** is described based on both sexes, and a syntype of *Angaeus comatulus* Simon, 1909 is illustrated.

Key words: biodiversity, taxonomy, China, India, Vietnam

Introduction

The crab spider genus *Angaeus* currently contains six described species and remains poorly known. All species are restricted to tropical Asia. Their descriptions are all outdated; they have been made more than 100 years ago. The type species of *Angaeus*, *A. pudicus* is known only from males, the five remaining species only from their females. Since 1909 no additional data have been added to the knowledge of this genus.

The genus *Paraborboropactus* Tang and Li, 2009 was established for three new species from Yunnan Province, China. *Paraborboropactus zhengi* Tang and Li, 2009 was designated as the type species of the genus. This and two related species were described based on relatively large series of material of both sexes and well illustrated (Tang & Li 2009, 2010b). One year later three more species were added (Tang & Li 2010a, 2010b). However, the authors, in all occasions, failed to examine if their new species would fit into well established generic concepts for crab spiders from the surrounding countries.

The aim of the present paper is to illustrate the type species of *Angaeus*, *A. pudicus* and to demonstrate that it is a senior synonym of *Paraborboropactus*. Further, morphology of two other species, *A. lenticulosus* Simon, 1903 and *A. rhombifer* Thorell, 1890 is presented, and proposed as senior synonyms of *Paraborboropactus oblatulus* Tang and Li, 2010 and *Paraborboropactus leguminaceus* Tang and Li, 2009 respectively. *Angaeus leucomenus* (Thorell, 1895) and *Stephanopsis weyersi* Simon, 1899 are proposed as junior synonyms of *A. rhombifer*. A new species *Angaeus christae* **sp. nov.** is described based on both sexes.

Material and methods

Types and other specimens were borrowed from the following institutions: MCSN Museo Civico di Storia Naturale

“Giacomo Doria”, Genova; MNHN Muséum National d’Histoire Naturelle, Paris; NHRS Swedish Museum of Natural History, Stockholm; NMINH National Museum of Ireland, Natural History, Dublin; RMBR Raffles Museum of Biodiversity Research, Singapore; RMNH Rijksmuseum van Natuurlijke Historie, Leiden. Methodology follows Benjamin (2011). Specimens used for habitus illustrations were placed in 70% ethanol and photographed using a dissecting microscope (Zeiss Discovery V20) with top illumination and a magnification of up to 150x. Digital images were taken with a Zeiss AxioCam HRc camera. Images were edited using Zeiss AxioVision Rel. 4.8 software package. Left structures are depicted unless otherwise stated. Setae are usually not depicted in the final palp drawings. All measurements are given in millimeters. Morphological abbreviations: AME anterior median eyes, C conductor, E embolus, EC epigynal cavity, EF epigynal folds, ET epigynal teeth, H hood, MA median apophysis, S spermatheca.

Taxonomy

Family Thomisidae

Genus *Angaeus* Thorell, 1881

Angaeus Thorell, 1881: 346 (type species by monotypy *Angaeus pudicus* Thorell, 1881). *Paraborboropactus* Tang and Li, 2009: 713 (type species by original designation *Paraborboropactus zhengi* Tang & Li, 2009). Tang and Li, 2010a: 49; Tang and Li, 2010b: 44. **New synonymy.**

Synonymy. The type species of *Paraborboropactus* is here considered a typical member of the genus *Angaeus* as it fulfills criteria given in the diagnosis below.

Diagnosis. *Angaeus* can be separated from all other thomisids, except for *Borboropactus* Simon, 1884 and *Geraesta* Simon, 1889 by the presence of ET in females (Figs 2D, 5C). Separated from *Borboropactus* by the absence of a sensory patch on tarsi (Benjamin 2011: figs 24C–E). Females can be separated by the presence of an epigynal lip in *Geraesta* (Benjamin 2011: figs 41E, 42C, 44D, 46D). Further, *Angaeus* females can be separated from those of *Geraesta* and *Borboropactus* by the presence of an anterior epigynal cavity or hood (Figs 1C, 3D, 4B, 5C). Separated from *Epidius* by the absence of an elongated male palp tibia (tibia is longer than the cymbium in *Epidius*; Benjamin 2011: fig 35C) and the absence of 4 to 6 thick long spines on the distal margin of the tibia of the male palp (Benjamin 2011: figs 33B, 35C, 36B). Further, enlarged AME, positioned at about 90° to the dorsal surface of the prosoma might be diagnostic (Fig 4C; Tang & Li 2009). However, this needs further investigation.

Remarks. *Angaeus* is related to *Geraesta* and *Borboropactus*. They share the following characters: bulb with a concave MA (absent in *A. christae* **sp. nov.**), hyaline conductor (except for *A. christae* **sp. nov.**), and epigynal teeth (characters: states, 13: 1, 17: 0, 26: 1 in Benjamin 2011). *Angaeus* and *Borboropactus* females also possess a median epigynal septum, termed epigynal folds; character 25: 1 in Benjamin (2011).

Description. See Tang & Li (2009).

Composition. *Angaeus canalis* (Tang & Li, 2010) **comb. nov.**, *A. christae* **sp. nov.**, *A. comatulus* Simon, 1909, *A. lenticulosus* Simon, 1903, *A. liangweii* (Tang & Li, 2010) **comb. nov.**, *A. pentagonalis* Pocock, 1901, *A. pudicus* Thorell, 1881, *A. rhombifer* Thorell, 1890, *A. rhombus* (Tang & Li, 2009) **comb. nov.** and *A. zhengi* (Tang & Li, 2009) **comb. nov.**

Distribution. Burma, China, India, Indonesia, Malaysia, Singapore, Vietnam.

Angaeus lenticulosus Simon, 1903

Figs 1B–E

Angaeus lenticulosus Simon, 1903: 729.

Paraborboropactus oblatulus Tang and Li, 2010a: 53, figs 40A–C, 41A–B. **New synonymy.**

Type material: Syntype of *Angaeus lenticulosus*: female from **VIETNAM: Annam:** Phuc-Son, H.Fruhstorfer, no more data given (MNHN 22125/1573), examined, Figs 1B–E. **Holotype** of *Paraborboropactus oblatulus*: female

from **CHINA: Hainan:** Wuzhishan Mountains, Shuiman Township, riverside (N18°53.024', E109°39.804', alt. 638 m), 11 April 2009, G. Tang (IZCAS, not examined).

Synonymy. The female holotype *Paraborboropactus oblatius* is well illustrated and is here compared with the female syntype of *Angaeus lenticulosus*. I can find no characters that would suggest that the specimens from China illustrated by Tang and Li (2010a) constitute a species different from *A. lenticulosus*.

Diagnosis. Females of *A. lenticulosus* can be distinguished from other species of *Angaeus* by the presence of H, EC and an EF that considerably widens over the copulatory openings (Fig 1C). Males remain unknown.

Description. This species is well described by Tang & Li (2010a).

Distribution. China, Vietnam.

***Angaeus pudicus* Thorell, 1881**

Figs 1F, 2F, 2G

Angaeus pudicus Thorell, 1881: 346

Type material: Holotype of *Angaeus pudicus* Thorell, 1881: male from Waihai (Ceram), 1872, L. U. D. d'Albertis, in MCSN, examined.

Diagnosis. Males of *A. pudicus* can be distinguished from other species of *Angaeus* by the fine tapering RTA.

Remarks. This species might be a senior synonym of *Angaeus liangweii* (Tang & Li, 2010) **comb. nov.** Male palps of both species are very similar in characters RTA, E and C. However, the MA seems to be shorter in *A. liangweii*. As the type localities of both nominal species are far apart, I prefer to keep both names until more specimens of both species could be examined.

Description. The holotype is very fragile with several legs detached and is not measured here to avoid further damage. Habitus as in Fig 1F. Coloration unclear; bleached due to preservation. Palps as in Figs 2F and 2G. RTA tapering to a sharp point, VTA with a relatively rounded tip. Bulb with an ear-shaped median apophysis, conductor membranous, embolus curved, digitiform. Female unknown.

Distribution. Indonesia: Maluku, Wahi.

***Angaeus rhombifer* Thorell, 1890**

Figs 2A–E, 3C, 3D, 4A–C

Angaeus rhombifer Thorell, 1890: 150; Workman, 1896: 88, pl. 88; Koh, 1989.

Angaeus rhombifer var *leucomenus* Thorell, 1895. **New synonymy.**

Stephanopsis weyersi Simon, 1899: 98. **New synonymy.**

Angaeus leucomenus (Thorell, 1895): Simon, 1909: 144.

Paraborboropactus leguminaceus Tang and Li, 2009: 716, figs 16–27. **New synonymy.**

Type material: Holotype of *Angaeus rhombifer* Thorell, 1890: 1 juvenile from **INDONESIA: Sumatra:** leg. H. O. Forbes, depository unknown, not examined. **Holotype** of *Angaeus rhombifer* var *leucomenus*: 1 juvenile from **BURMA:** Tharawaddy, leg. Oates (BMNH 1895.9.21.869), images of the holotype were kindly provided by David Court. **Syntypes** of *Stephanopsis weyersi*: 4 females, 1 juvenile from **INDONESIA: Sumatra:** no more data given (MNHN 10869), examined. **Holotype** and **Paratypes** of *Paraborboropactus leguminaceus*: **CHINA: Yunnan:** Xishuangbanna, Mengla County, Menglun Town (IZCAS, not examined).

Other material examined. **BURMA: Kachin State:** Bhamo, 1 immature female, collection Thorell, det. Thorell (NHRS-MAKA04460). **MALAYSIA: Borneo:** 1 female, West Sabah, 5°59' N 116°42' E, Kinabalu N.P., Poring Hot Springs, 650m, General, fr. Leaves, 8 April 1998, leg. P. Zborowski and C.L. Deeleman-Reinhold (RMNH ARA 15927). **SINGAPORE:** 1 immature female, labeled 'A. *rhombifer* Thorell, det. Workman', collection Workman, no more data given (NMINH 1901.144.348); 1 male, Central Catchment, Venus Road, 13 November 2007, leg. D. J. Court (RMBR).

Synonymy. The syntypes of *Stephanopsis weyersi* and illustrations of the type specimens of *Paraborboropactus leguminaceus* by Tang and Li (2009) unambiguously match material of *A. rhombifer*

determined by Thorell and examined by me. The two immature females from Thorell and Workman collections are very close to maturing and the characteristic outline of the epigynum is clearly visible. The holotype of *Angaeus rhombifer* var *leucomenus* is a subadult female. The validity of a sympatric taxon based on juvenile specimens is difficult to assess. Fortunately, the characteristic outline of the epigynum is clearly visible. Based on this observation, I consider this name a junior subjective synonym of *Angaeus rhombifer* Thorell, 1890.

Diagnosis. Males of *A. rhombifer* can be distinguished from other species of *Angaeus* by the robust, broad based RTA (Figs 2A, 2B; Tang & Li, 2009: fig 20). Females can be distinguished by the lack of H and the presence of a narrow EF that somewhat widens over the copulatory openings (Figs 2D, 3D; Tang & Li, 2009: fig 21).

Description. This species is well described by Tang and Li (2009). Measurements of the male from Singapore, Total: 5.1, Prosoma: length 2.8 width 2.7, Abdomen: length 3.1 width 2.7, Leg 1: femur 4.0, patella 1.4, tibia 3.8, metatarsus 2.5, tarsus 1.2 (total = 12.9). Leg 2: femur 3.7, patella 1.2, tibia 3.7, metatarsus 2.5, tarsus 1.2 (total = 12.3). Leg 3: femur 1.8, patella 0.9, tibia 1.3, metatarsus 1.1, tarsus 0.8 (total = 5.9). Leg 4: femur 2.1, patella 0.8, tibia 1.6, metatarsus 1.4, tarsus 0.8 (total = 6.7). Palp: femur 1.2, patella 0.4, tibia 0.8, tarsus 0.8. Leg formula = 1243. Coloration and markings as in Fig 3C. Palps as in Figs 2A–C. Epigynum and vulva as in Figs 2D, 2E, 3C and 4B.

Distribution. Burma, China, Indonesia, Malaysia, Singapore, Vietnam.

Angaeus christae sp. nov.

Figs 3A, 3B, 3E, 5A–D

Type material: HOLOTYPE: male from **MALAYSIA: Borneo:** West Sabah, 6°06' N 116° 50' E, Sorinsim, 5 yr old adjacent sec. forest, Loc 28, canopy fogging *Melochia umbellata* (Sterculiaceae), tree 5 fog 4, leg. Floren, A., 25 February 1997 (RMNH.ARA.15917).

Other material examined. MALAYSIA: Borneo: 1 female, West Sabah, 6°06' N 116° 50' E, Sorinsim, 5 yr old adjacent sec. forest, Loc 34, canopy fogging *Melochia umbellata* (Sterculiaceae), tree 10 fog 2, leg. Floren, A., 11 March 1997 (RMNH.ARA.15946).

Etymology. The species is named in honor of Christa L. Deeleman-Reinhold.

Diagnosis. Males of *A. christae* sp. nov. can be distinguished from males of other species of *Angaeus* by the absences of a MA; females by the presences of kidney shaped S.

Description. Male (holotype): Total length: 5.2; prosoma length: 2.6, width: 2.4. Leg I: femur 3.2, patella 1.2, tibia 2.6, metatarsus 1.7, tarsus 0.8. Leg formula 4132. Coloration and markings as in Fig 3A. Palps as in Figs (5A, 5B). **Female:** Total length: 5.2; prosoma length: 2.6, width: 2.4. Leg I: femur 3.2, patella 1.2, tibia 2.6, metatarsus 1.7, tarsus 0.8. Leg formula 4132. coloration and markings as in Fig 3B. Epigynum and vulva as in Figs 3E, 5C and 5D.

Distribution. Known only from the type locality.

Other material examined. *Angaeus comatulus* Simon, 1909: 145. Type material: **Syntypes** of *Angaeus comatulus*: 2 immature females from **VIETNAM:** 'Tonkin' (MNHN 22168/1573), no more data given, examined (Fig 1A).

Acknowledgments

This study was mainly funded by a fellowship from the Alexander von Humboldt Foundation. Additional funding came from Institute of Fundamental Studies and the Zoological Research Museum Alexander Koenig. Thanks to David Court and Christa L. Deeleman-Reinhold for spider specimens; David also readily helped with measuring the male specimen of *A. rhombifer* that he loaned to me and let me use his unpublished images of *A. rhombifer* var *leucomenus*. Thanks to the following curators for granting access to collections under their care: Karen van Dorp (RMNH), Torbjörn Kronestedt and Marika Kaellsen (NHRS), Myles Nolan and Nigel T. Monaghan (NMNH), Christine Rollard and Elise-Anne Leguin (MNHN), Maria Tavano (MCSN). David Court, Christa L. Deeleman-Reinhold, two anonymous reviewers and Christoph Muster read and improved the manuscript; I am extremely grateful to all of them.

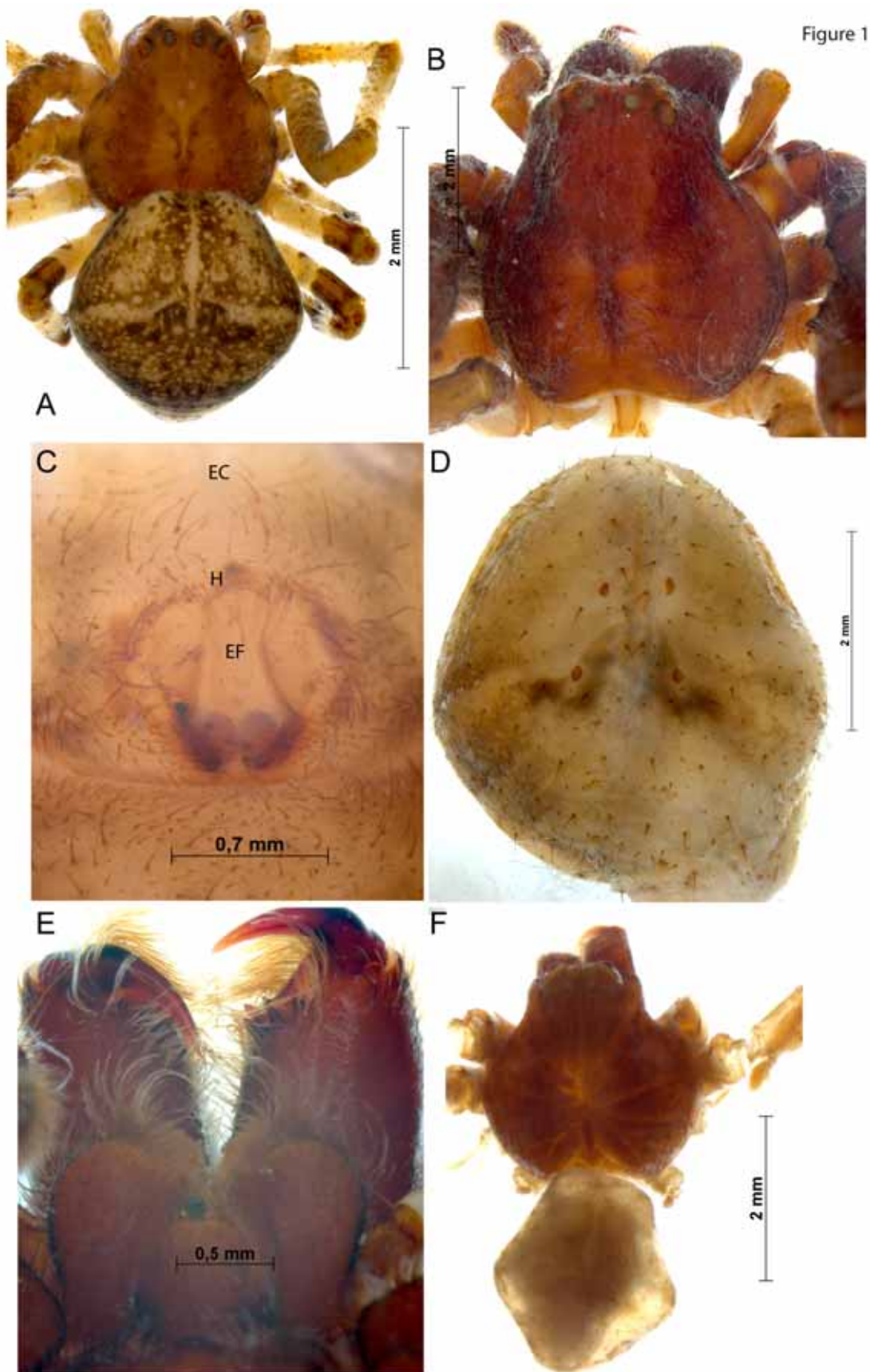


FIGURE 1. *Angaeus comatulus*. A juvenile syntype (MNHN 22168/1573), habitus (dorsal). B–E *Angaeus lenticulosus* female syntype (MNHN 22125/1573). B prosoma (dorsal); C epigynum (ventral); D opisthosoma (dorsal); E chelicerae (ventral). *Angaeus pudicus*. F male holotype (MCSN), habitus (dorsal).

Figure 2

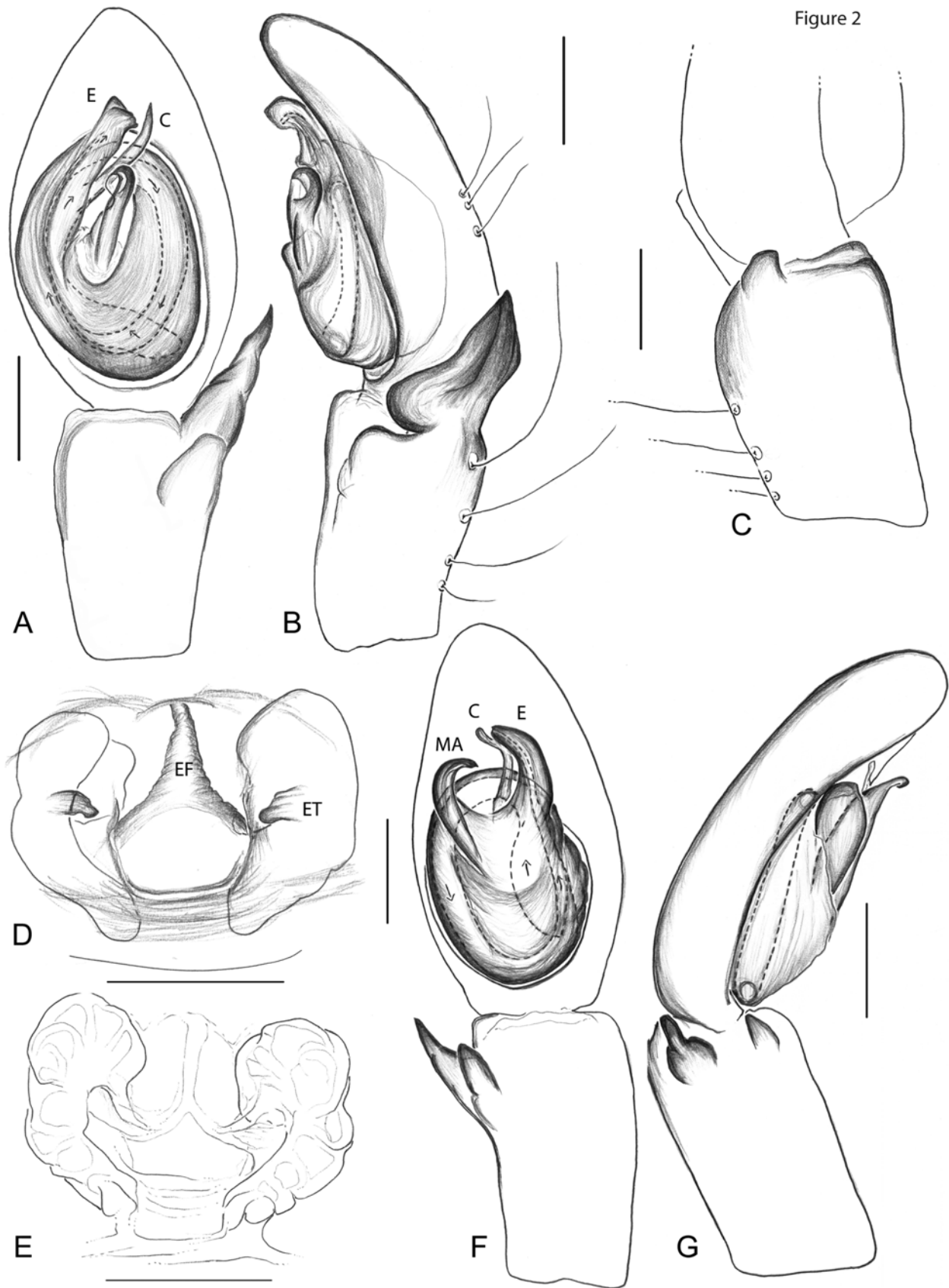


FIGURE 2. *Angaeus rhombifer* (RMBR). A–C male from Singapore, left male palp (A ventral, B retrolateral, C prolateral); D–E Syntype of *Stephanopsis weyersi* (MNHN 10869) (D epigynum, ventral, E vulva, dorsal); F–G *Angaeus pudicus*, male holotype, right palp (F ventral, G retrolateral). Scale bars = 0.2 mm.

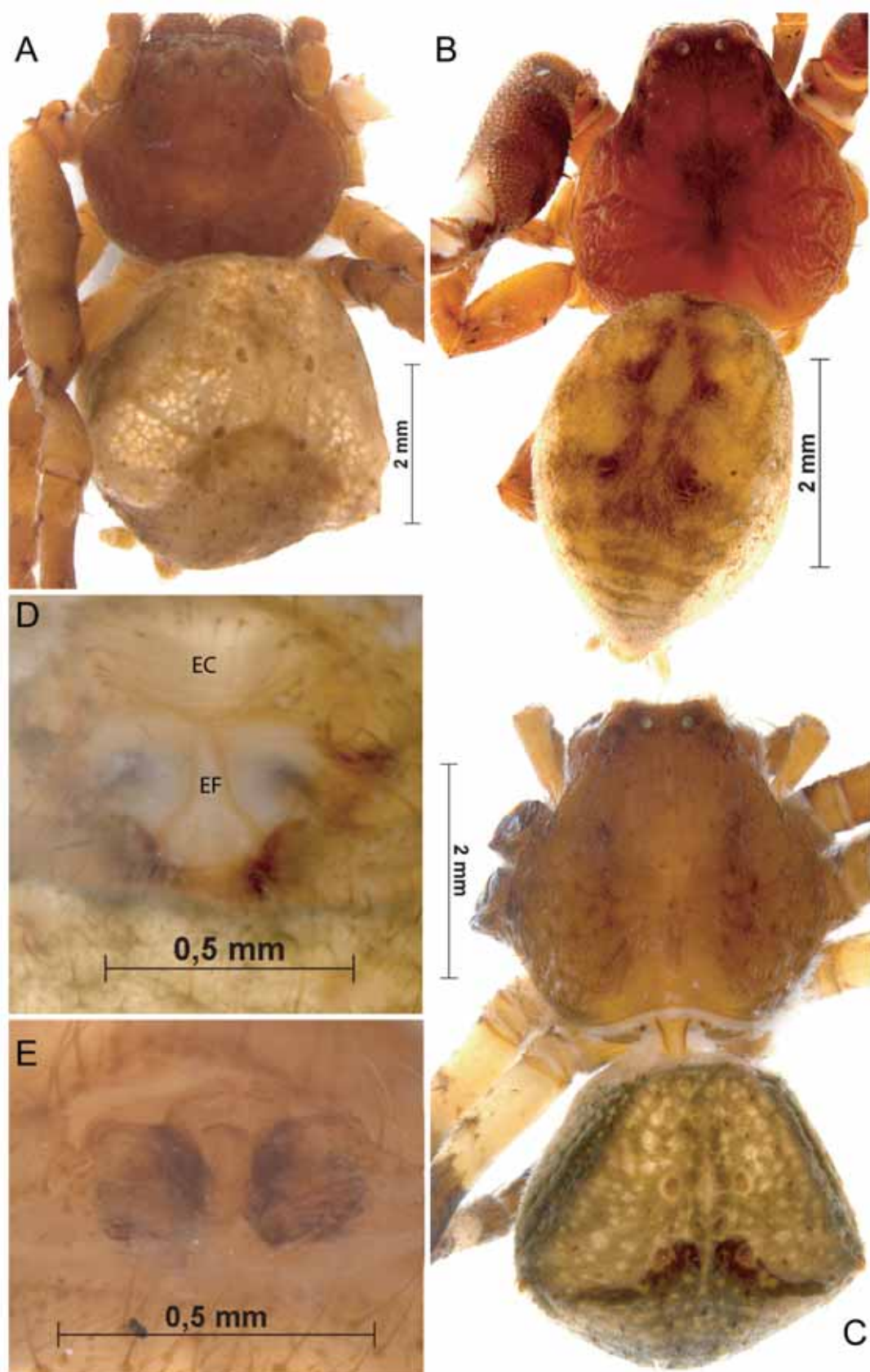


FIGURE 3. *Angaeus christae* **sp. nov.** A female (RMNH 15917), habitus (dorsal); B male holotype (RMNH 15946), habitus (dorsal); E female (RMNH 15917), epigynum (ventral). *Angaeus rhombifer*. C female from Poring Hot Springs (RMNH 15927), habitus (dorsal); D epigynum (ventral).

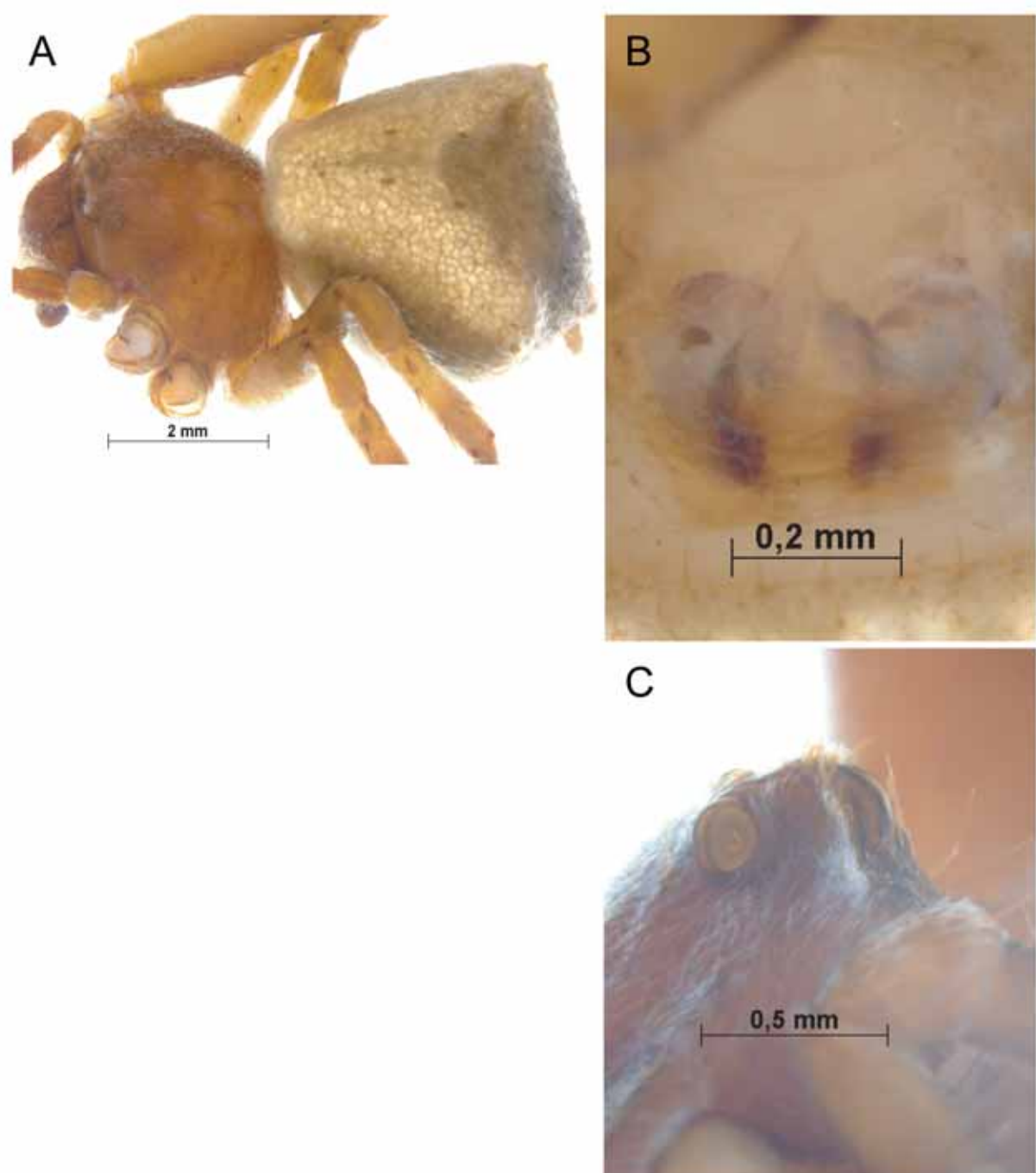


FIGURE 4. *Angaeus rhombifer*. Syntype of *Stephanopsis weyersi* (MNHN 10869). A female habitus (dorsal); B epigynum (ventral); C eye region.

Figure 5

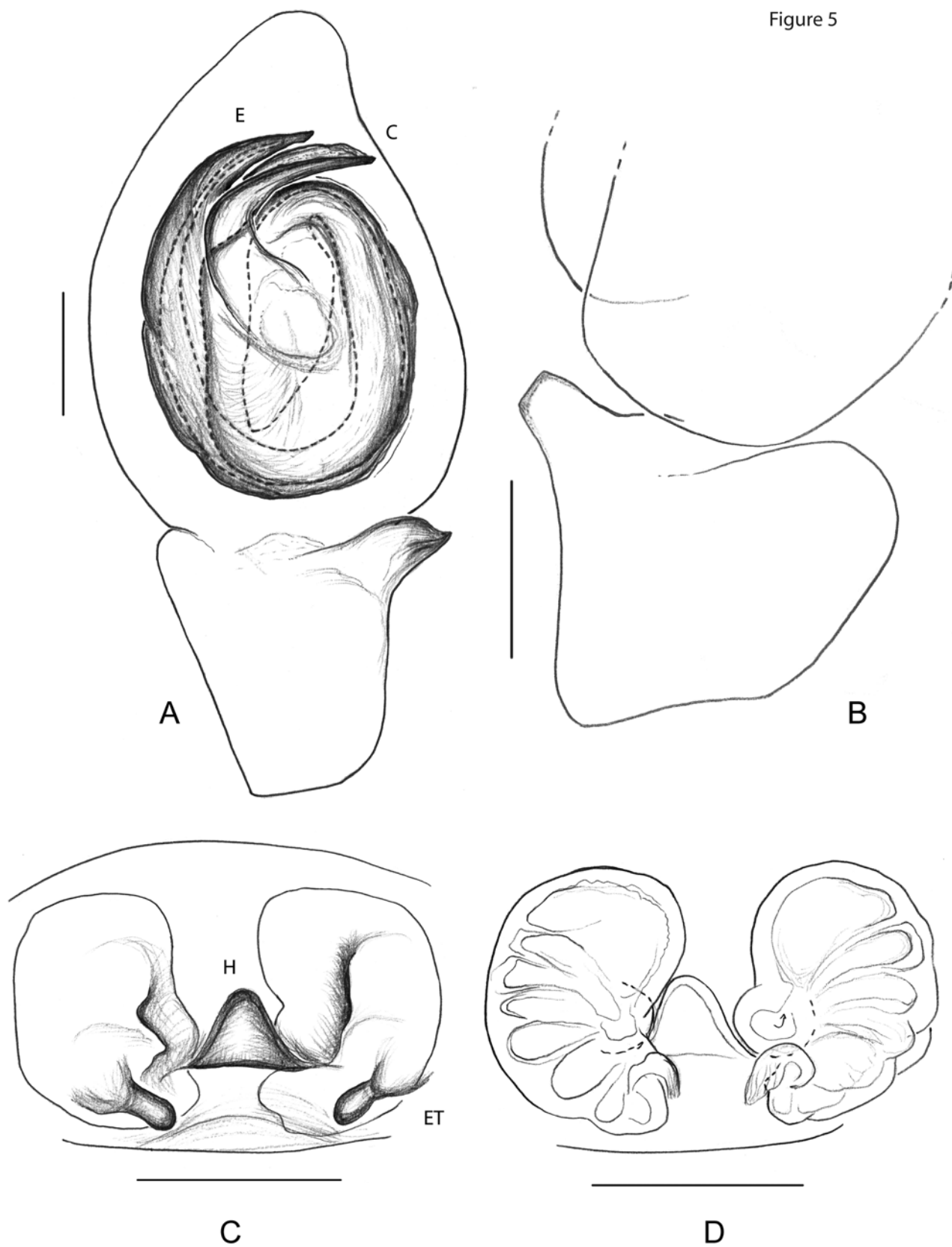


FIGURE 5. *Angaeus christae* sp. nov., A–B left male palp (A ventral, B retrolateral); C epigynum (ventral); D vulva (dorsal). Scale bars = 0.2 mm.

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