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Eleven new species of theridiosomatid spiders from southern China (Araneae, Theridiosomatidae)

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Abstract

Two new genera of the spider family Theridiosomatidae, *Alaria* **gen.n.** with the type species *Alaria chengguanensis* **sp. n.**, *Menglunia* **gen.n.** with the type species *Menglunia inaffecta* **sp. n.**, are described from Guizhou and Yunnan, China. Nine more new species from Guangxi, Guizhou, Hainan and Yunnan Provinces of southern China are described: *Baalzebub rastrarius* **sp. n.**, *B. youyiensis* **sp. n.**, *Karstia nitida* **sp. n.**, *K. prolata* **sp. n.**, *Ogulnius hapalus* **sp. n.**, *Theridiosoma plumaria* **sp. n.**, *T. triumphalis* **sp. n.**, *T. vimineum* **sp. n.**, *Zoma fascia* **sp. n.** The type specimens are deposited in the Institute of Zoology, Chinese Academy of Sciences in Beijing.

Keywords

Biodiversity, taxonomy, canopy, cave, leaf litter

Introduction

Theridiosomatids are small (usually ≤ 3mm), widely distributed, and cryptozoic spiders, which can be found in damp, dark habitats (litter layer of forest or caves). They can be easily recognized by the presence of a pair of pits on the anterior margin of the sternum near the labial base (Fig. 9D), the disproportionately large globular pedipalps (except for genus *Menglunia*), and the long dorsal trichobothria on the third and fourth tibia (Coddington 1986).

The genera of family Theridiosomatidae were reviewed and revised by Coddington in 1986. Based on cladistic analysis, he recognized 4 subfamilies: Platoninae, Epeirotypinae, Ogulniinae and Theridiosomatinae. He also described/redescribed 9 genera and validated 28 species in his paper. Since then, 5 new genera and 25 new species have been discovered worldwide. In 2011, Wunderlich introduced three new theridiosomatid species from Laos and recognized one new subfamily: Luangnaminae. He also downgraded Platoninae, Epeirotypinae, and Ogulniinae to tribal rank based on rare or special characters. According to Platnick (2012), there are currently 16 genera and 89 species belonging to this family. Three widespread genera including *Ogulnius*, *Theridiosoma*, *Wendilgarda*, can be found in China and other Asian countries. The genus *Coddingtonia* was the first genus known only from China. As a monotypic genus, *Coddingtonia* is distinguished from other theridiosomatids by its distantly-separated spermathecae and long copulatory ducts. Miller et al. (2009) also discovered new species from other six genera, three of which were found in China for the first time. *Zoma dibaiyin* as the second speices and first known male from the genus *Zoma*, gives us new thoughts about the validation of *Theridiosoma taiwanica* (Zhang & Zhu, 2006). According to the illustrations given by that paper, we found that it resembles several critical features possessed by *Zoma* rather than *Theridiosoma*. We have no doubt that it will make more sense if it could be transferred to genus *Zoma*. The genus *Karstia*, including two species, was created by Chen (2010). As the second genus endemic to China, *Karstia* is placed in the Theridiosomatinae for three synapomorphies it shares with the other members of this subfamily: a row of short bristles on the cymbium at the junction with cymbial lamella, elongated median apophysis with a trough or groove along its upper surface, and singly attached egg sacs (Chen 2010: figs 12, 13, 30). Two new species of *Kastia* are described here in this paper, merely on the basis of the female characteristics, further diagnosis will be done when males are collected. To a certain extant, *Karstia* and *Baalzebub* are seemingly closely related, despite the fact *Karstia* has a few unique features: presence of cymbium apophysis, and stout, overlapped spermathecae, the accuracy or verity of it is still questionable to us, and more study efforts desperately need to be put into this extraordinary genus in the future.

Theridiosomatids in China are mainly found in the southern provinces: Guangxi, Guizhou, Hainan, Taiwan and Yunnan, which is consistent with the tropical and subtropical preferences typical for this family. Some theridiosomatids are associated with caves, which are characterized by stable humidity and temperature. In this paper, we provide descriptions and distribution data for eleven new species collected in Guangxi, Guizhou, Hainan and Yunnan.

Method

Specimens were examined using a LEICA M205 C stereomicroscope. Further details were studied under an Olympus BX51 compound microscope. All illustrations were made using a camera lucida attached to an Olympus BX51 compound microscope, and then inked on ink jet plotter paper. Male and female genitalia were examined and illustrated after being dissected from the spiders' bodies. Left pedipalps of male spiders were illustrated, except as otherwise indicated. Vulvae of female were removed and cleared in lactic acid or warm 10% potassium hydroxide (KOH) solution before illustration. All embolic divisions and vulvae were illustrated after being embedded in Arabic gum. Type specimens examined were preserved in 75% ethanol solution. Photos were taken with an Olympus c7070 wide zoom digital camera (7.1 megapixels) mounted on an Olympus SZX12 stereomicroscope. Images from multiple focal planes were combined using Helicon Focus (version 3.10.3) image stacking software. All measurements are given in millimeters. Leg measurements are shown as: total length (femur, patella, tibia, metatarsus, tarsus).

SEM images were taken using the HITACHI S-3000N at the Institute of Genetics and Developmental Biology, Chinese Academy of Sciences. Specimens for SEM examination were critical point dried and sputter coated with gold-palladium. Specimens were mounted on copper pedestal using double-sided adhesive tape.

All type specimens are deposited in the Institute of Zoology, Chinese Academy of Sciences in Beijing.

Chaetotaxy. Macrosetae are marked for the dorsal (d), prolateral (p), retrolateral (r), and ventral (v) surfaces of the legs. Metatarsal trichobothrium (Tm) is given as the ratio of the distance between the proximal margin of the metatarsus and the root of the trichobothrium divided by the total length of the metatarsus (Locket and Millidge 1953) and Tm value for each leg is given as Tm I, Tm II, Tm III, Tm IV respectively.

Abbreviations and conventions. Abbreviations used in the text are given in Table 1. References to figures in cited papers are listed in lowercase type (fig.); Figures of this paper are noted with an initial capital (Fig.).

When extra materials are examined and recorded, and the paratype's collecting information is the same as holotype's, it will be implied in brackets as [same data as holotype].

Table 1. List of abbreviations used in the text and figures.

Male pedipalp	
Co	conductor
E	embolus
EA	embolic apophysis
MA	median apophysis
PC	paracymbium
T	tegulum
Vulva	
CD	Copulatory duct
S	spermatheca
Spinnerets spigot morphology	
AC	aciniform gland spigot
AG	aggregate gland spigot
ALS	anterior lateral spinneret
CY	cylindrical gland spigot
FL	flagelliform gland spigot
MAP	major ampullate gland spigot

mAP	minor ampullate gland spigot
PI	piriform gland spigot
PLS	posterior lateral spinneret
PMS	posterior median spinneret
t	tartipore
Institution	
IZCAS	Institute of Zoology, Chinese Academy of Sciences

Taxonomy

Key to Theridiosomatidae from southern China

(Species known from one sex is marked as 'm' or 'f' to represent their holotype's sex 'male' or 'female'; if unmarked, it means they are known from both sexes)

1 Posterior median eyes separated by about their diameter or more (Figs 20C–D) **2**
– Posterior median eyes separated by less than 1/2 their diameter or less (Figs 7C–D) **3**
2 The turning made by the copulatory ducts bends outwardly (Fig. 20B). Median apophysis mesally with a projection oriented distoventrally (Fig. 19A). Embolic apophysis long, whip-like (Fig. 19C) ..... ***Ogulnius hapalus*** **sp. n.**
– The turning made by the copulatory ducts bends inwardly. Median apophysis with apex oriented distodorsally. Embolic apophysis filiform (Miller et al. 2009: figs 5C, 3D, 4G) .... ***Ogulnius barbandrewsi***
3 Females **4**
– Males **21**
4 Scape present (Fig. 2B) **5**
– Scape absent (Fig. 16A) **14**
5 Scape protruding from beneath the epigynal plate (Fig. 4A) **6**
– Scape protruding from epigyne's posterior rim (Fig. 7A) **9**
6 Scape less sclerotized, smaller and partially exposed (Coddington 1986: fig. 206) **7**
– Scape more sclerotized, and utterly exposed. Spermathecae juxtaposed. Copulatory ducts rise and curl up to form a blunt-tipped projection at each side (Figs 2A, 5D) .... ***Alaria chengguanensis*** **sp. n.**
7 Spermathecae juxtaposed, unseparated **8**
– Spermathecae separated (Song and Zhu 1994: fig. 5) .... (f) ***Wendilgarda assmensis***
8 Epigyne with a deeper median invagination of the posterior margin Miller et al. 2009: 11D .... ***Wendilgarda muji***
– Epigyne with a blunt tip and concave posterior margin (Zhu and Wang 1992: fig. 3) .... ***Wendilgarda sinensis***

9 Spermathecae distally fused (Fig. 7B) **10**

– Spermathecae juxtaposed or overlapped (Fig. 11B) **11**

10 Scape with a central pit on the epigynal plate. Spermathecae long,narrow, form an arcade-shaped conformation (Figs 7A–B) .... ***Baalzebub rastrarius* sp. n.**

– Scape with a semi-transparent distal tip. Spermathecae small, elliptical (Figs 9A–B) .... (f) ***Baalzebub youyiensis* sp. n.**

– Epigyne subtriangular, pointed posteriorly with concave margins so medial part is more acute than lateral part (Miller et al. 2009: fig. 3E) .... (f) ***Baalzebub nemesis***

11 Spermathecae juxtaposed (Fig. 11B) **12**

– Spermathecae overlapped at the tip (Chen 2010: fig. 6) **13**

12 Epigyne small, with a short, distally spherical scape protruding from posterior margin of epigynal plate (Figs 17A, D, E) .... (f) ***Karstia nitida* sp. n.**

– Epigyne with a long, apiculate scape protruding perpendicularly (slightly tilted) from posterior margin of epigynal plate (Figs 5A, 18E–F) .... (f) ***Karstia prolata* sp. n.**

13 Epigyne with an apiculate, approximately triangular scape. Spermathecae potato-like, bulging and stout (Chen 2010: fig. 20) ...... ***Karstia coddingtoni***

– Epigyne with a triangular scape protruding from its posterior rim. Spermathecae peanut-shape stout and simple (Chen 2010: fig. 6) .... ***Karstia upperyangtz***

14 Spermathecae separated by less their diameter or juxtaposed (Fig. 16B) ... **15**

– Spermathecae separated by nearly their diameter (Miller et al. 2009: fig. 11F) .... (f) ***Coddingtonia euryopoides***

15 Spermathecae spherical, separated from each other (Fig. 16B) .... ***Menglunia inaffecta* sp. n.**

Spermathecae juxtaposed (Fig. 2A) **16**

16 Abdomen with silver patches forming curved transverse strip (Figs 29 C–D) **17**

Abdomen without silver patches forming curved transverse strip **18**

17 The upper rim of the spermathecae is the same height as the copulatory ducts (Miller et al. 2009: fig. 11B) .... ***Zoma didaiyin***

– The spermathecae is above the loop made by the copulatory ducts (Fig. 29B) .... ***Zoma fascia* sp. n.**

18 Epigyne with a deep atrium, height of opening about one third the width in posterior view (Miller et al. 2009: fig. 3B) .... ***Epeirotypus dalong***

– Atrium absent (Miller et al. 2009: fig. 3F) or slit-like (Miller et al. 2009: fig. 13A), height of opening (if visible) much less than one third the width in posterior view **19**

19 Epigyne with pair of processes arising from posterolateral margin running toward each other (Miller et al. 2009: fig. 3H)... (f) ***Theridiosoma shuangbi***

– Epigyne without pair of processes arising from posterolateral margin........ **20**

20 Posterior margin of epigyne with median longitudinal slit (Miller et al. 2009: fig. 9A) .... ***Theridiosoma diwang***

– Posterior margin of epigyne without median longitudinal slit, but with a median transverse ridge (Zhang et al. 2006: fig. 2)...... ***Theridiosoma taiwanica***

21 Embolic apophysis absent (Fig. 1C) **22**

– Embolic apophysis present (Fig. 6C) **24**

22 Tegulum without tuberculate-textured mesal lobe **23**

– Tegulum with tuberculate-textured mesal lobe. Median apophysis lightly sclerotized, with fine distoventral projection. Conductor a complex of sclerotized and membranous structure enveloping thick embolus for most of its length (Miller et al. 2009: fig. 2A) .... ***Epeirotypus dalong***

23 Embolus long, whip-like, mostly enveloped in conductor (Figs 1B–D). Median apophysis disproportionately large, orienting and stretching along the longitudinal axis of pedipalp (Figs 1A, 3A) ..... ***Alaria chengguanensis* sp. n.**

– Embolus short, stout (Figs 15B, 17B). Tegulum suboval shaped (Fig. 15D). Median apophysis with a short projection oriented distoventrally (Fig. 15A) .... ***Menglunia inaffecta* sp. n.**

24 Embolic division simple with one filiform embolic apophysis (Fig. 28C)... **25**

– Embolic division complex with more than one embolic apophysis (Fig. 24C) **26**

25 Exposed embolic apophysis short with a triangular tip, embolus 'Z'-shaped (Figs 28A–D) .... ***Zoma fascia* sp. n.**

– Exposed embolic apophysis long; embolic division with a moderate branching (Miller et al. 2009: fig. 10F) .... ***Zoma dibaiyin***

26 The mesal bristle of the embolic apophysis protruding from beneath the conductor and lying long the mesal side of the conductor itself (Coddington 1986: fig. 198) **27**

– The palp without a mesal bristle of apophysis protruding from beneath the conductor and lying long the mesal side of the conductoritself **28**

27 Conductor with a spear-shaped apophysis, above median apophysis (Zhu and Wang 1992: fig. 7) .... ***Wendilgarda sinensis***

– Conductor without a spear-shaped apophysis. Palpa tibia with one trichobothrium. Median apophysis sclerotized with concave dorsal margin (Miller et al. 2009: fig. 12E) .... ***Wendilgarda muji***

28 Embolic apophysis with blunt, spatulate processes, without a mesal bristle (Coddington 1986: fig. 162; Chen 2010: fig. 11) **29**

– Embolic apophysis fragments, filiform, with tips protruding out of conductor (Fig. 24B) **31**

29 Median apophysis elongated and has a trough of groove along its upper surface. Cymbium with apophysis (Chen 2010: figs 26–27) **30**

– Median apophysis small, triangular and cleft (Figs 6A, D). Embolic apophysis spatulate arching structure with abruptly acuminated distal ends (Fig. 6C)... .... ***Baalzebub rastrarius* sp. n.**

30 Cymbium apophysis small. Paracymbium with a long spine on the distal end (Chen 2009: fig. 13) .... ***Karstia upperyangze***

– Cymbium apophysis big, distally crooked. Paracymbium without a long spine (Chen 2009: fig. 27) ....***Karstia coddingtoni***

31 Conductor with plumose branching (Fig. 22C). Median apophysis with a curved lobe attenuates distally (Fig. 23A) ... (m) ***Theridiosoma plumaria*** **sp. n.**

– Conductor without plumose branching **32**

32 Two embolic apophysis fragments form a 'V'-shaped conformation (Figs 24A–B) .... (m) ***Theridiosoma triumphalis*** **sp. n.**

– One embolic apophysis fragment forms a beak-shaped conformation (Figs 26 A–B). Conductor with a piece of long, pliant apophysis protruding from its ridge and stretching towards median apophysis (Figs 26B, D) .... (m) ***Theridiosoma vimineum*** **sp. n.**

Genus *Alaria* gen. n.

urn:lsid:zoobank.org:act:A977D6FD-0DFF-448D-A83D-09193762595F
http://species-id.net/wiki/Alaria

Type species. *Alaria chengguanensis* sp. n.

Etymology. The generic epithet is derived from the Latin ‘alarius’, meaning ‘of wings’, which refers to the two projections of the copulatory ducts at each side, which resembles a pair of wings. Gender is feminine.

Diagnosis. The unique structure of epigyne distinguishes *Alaria* from other theridiosomatids. Like in *Wendilgarda* and *Chthonopes,* the scape in female *Alaria* protrudes from beneath epigynal plate (Coddington 1986: figs 206, 213; Wunderlich 2011: figs 18d–e), but is utterly exposed, and more sclerotized, like a shield attached to the abdomen (Figs 2A–B, 4A–B). The conformation of the copulatory ducts is similar to that in *Ogulnius obtectus* (Coddington 1986: fig. 113), but copulatory ducts make one coil before the conjuncture with spermathecae instead a fold (Fig. 2B). The paracymbium in *Alaria* is neither a T-shaped lobe as in most thridiosomatids nor a broad apophysis as in Epeirotypinae, it is a thick, elongated structure with a small hooked projection (Fig. 3D). The long, whip-like embolus in *Alaria* resembles embolic apophysis in *Ogulnius* (Coddington 1986: figs 100–101, 116, 118)*,* but proportionately much longer and mostly enveloped in conductor (Fig. 1B–D). The median apophysis of *Alaria* is disproportionately large, stretching along the longitudinal axis of pedipalp with two curved, pointed distal ends (Figs 1A, 3A), which is never seen in any other theridiosomatid genus. Based on the combination of features mentioned above, *Alaria* should be recognized as a new genus, and is likely close to *Wendilgarda* and *Chthonopes*.

Species. *Alaria chengguanensis* sp. n.

***Alaria chengguanensis* sp. n.**
urn:lsid:zoobank.org:act:5EEE5079-3F6D-48CC-84D1-1A26BAD71F78
http://species-id.net/wiki/Alaria_chengguanensis
Figs 1–5

Material examined. Holotype: CHINA, Guizhou: Bijie City, Chengguan Town, Xiaohe Village, Xiniu Cave, 27°21.231'N, 105°17.186'E, elevation ca 1515 m, 30 April 2007, J. Liu & Y.C. Lin (IZCAS), 1 male.

Paratypes: [same data as holotype] (IZCAS), 13 males, 8 females.

Etymology. This specific name chéng guān (城关) refers to its type locality; adjective.

Diagnosis. See diagnosis for genus.

Description. Carapace brownish red, with symmetric dark veins. Sternum yellow with dark brown margins. Legs yellow, dark brown distally at joints, especially tibiae. Abdomen tan with dark grey and silver patches (Figs 2A–B).

Male pedipalp: Patella with strong sinuous macroseta. Tibia with two trichobothria. Cymbium with small cluster of long setae proximally (Figs 1B, 3D). Paracymbium elongated, curved near base (Figs 1B, 3D). Tegulum smooth. Median apophysis wide, longitudinally grooved, strongly sclerotized, with curved and pointed distal region. Conductor a thick, looped, blade-shaped structure enveloping embolus for most of its length (Figs 1B–D). Embolus long, slim.

Vulva: Epigyne with long, tongue-shaped scape protruding from beneath its concaved margin. Scape slightly humped with a small transverse opening at its distal end. Spermathecae juxtaposed. Copulatory ducts rise and curl up to form a blunt-tipped projection at each side (Figs 2A, 5D).

Male (holotype): Total length 2.10, carapace 1.24 long, 1.08 wide, clypeus 0.13, sternum 0.6 long, 0.6 wide, coxae IV separated by two thirds their width. Posterior median eyes separated by half their diameter. Macrosetae: Leg I: femur d 1, patella d 1, tibia d 1, p 1, v 2, r 1, metatarsus p 1, v 1; Leg II: femur d 2, patella d 2, tibia d 1, p 1, v 1, r 1, metatarsus p 1, v 1; Leg III: femur d 3, patella d 1, tibia p 1, v 2, metatarsus d 1, p 1, r 1; Leg IV: femur d 1, tibia p 1, v 1, r 1, metatarsus p 1, v 1, r 1. Metatarsal trichobothria: Tm I: 0.27; Tm II: 0.30; Tm III: 0.84; Tm IV: 0.24. Leg measurements: I 3.98 (1.25, 0.50, 0.85, 0.88, 0.50); II 3.09 (1.00, 0.43, 0.63, 0.63, 0.40); III 2.27 (0.68, 0.35, 0.38, 0.48, 0.38); IV 2.95 (0.93, 0.38, 0.63, 0.63, 0.38).

Female (one of paratypes): Total length 2.50, carapace 1.25 long, 1.25 wide, clypeus 0.08, sternum 0.78 long, 0.63 wide, coxae IV separated by 1 time their width. Posterior median eyes separated by half their diameter. Macrosetae as in male. Metatarsal trichobothria: Tm I: 0.21 ; Tm II: 0.25; Tm III: 0.48; Tm IV: 0.27. Leg measurements: I 4.66 (1.05, 0.63, 0.95, 0.95, 0.63); II 3.75 (1.20, 0.55, 0.75, 0.75, 0.50); III 2.48(0.75, 0.33, 0.50, 0.50, 0.40); IV 3.75 (1.25, 0.50, 0.75, 0.75, 0.50).

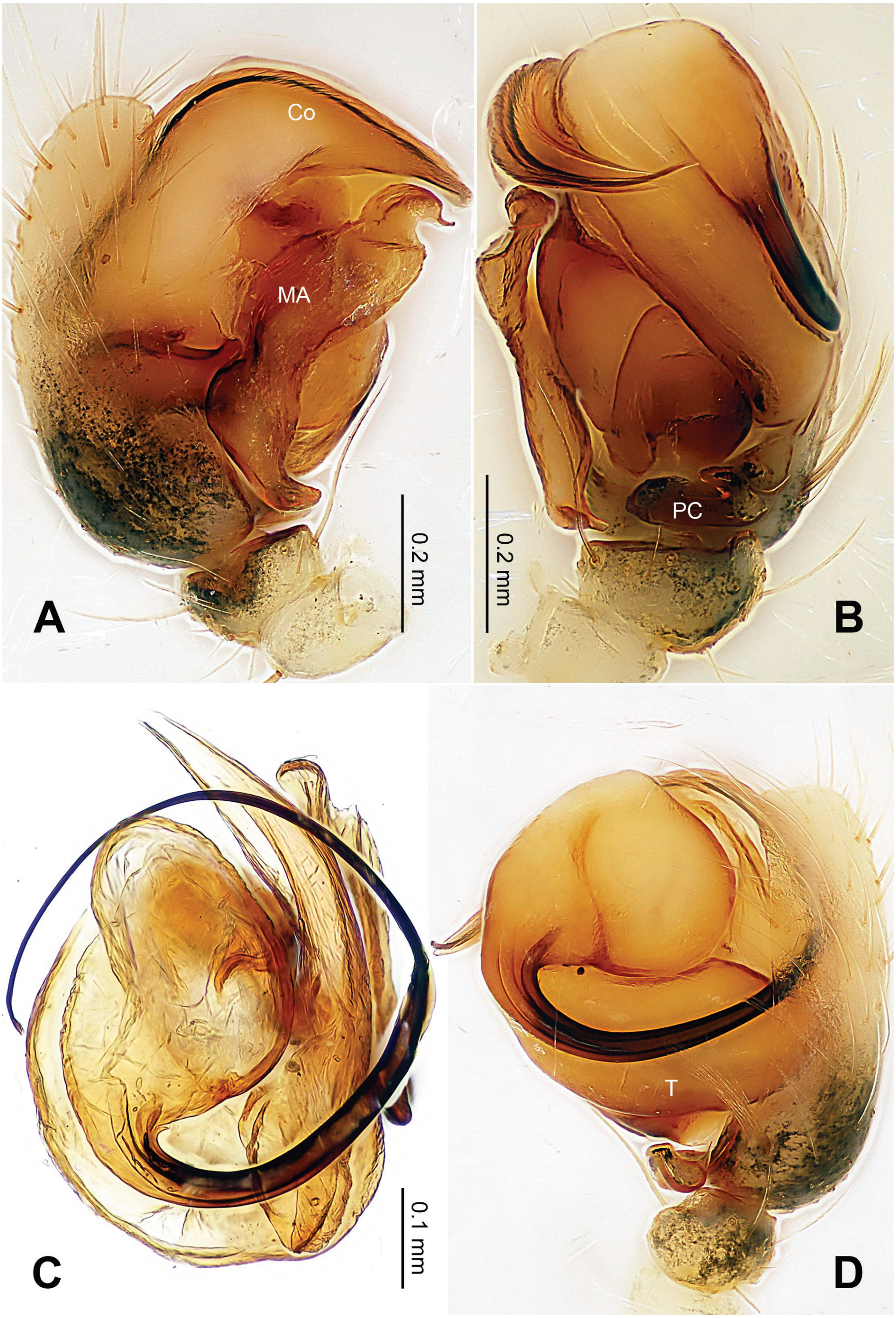

Figure 1. *Alaria chengguanensis* sp. n., male holotype. **A** Pedipalp, prolateral view **B** Pedipalp, ventral view **C** Embolic division, dorsal view **D** Pedipalp, retrolateral view. **Co** conductor; **MA** median apophysis; **PC** paracymbium; **T** tegulum. Scale bars: **D** as **A**.

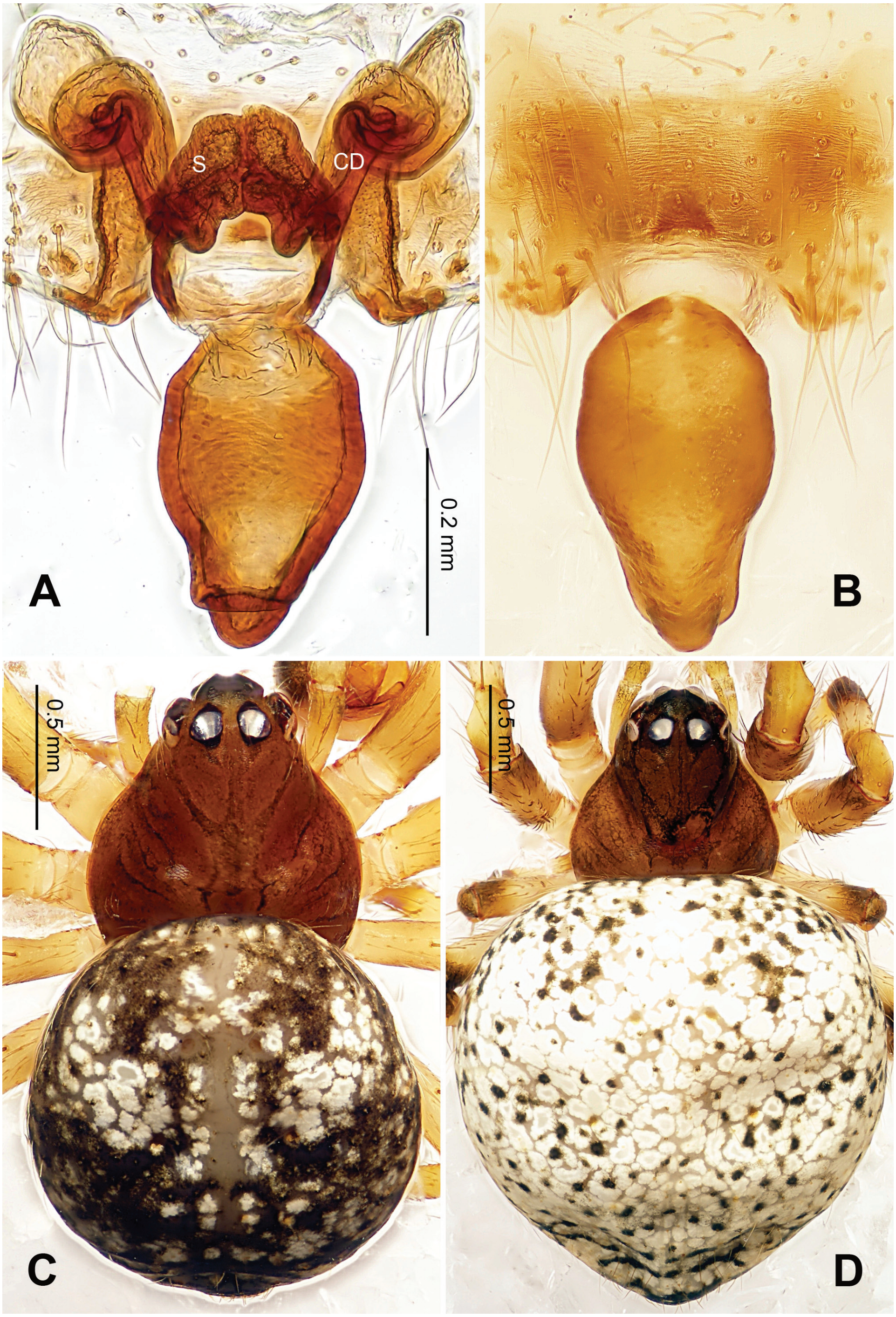

Figure 2. *Alaria chengguanensis* sp. n., male holotype (**C**) and female paratype (**A–B, D**). **A** Vulva, dorsal view **B** Epigyne, ventral view **C** Male, dorsal view **D** Female, dorsal view. **CD** copulatory duct; **S** spermatheca. Scale bars: **B** as **A**.

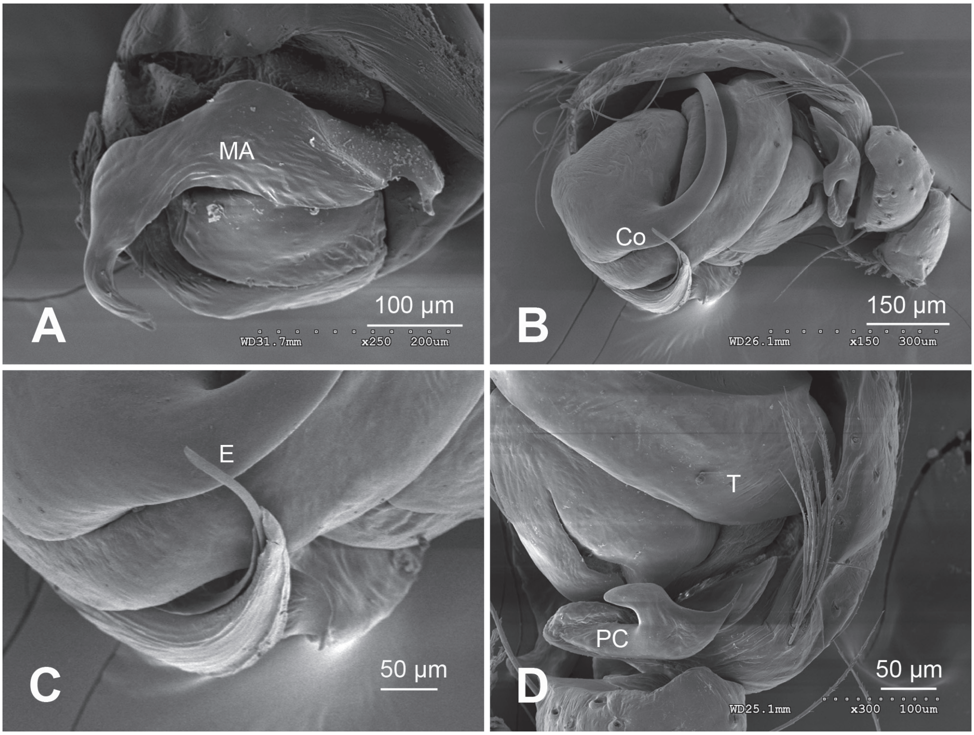

Figure 3. *Alaria chengguanensis* sp. n., SEM of pedipalp of a male paratype. A Prolateral view, detail showing MA **B** Retrolateral view **C** Retrolateral view, detail showing embolus **D** Retrolateral view, detail showing **PC**. **Co** conductor **E** Embolus; **MA** median apophysis; **PC** paracymbium; **T** tegulum.

Genus *Baalzebub* Coddington, 1986

Baalzebub Coddington, 1986: 71. Type species *Baalzebub baubo* Coddington, 1986.

Baalzebub rastrarius sp. n.

urn:lsid:zoobank.org:act:7E74FF15-FCE5-45FB-807A-12724669D543
http://species-id.net/wiki/Baalzebub_rastrarius
Figs 6–8

Material examined. Holotype: CHINA, Guizhou: Bijie City, Chengguan Town, Xiaohe Village, Xiniu Cave, 27°21.231'N, 105°17.186'E, elevation ca 1515 m, 30 April 2007, J. Liu & Y.C. Lin (IZCAS), 1 male.

Paratypes: [same data as holotype] (IZCAS), 1 male, 7 females. CHINA, Guizhou: Xishui County, Sangmu Town, Tuhe Village, Dongkouwan Cave, 28°15.679'N, 106°18.355'E, elevation ca 1271 m, 16 March 2011, Z.G. Chen & Z.W. Zha (IZCAS), 4 males, 8 females; Dafang County, Wenge Town, Taibai Village, Yelaoda

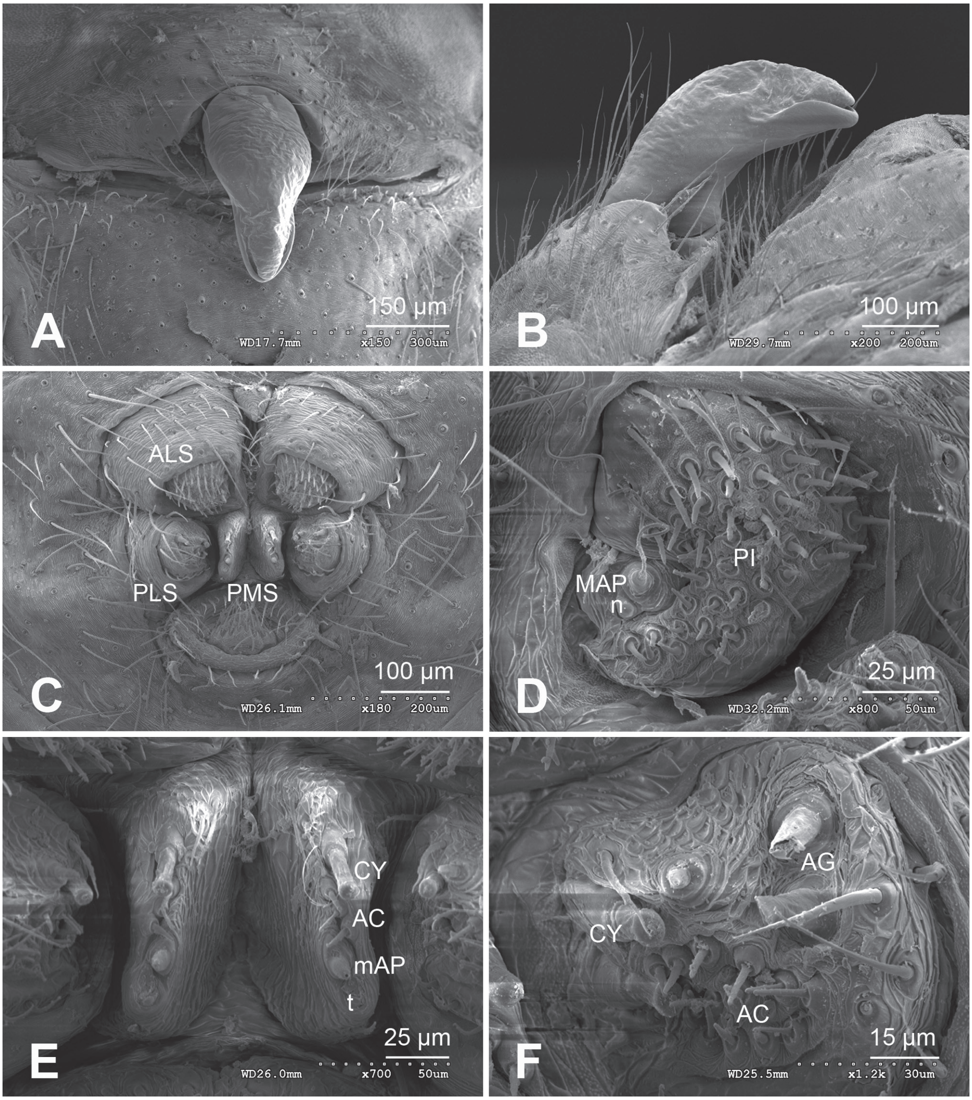

Figure 4. *Alaria chengguanensis* sp. n., SEM of a female paratype. **A** Epigyne, ventral view **B** Epigyne, lateral view **C** Spinnerets **D** ALS **E** PMS **F** PLS. **AC** aciniform gland spigot; **AG** aggregate gland spigot; **ALS** anterior lateral spinneret; **CY** cylindrical gland spigot; **MAP** major ampullate gland spigot; **mAP** minor ampullate gland spigot; **n** nubbin; **PI** piriform gland spigot; **PLS** posterior lateral spinneret; **PMS** posterior median spinneret; **t** tartipore.

Cave, 27°10.869'N, 105°28.289'E, elevation ca 1398 m, 12 March 2011, Z.G. Chen & Z.W. Zha (IZCAS), 2 males, 2 females.

Etymology. The epithet comes from Latin word 'rastrarius' which means 'of a hoe', referring to the hoe-shaped conductor in prolateral view; adjective.

Diagnosis. The presence of small, cleft median apophysis and blunt, spatulate processes of embolic apophysis in males, and tip-fused spermathecae in females indicates

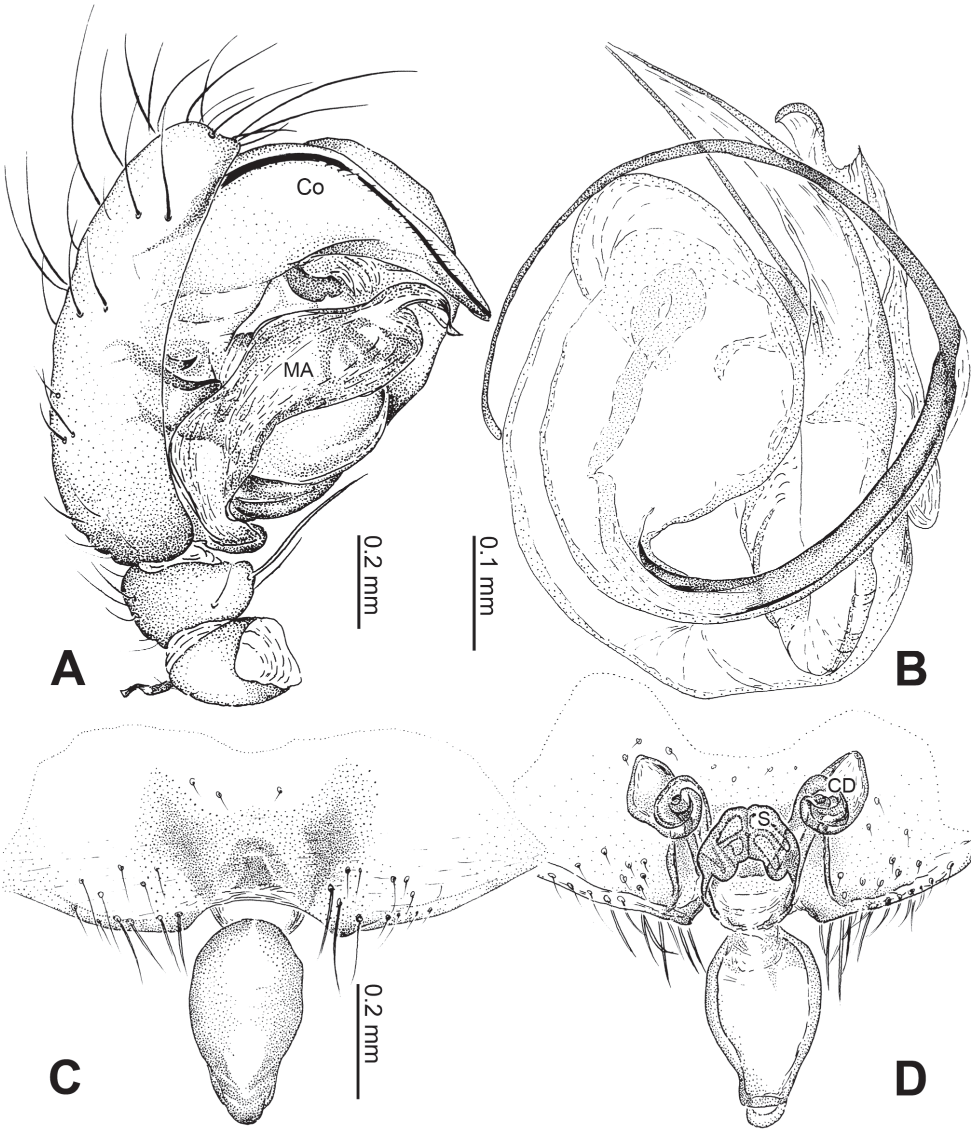

Figure 5. *Alaria chengguanensis* sp. n., male holotype (**A–B**) and female paratype (**C–D**). **A** Pedipalp, prolateral view **B** Embolic division, dorsal view **C** Epigyne, ventral view **D** Vulva, dorsal view. **CD** copulatory duct; **Co** conductor; **MA** median apophysis; **S** spermatheca. Scale bars: **D** as **C**.

that this species belongs to the genus *Baalzebub*. Conductor in males envelopes the entire embolic apophysis (Fig 6A), which is similar to *B. albinotatus*, but the rectangular conductor and the small, pointed cymbium apophysis are different from other described *Baalzebub* species. Females distinguished by the triangular epigynal plate, similar to *B. baubo* (Coddington 1986: figs 183, 184), but distinguished by the narrower, arcade-shaped spermathecae (Fig. 7B).

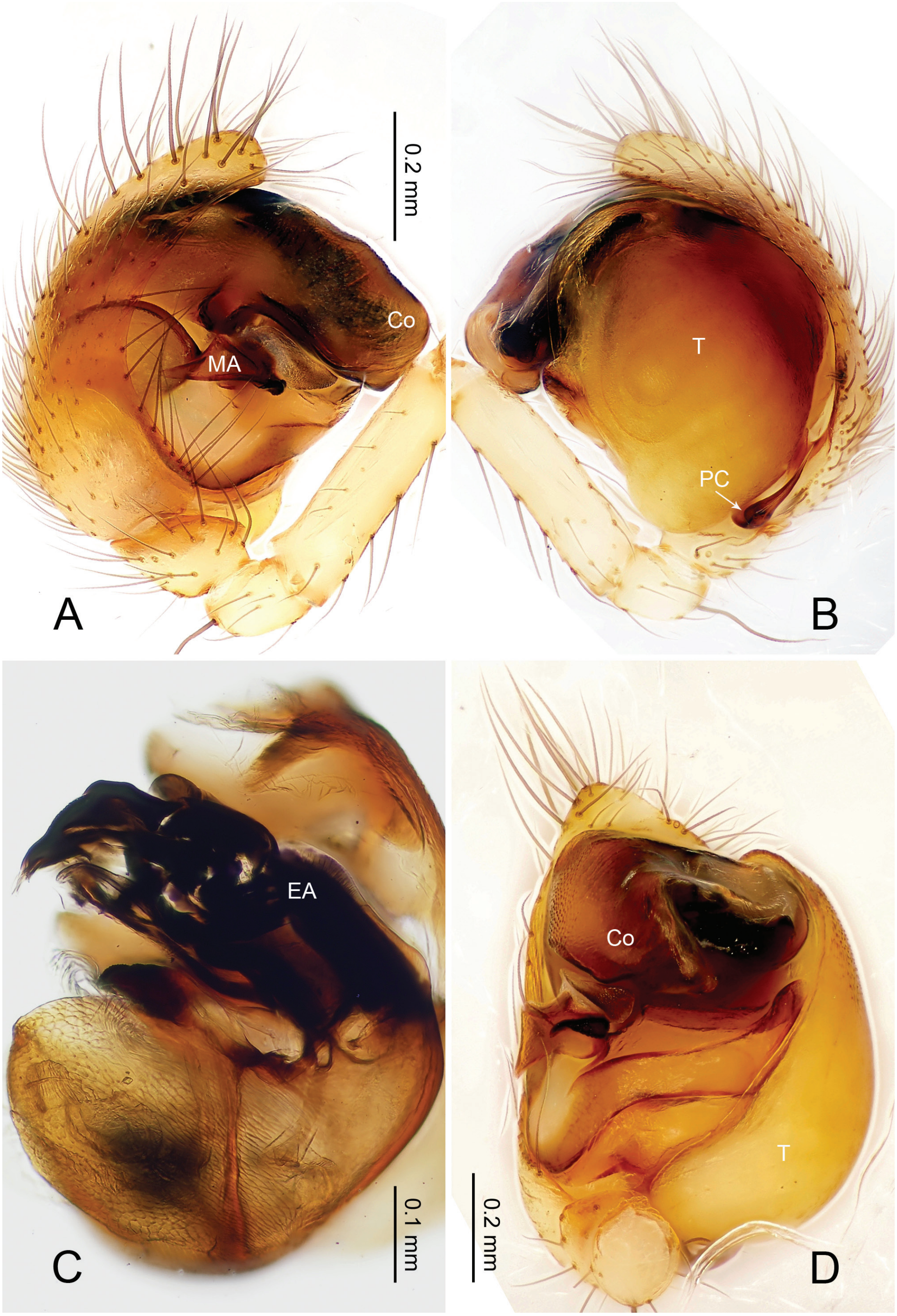

Figure 6. *Baalzebub rastrarius* sp. n., male holotype. **A** Pedipalp, prolateral view **B** Pedipalp, retrolateral view **C** Embolic division, retrolateral view **D** Pedipalp, ventral view. **Co** conductor; **EA** embolic apophysis; **MA** median apophysis; **PC** paracymbium; **T** tegulum. Scale bars: **B** as **A**.

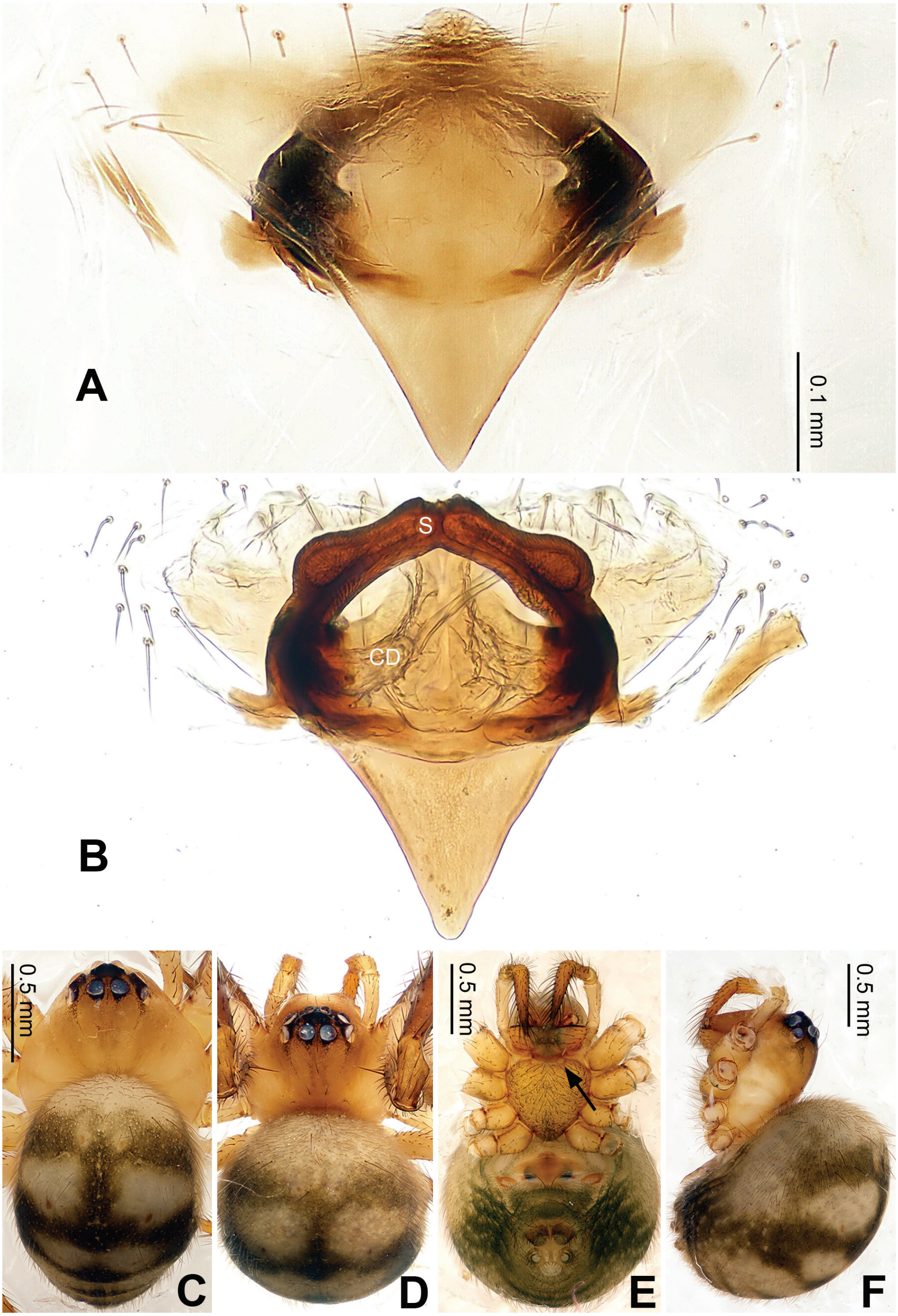

Figure 7. *Baalzebub rastrarius* sp. n., male holotype (**C**) and female paratype (**A–B, D–F**). **A** Epigyne, ventral view **B** Vulva, dorsal view **C** Male, dorsal view **D** Female, dorsal view **E** Female, ventral view **F** Female, lateral view. **CD** copulatory duct, **S** spermatheca. Scale bars: **B** as **A, D** as **E**.

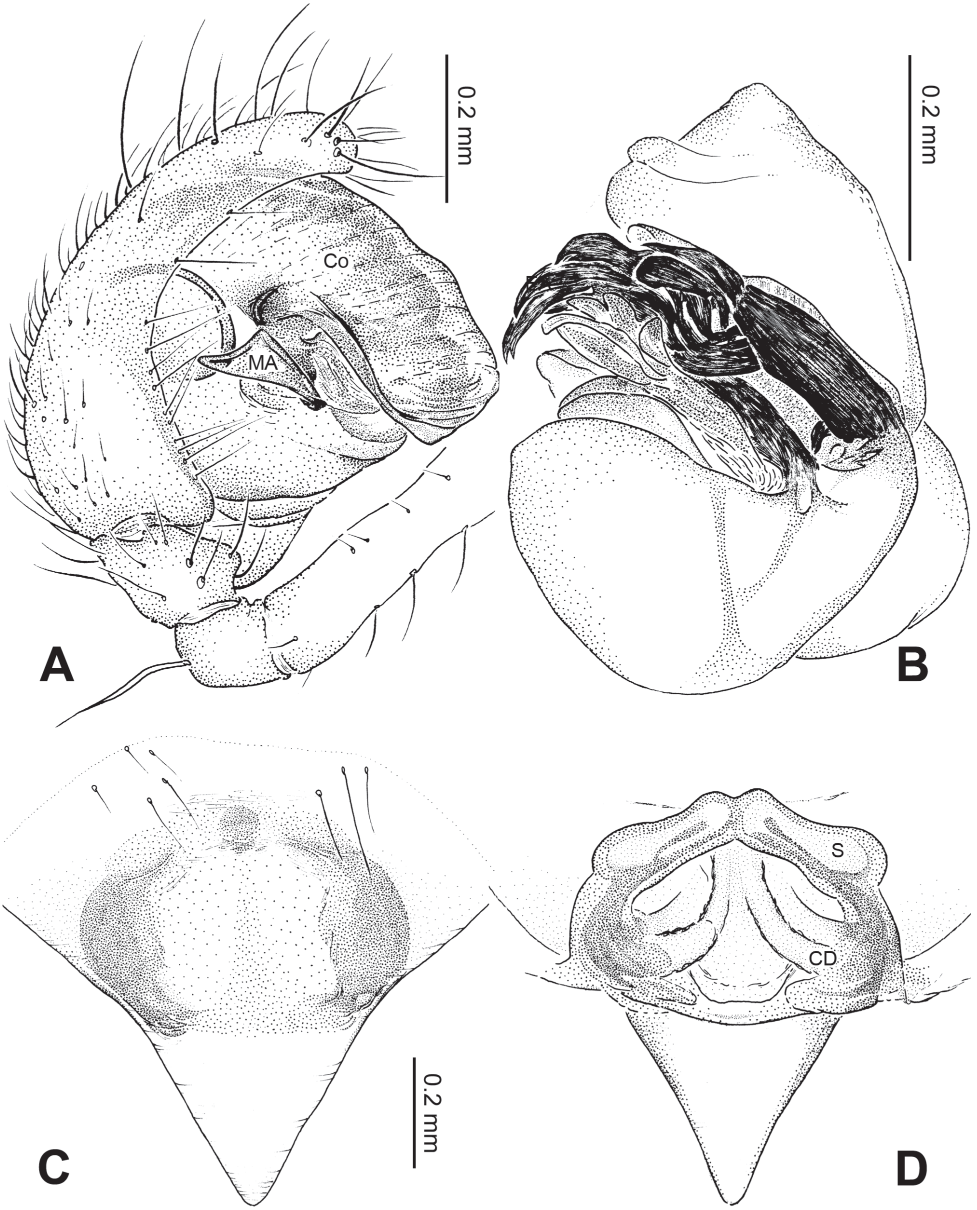

Figure 8. *Baalzebub rastrarius* sp. n., male holotype (**A–B**) and female paratype (**C–D**). **A** Pedipalp, prolateral view **B** Embolic division, retrolateral view **C** Epigyne, ventral view **D** Vulva, dorsal view. **CD** copulatory duct; **Co** conductor; **MA** median apophysis; **S** spermatheca. Scale bars: **D** as **C**.

Description. Carapace yellow tan. Sternum yellow with dark orange margins and setae. Legs yellow, dark brown distally at joints, especially tibiae. Abdomen tan with 2–4 rows of dark grey patches, the first two of which are connected by a perpendicular grey patch at midline, and two pairs of small dorsal brown spots (Figs 7C–F).

Male pedipalp: Patella with strong sinuous macroseta. Tibia with two trichobothria. Cymbium with a row of short regular bristles at its junction with cymbial lamella. Paracymbium with a long, pointed distal end (Fig. 6B). Cymbium apophysis small and pointed (Fig. 6B). Median apophysis triangular, strongly sclerotized (Figs 6A, 8A). Conductor a sub-rectangular translucent theca covering the complex embolic division and embolic apophysis. Embolic apophysis a spatulate arching structure with abruptly acuminated distal ends (Fig. 6C).

Vulva: Epigyne with a smooth triangular scape protruding from posterior margin of epigyne plate (Figs 7A–B). A deep pit lies on the epigynal mesal anterior edge. Spermathecae long, narrow, meeting at the tip to form an arcade-shaped structure. Copulatory ducts follow simple curve (Figs 7B, 8D).

Male: Total length 1.75, carapace 0.94 long, 1.09 wide, clypeus 0.25, sternum 0.53 long, 0.56 wide, coxae IV separated by their width. Posterior median eyes separated by less than half their diameter. Macrosetae: Leg I: femur p 1, patella d 1, tibia d 3, r 1; Leg II: femur r 1, patella d 2, tibia d 1, r 1; Leg III: patella d 2, tibia d 1; Leg IV: patella d 2, tibia d 1. Metatarsal trichobothria: Tm I: 0.25; Tm II: 0.29; Tm III: 0.23; Tm IV: 0.26. Leg measurements: I 4.66 (1.50, 0.50, 1.26, 1.00, 0.40); II 3.45 (1.10, 0.40, 0.80, 0.80, 0.35); III 2.50 (0.75, 0.30, 0.50, 0.50, 0.45); IV 3.10 (0.75, 0.60, 0.75, 0.70, 0.30).

Female: Total length 2.24, carapace 0.93 long, 0.93 wide, clypeus 0.11, sternum 0.5 long, 0.5 wide, coxae IV separated by their width. Posterior median eyes separated by less than half their diameter. Macrosetae as in male. Metatarsal trichobothria: Tm I: 0.28; Tm II: 0.25; Tm III: 0.45; Tm IV: 0.27. Leg measurements: I 4.17 (1.38, 0.48, 0.98, 0.88, 0.45); II 3.39 (1.10, 0.43, 0.73, 0.75, 0.38); III 2.50 (0.75, 0.35, 0.50, 0.55, 0.35); IV 3.11 (1.00, 0.33, 0.65, 0.75, 0.38).

Baalzebub youyiensis **sp. n.**

urn:lsid:zoobank.org:act:791FC4A5-1C1F-4E54-97BA-EEDF7FAFFCA9
http://species-id.net/wiki/Baalzebub_youyiensis
Figs 9–10

Material examined. Holotype: CHINA, Guangxi: Pingxiang City, Youyi County, Bantou Village, Niuyan Cave, 22°05.666'N, 106°45.439'E, elevation ca 251 m, 18 January 2011, Z.G. Chen & Z.W. Zha (IZCAS), 1 female.

Paratypes: [same data as holotype] (IZCAS), 3 females.

Etymology. This specific name formed from the Chinese words for friendship yǒu yì（友谊), which is the name of the county where this species was collected; adjective.

Diagnosis. Females distinguished from other described *Baalzebub* by the shape of the semi-transparent scape, which is proportionately shorter and with a blunt tip (Fig. 9A). Spermathecae, contrasted with narrow, long spermathecae in other *Baalzebub* species, is relatively shorter and smaller compared to the ovoid loops made by copulatory ducts (Fig. 9B)

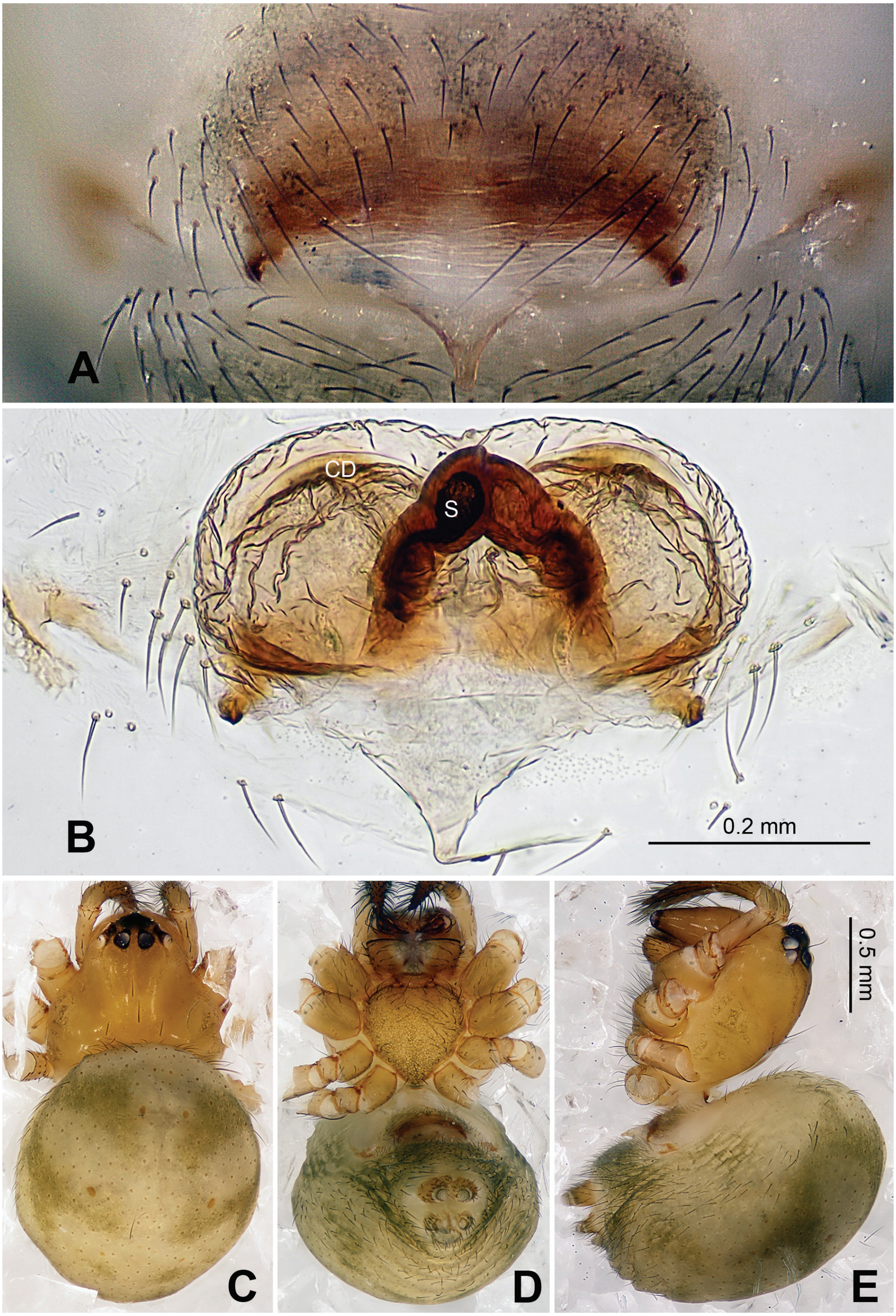

Figure 9. *Baalzebub youyiensis* sp. n., female holotype. **A** Epigyne, ventral view **B** Vulva, dorsal view **C** Female, dorsal view **D** Female, ventral view **E** Female, lateral view. **CD** copulatory duct; **S** spermatheca. Scale bars: **A** as **B, C, D** as **E**.

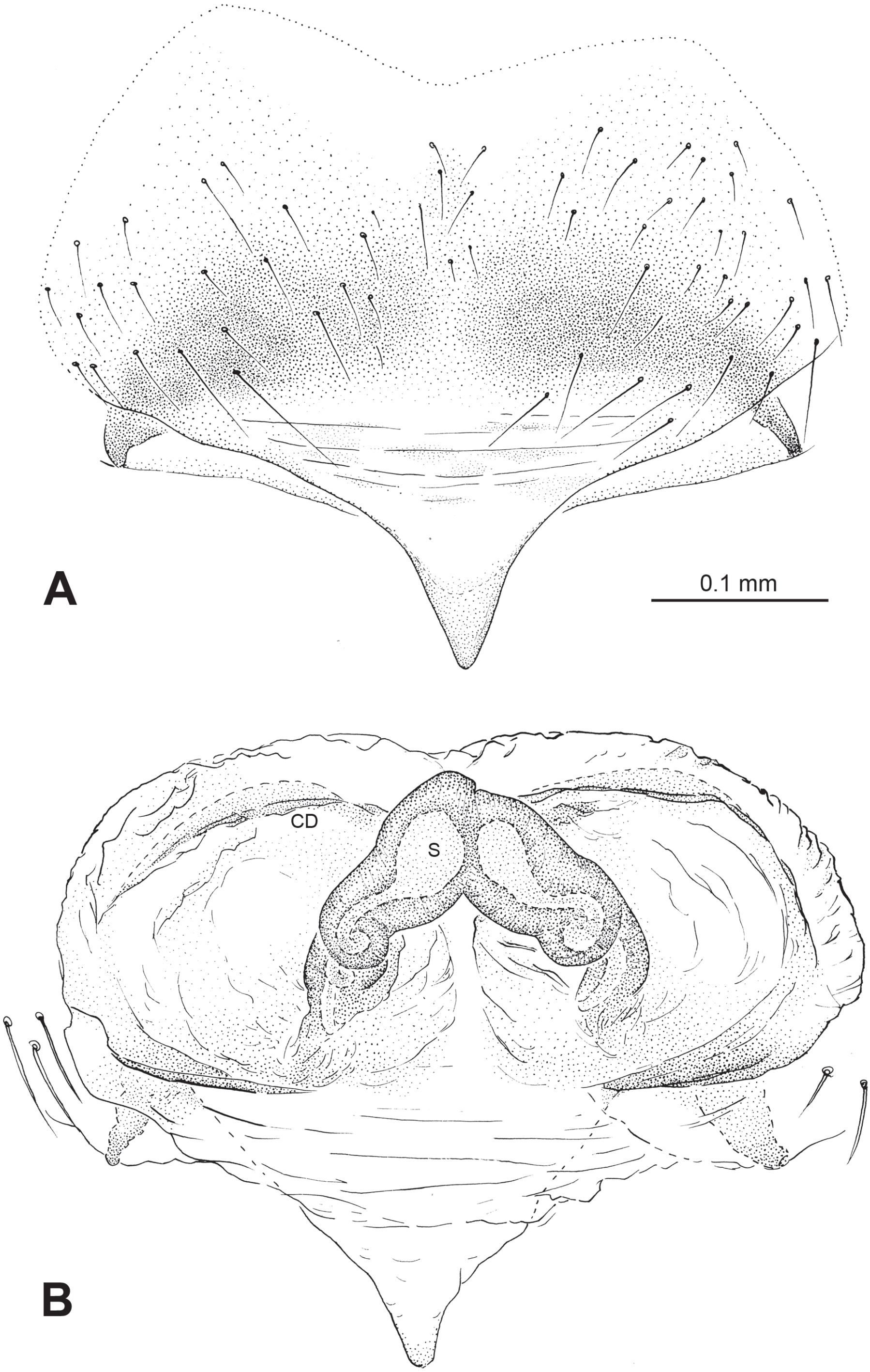

Figure 10. *Baalzebub youyiensis* sp. n., female holotype. **A** Epigyne, ventral view **B** Vulva, dorsal view. **CD** copulatory duct; **S** spermatheca. Scale bars: **B** as **A**.

Description. Carapace broad, orange. Sternum yellow with dusky margins. Legs yellow, brown from patella to tarsus (except for leg I, which only brown distally at joints). Abdomen beige with irregular light, greenish-grey patches (Figs 9C–E).

Vulva: Epigyne with a short, pointed triangular scape with concave lateral margins protruding from posterior margin of epigyne plate, through which dark orange vulva is visible (Fig. 9A). Scape translucent. Epigyne plate with transverse grooves (Fig. 9A). Spermathecae small, elliptical, joining each other at the tip (Figs 9B, 10B). Copulatory ducts simple, with three coils toward spermathecae.

Female: Total length 2.10, carapace 1.00 long, 1.00 wide, clypeus 0.19, sternum 0.53 long, 0.53 wide, coxae IV separated by 1.00 time their width. Posterior median eyes separated by less than half their diameter. Macrosetae: Leg I: femur d 1, p 1, patella d 1, tibia d 2, p 1, r 1; Leg II: patella d 3, tibia d 2, r 1; Leg III: patella d 2, tibia d 2, r 2; Leg IV: patella d 2, tibia d 1. Metatarsal trichobothria: Tm I: 0.20; Tm II: 0.15; Tm III: 0.19; Tm IV: 0.22. Leg measurements: I 3.76 (1.20, 0.40, 0.88, 0.80, 0.48); II 3.2 (1.00, 0.36, 0.72, 0.64, 0.48); III 2.24 (0.72, 0.32, 0.44, 0.45, 0.31); IV 2.92 (1.00, 0.40, 0.60, 0.52, 0.40).

Male unknown.

Genus *Karstia* Chen, 2010

Karstia Chen, 2010: 2. Type species *Karstia upperyangtzica* Chen, 2010.

Karstia nitida sp. n.

urn:lsid:zoobank.org:act:5ABD3E69-462D-4811-9851-EF178144FE62
http://species-id.net/wiki/Karstia_nitida
Figs 11–12

Material examined. Holotype: CHINA, Guangxi: Hechi City, Hechi County, Laba Village, Shoushui Cave, 24°41.229'N, 107°52.609'E, elevation ca 268 m, 31 March 2011, Z.G. Chen & Z.W. Zha (IZCAS), 1 female.

Paratypes: [same data as holotype] (IZCAS), 14 females.

Etymology. This specific name comes from the Latin word 'nitidus' which means 'shinning and elegant', referring to the glossiness of the swollen tip of the epigynal scape; adjective.

Diagnosis. Females distinguished by the following combination of characters: the structure of the scape, the stout, overlapped spermathecae (Fig. 11B), and the habitus of this species (Figs 11C–E). Spermathecae oval-shaped with vertically longer diameter, slightly detached from each other along their inner margin. The abdomen large, contrasted with distinctly small epigynal area. The scape structure is quite different from other *Karstia* or *Baalzebub* species: the tip of scape is swollen and shimmery, and the lateral margins of the plate extend toward the scape tip to form a armet-

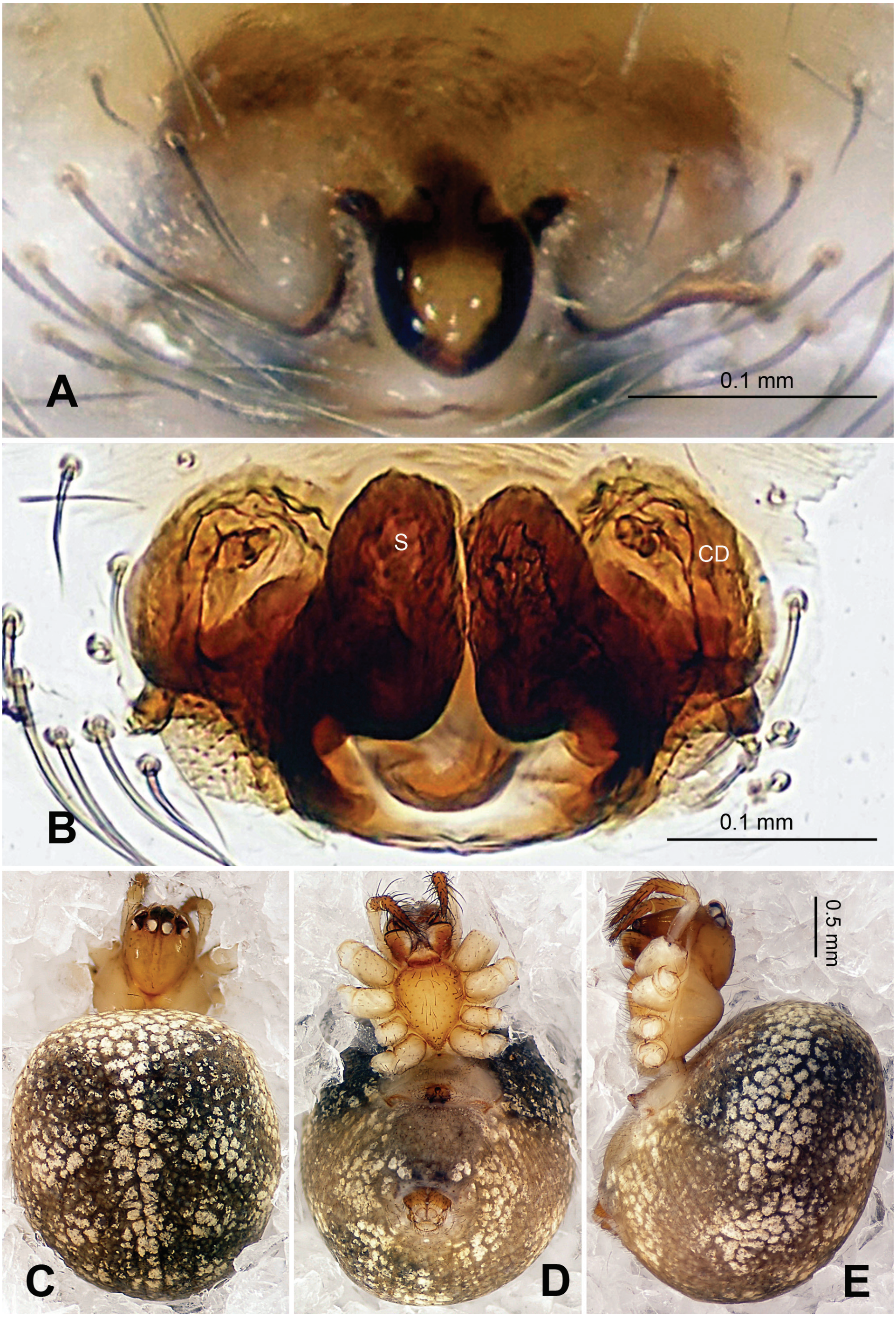

Figure 11. *Karstia nitida* sp. n., female holotype. **A** Epigyne, ventral view **B** Vulva, dorsal view **C** Habitus, dorsal view **D** Habitus, ventral view **E** Habitus, lateral view. **CD** copulatory duct **S** spermatheca. Scale bars: **C, D** as **E**.

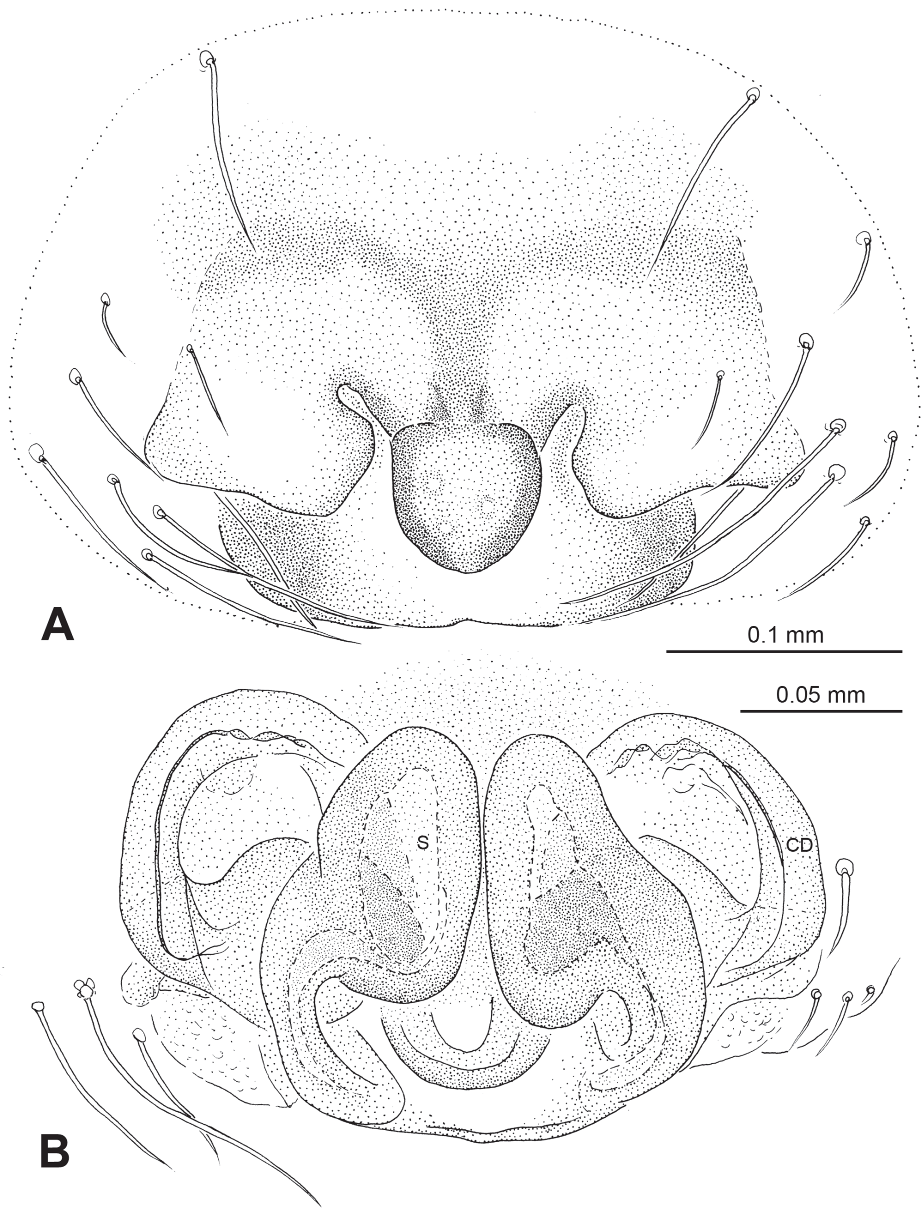

Figure 12. *Karstia nitida* sp. n., female holotype. **A** Epigyne, ventral view **B** Vulva, dorsal view. **CD** copulatory duct, **S** spermatheca.

shaped conformation (Fig. 11A). Generic placement tentative pending discovery and examination of the male.

Description. Carapace pale yellow with yellow ocular region. Sternum yellow with tan margins. Legs yellow, brown distally at joints. Abdomen dark grey mottled with white patches (Figs 11C–E).

Vulva: Epigyne small, with short, distally spherical scape protruding from posterior margin of epigyne plate. Epigyne plate extends posteriorly, together with scape to form a barbute-shaped conformation (Figs 11A, 12A). End of scape glossy with black purfle (Fig. 11A). Spermathecae peanut-shaped, juxtaposed, slightly detached from each other (Figs 11B, 12B). Copulatory ducts follow simple rout to form small loops and one turning before connected with spermathecae at the bottom (Figs 11B, 12B).

Female: Total length 3.25, carapace 1.38 long, 1.13 wide, clypeus 0.10, sternum 0.70 long, 0.65 wide, coxae IV separated by their width. Posterior median eyes separated by less than half their diameter. Macrosetae: Leg I: femur p 1, r 1, patella d 1, tibia d 2, p 2, v 2, r 1, metatarsus d 1, v 2, r 1; Leg II: femur d 2, patella d 2, tibia d 4, p 1, v2, metatarsus p 1, v 2; Leg III: femur d 1, patella d 2, tibia d 1, v 1, metatarsus d 3; Leg IV: patella d 2, tibia d 1, v 1, r 1, metatarsus d 2. Metatarsal trichobothria: Tm I: 0.23; Tm II: 0.21; Tm III: 0.16; Tm IV 0.22. Leg measurements: I 4.00 (0.56, 0.63, 1.09, 1.09, 0.63); II 4.16 (1.25, 0.50, 0.94, 0.94, 0.53); III 2.98 (0.78, 0.47, 0.63, 0.63, 0.47); IV 3.66 (1.25, 0.38, 0.78, 0.78, 0.47).

Male unknown.

Karstia prolata sp. n.

urn:lsid:zoobank.org:act:38E8200D-E27D-4710-ABEE-FBF657944027
http://species-id.net/wiki/Karstia_prolata
Figs 13–14

Material examined. Holotype: CHINA, Guangxi: Pingxiang City, Youyi County, Bantou Village, Niuyan Cave, 22°05.666'N, 106°45.439'E, elevation ca 251 m, 18 January 2011, Z.G. Chen & Z.W. Zha (IZCAS), 1 female.

Paratypes: [same data as holotype] (IZCAS), 9 females.

Etymology. The specific name is derived from the Latin word ‘prolatus’ meaning elongated’, and refers to the extended epigynal scape; adjective.

Diagnosis. Females distinguished by the protruding scape and the overlapped, stout spermathecae. The long acute-angled scape protrudes vertically from the posterior epigynal margin (Figs 13B, F), which is different from other known *Karstia* species and *Baalzebub* species.

Description. Relatively large in total body length, compared to other theridiosomatid species. Carapace greenish tan, with brown ocular region. Sternum yellow with dark margins. Femur yellow, brown from patella to tarsus. Abdomen beige with evenly distributed silver spots within dorsal area and 8 or more rows of mesally disrupted greenish grey patches, with a large, wedge-shaped greenish grey patch between epigyne and spinnerets (Figs 13D–E).

Vulva: Epigyne with a long, apiculate scape protruding perpendicularly (slightly tilted) from posterior margin of epigyne plate, flanked by a cluster of long sinuous setae on each side (Figs 13A, E–F). Two deep grooves occur at the posterior base of epigyne which are likely connected to the copulatory openings (Figs 13B, E). Tip of

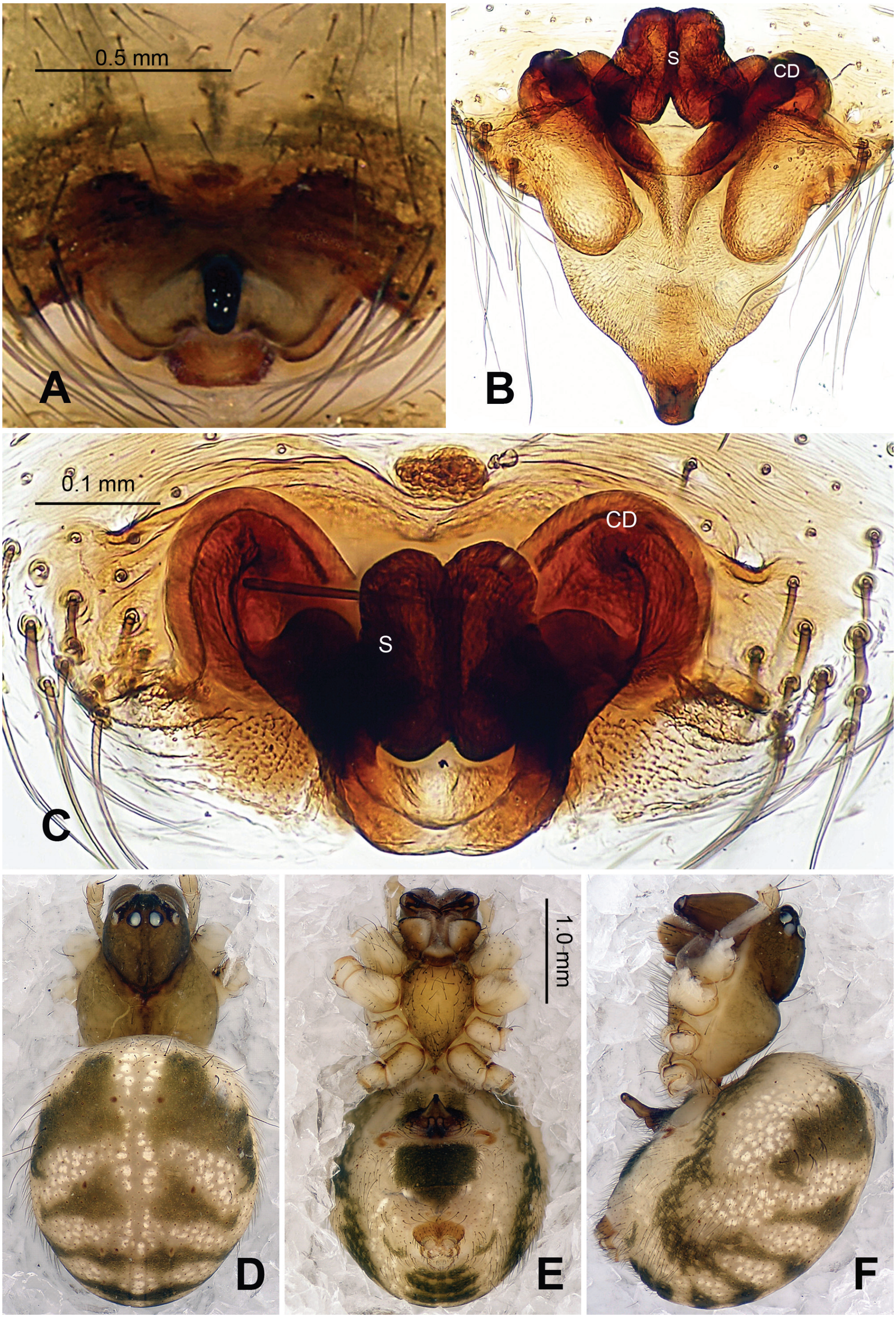

Figure 13. *Karstia prolata* sp. n., female holotype. **A** Epigyne, ventral view **B** Vulva, posterior view **C** Vulva, dorsal view **D** Habitus, dorsal view **E** Habitus, ventral view **F** Habitus, lateral view. **CD** copulatory duct; **S** spermatheca. Scale bars: **B** as **A, D, F** as **E.**

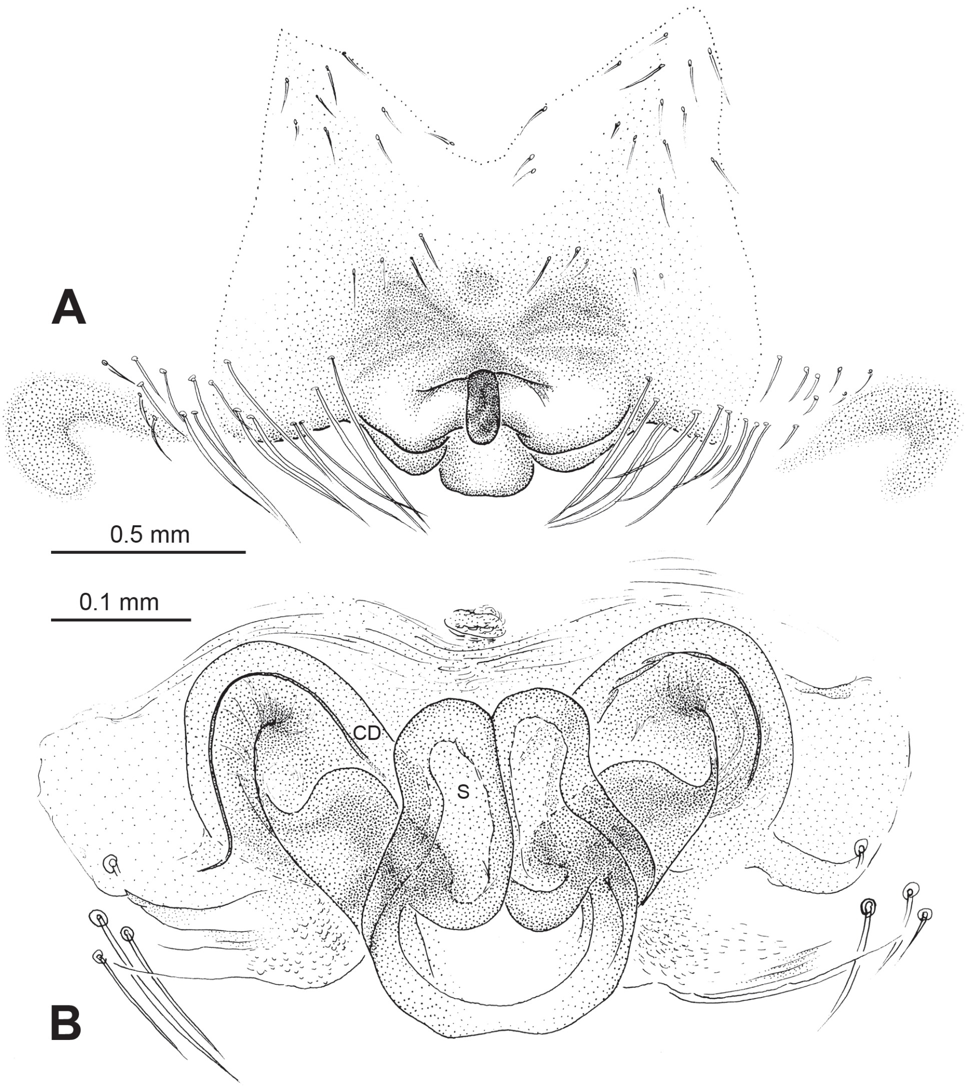

Figure 14. *Karstia prolata* sp. n., female holotype. **A** Epigyne, ventral view **B** Vulva, dorsal view. **CD** copulatory duct; **S** spermatheca.

scape glossy black (Fig. 13A). Spermathecae peanut-shaped, juxtaposed (Fig. 13C). Copulatory ducts' routing simple, half-looped (Figs 13C, 14B).

Female: Total length 3.85, carapace 1.92 long, 1.25 wide, clypeus 0.15, sternum 0.63 long, 0.65 wide, coxae IV separated by 2.00 times their width. Posterior median eyes separated by half their diameter. Macrosetae: Leg I: femur d 2, p 1, patella d 2, tibia d 2, p 2, v 1, r 1, metatarsus p 1, v 3, r 1; Leg II: femur d 2, patella d 2, tibia d 1, p 2, v 1, r 1, metatarsus p 1, v 2, r 1; Leg III: femur d 1, v 1, patella d 1, tibia d 1, p 2, v 2, metatarsus d 3; Leg IV: tibia d 2, p 1, metatarsus d 2. Metatarsal trichobothria:

Tm I: 0.13; Tm II: 0.22; Tm III: 0.27; Tm IV: 0.22. Leg measurements: I 6.35 (2.00, 0.75, 1.35, 1.50, 0.75); II 5.25 (1.50, 0.70, 1.10, 1.20, 0.75); III 3.35 (0.95, 0.45, 0.70, 0.75, 0.50); IV 4.60 (1.50, 0.50, 1.00, 1.00, 0.60).

Male unknown.

Genus *Menglunia* gen. n.

urn:lsid:zoobank.org:act:272F2972-D45B-4401-AD1E-62ADCB6D498E
http://species-id.net/wiki/Menglunia

Type species. *Menglunia inaffecta* sp. n.

Etymology. The generic epithet refers to the place měng lún (勐仑) where these specimens were collected. Menglun Town is located at Xishuangbanna in Yunnan province, where tropical rain forest harbors countless species, both vertebrates and invertebrates. Gender is feminine.

Diagnosis. Distinguished from other theridiosomatids by the extremely simple, short embolus, and the round, separated spermathecae. The pedipalp in males is an elliptical (slightly rectangular in total), theca-textured, and obscurely circumscribed structure (Figs 15A, D). Conductor is less extensive, and fully covers the embolus (Fig. 18A). The embolus is beak-like, and enveloped in conductor (Fig. 15B). Unlike any other theridiosomatid genus, the median apophysis in *Menglunia* is merely a small projection, mildly curved without any sharp tip or trough (Fig. 15A). Spermathecae similar to *Coddingtonia euryopoides* (Miller et al. 2009) and *Luangnam discobulbus* (Wunderlich, 2011), but instead of being elliptical and separated by their diameter, they are more rounded and separated by less than half of their diameter. Copulatory duct is shorter and forms a simple loop which is about the same height as spermathecae's diameter, compared to the big loop and higher-positioned copulatory ducts in *C. euryopoides and L. discobulbus* (Fig. 16B).

Species. *Menglunia inaffecta* sp. n.

Menglunia inaffecta sp. n.

urn:lsid:zoobank.org:act:63DFDE88-8154-412E-B02E-47A71157F286
http://species-id.net/wiki/Menglunia_inaffecta
Figs 15–18

Material examined. Holotype: CHINA, Yunnan: Menglun Town: Xishuangbanna Botanical Garden, 21°55.035'N, 101°16.500'E, elevation ca 558 m, 22 July 2007, primary tropical seasonal rain forest, searching, G. Zheng (IZCAS), 1 male.

Paratypes: [same data as holotype] (IZCAS), 9 males, 9 females.

Etymology. Its Latin origin 'inaffectus' means 'natural and simple', which refers to the simplicity of the structure of the male pedipalp; adjective.

Diagnosis. See diagnosis for genus.

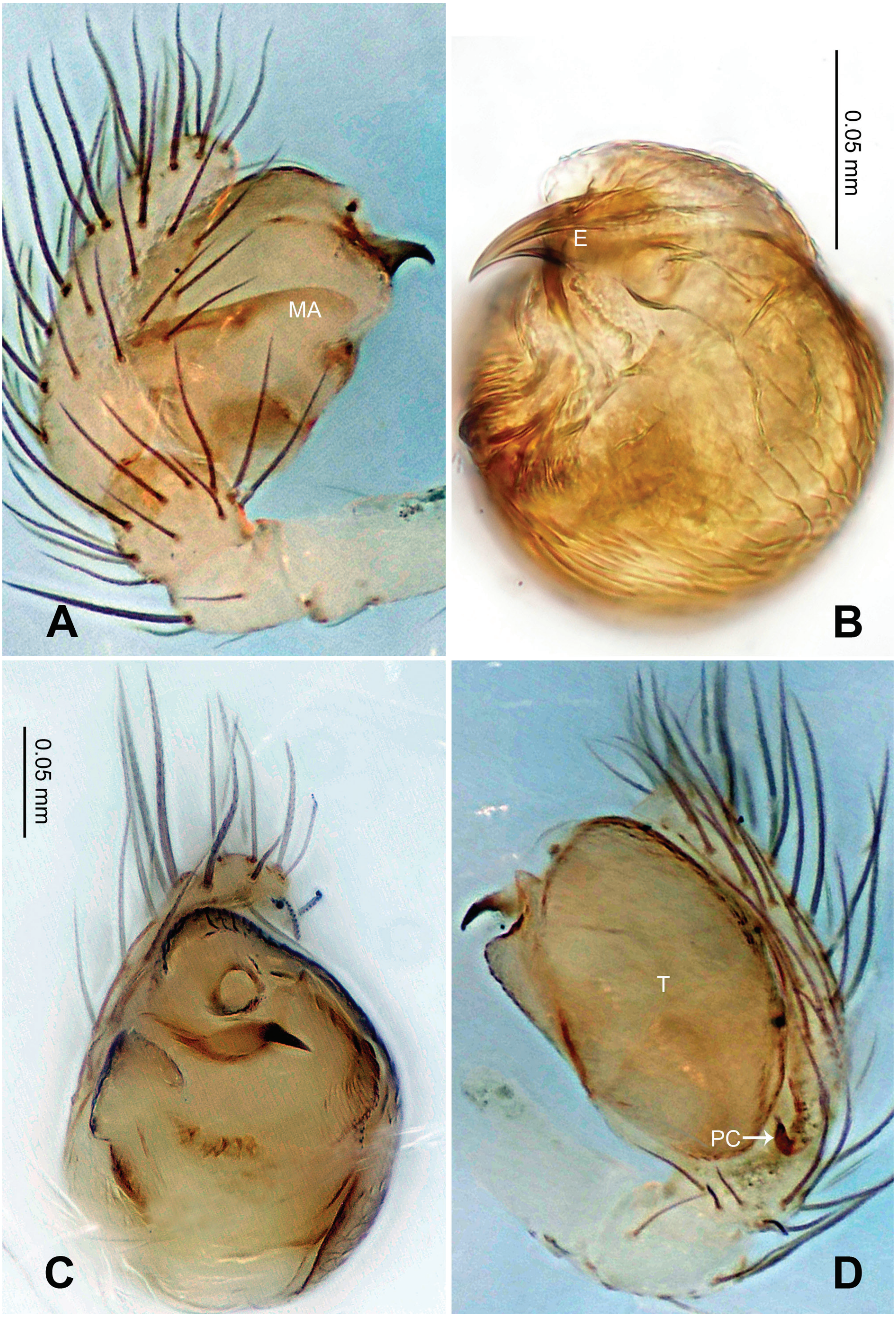

Figure 15. *Menglunia inaffecta* sp. n., male holotype. **A** Pedipalp, prolateral view **B** Embolic division **C** Pedipalp, ventral view **D** Pedipalp, retrolateral view. **E** embolus; **MA** median apophysis; **PC** paracymbium; **T** tegulum. Scale bars: **A, D** as **C**.

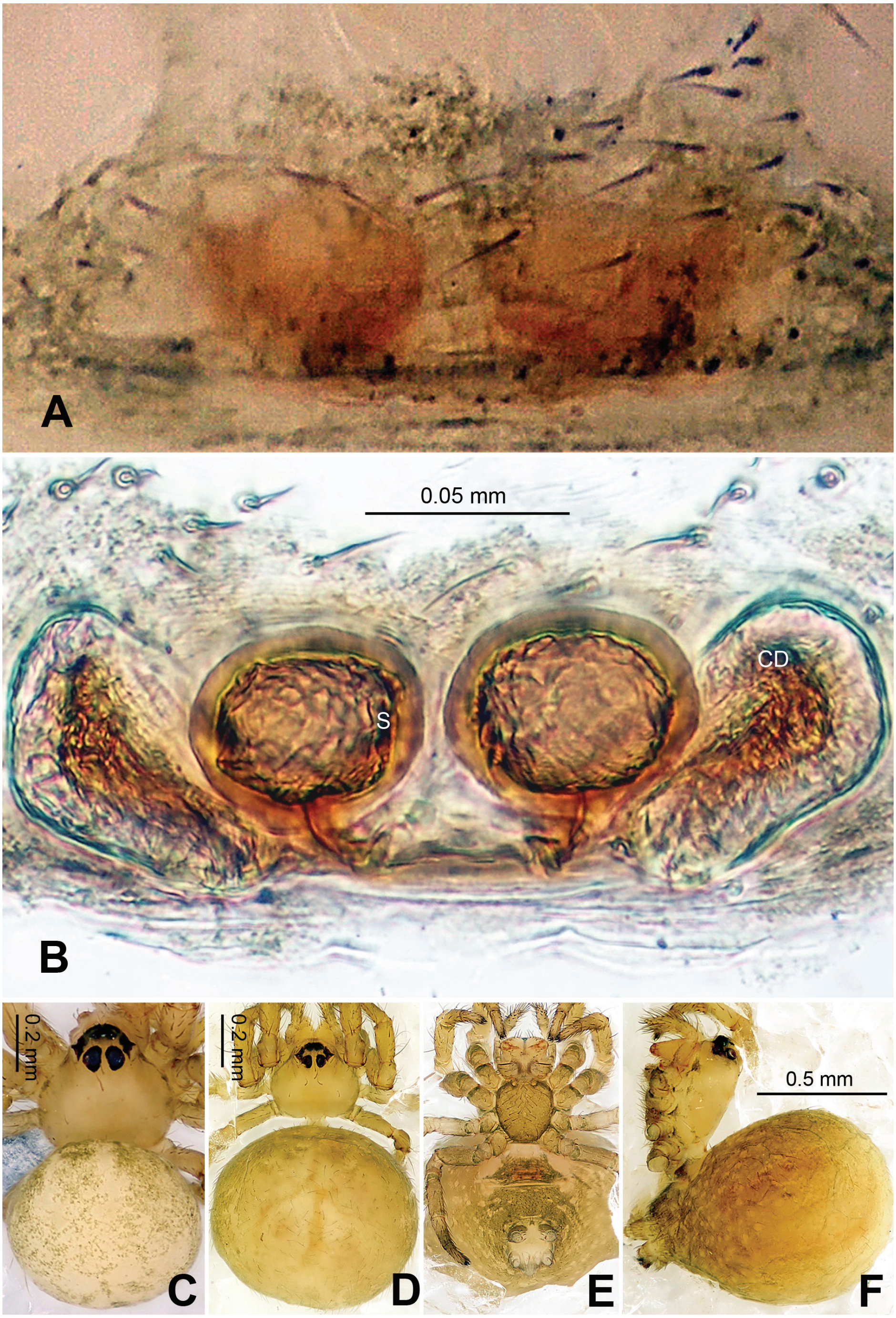

Figure 16. *Menglunia inaffecta* sp. n., male holotype (**C**) and female paratype (**A–B, D–F**). **A** Epigyne, ventral view **B** Vulva, dorsal view **C** Male habitus, dorsal view **D** Female habitus , dorsal view **E** Female habitus, ventral view **F** Female habitus, lateral view. **CD** copulatory duct, **S** spermatheca. Scale bars: **A** as **B, E** as **D**.

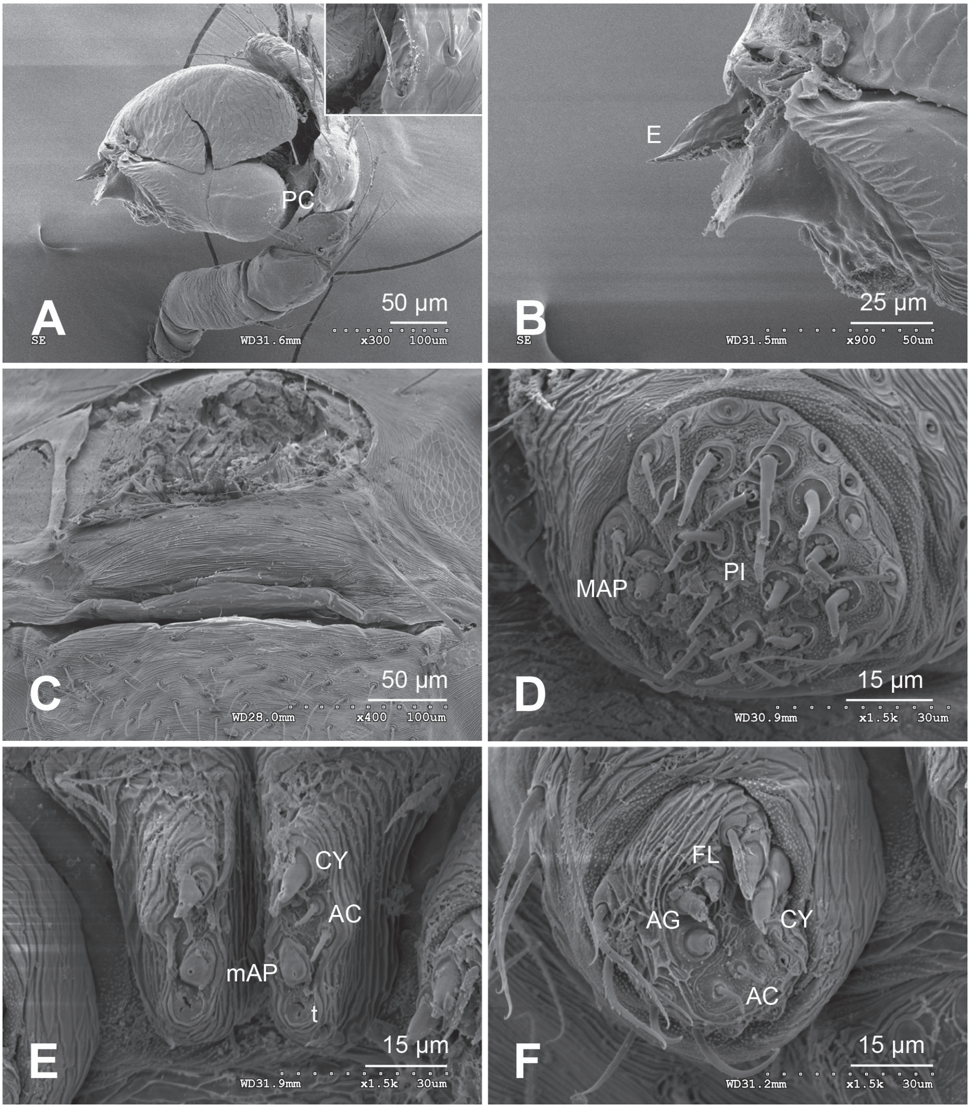

Figure 17. *Alaria chengguanensis* sp. n., SEM of male paratype (**A–B**) and female paratype (**C–F**). **A** Pedipalp, retrolateral view **B** Pedipalp, retrolateral view, detail showing embolus **C** Epigyne **D** ALS **E** PMS **F** PLS. **AC** aciniform gland spigot; **AG** aggregate gland spigot; **ALS** anterior lateral spinneret; **CY** cylindrical gland spigot **E** embolus; **FL** flagelliform gland spigot; **MAP** major ampullate gland spigot; **mAP** minor ampullate gland spigot; **PC** paracymbium; **PI** piriform gland spigot; **PLS** posterior lateral spinneret; **PMS** posterior median spinneret; **t** tartipore.

Description. Carapace yellow tan. Sternum yellow with greenish brown margins and sparse hairs. Legs thick, yellow. Abdomen beige with small, irregularly-distributed greenish brown spots.

Male pedipalp: Patella with erect macroseta. Tibia with one trichobothrium. Paracymbium with a short pointed distal end (Fig. 17A). Tegulum sub-oval. Median

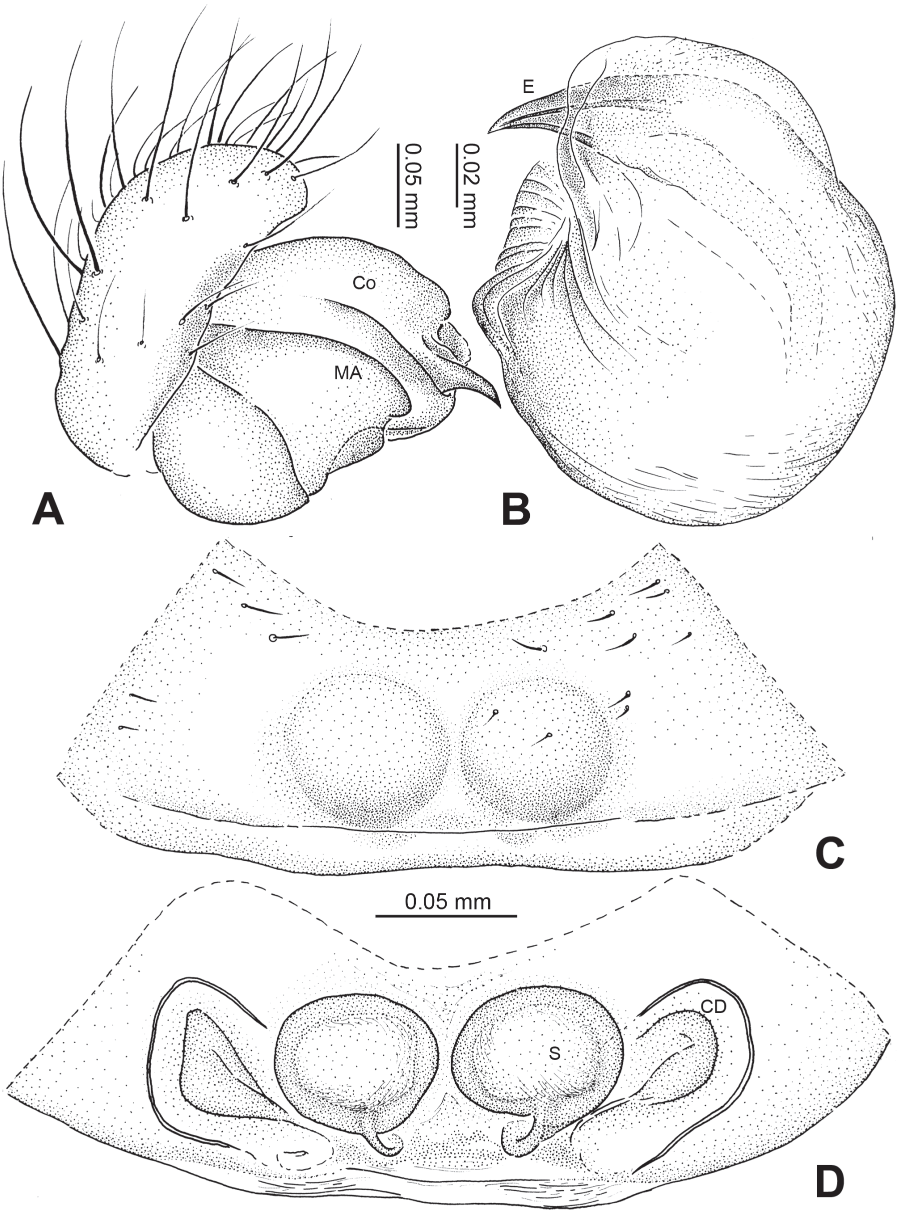

Figure 18. *Menglunia inaffecta* sp. n., male holotype (**A–B**) and female paratype (**C–D**). **A** Pedipalp, prolateral view **B** Embolic division, retrolateral **C** Epigyne, ventral view **D** Vulva, dorsal view. **CD** copulatory duct; **Co** conductor; **MA** median apophysis **S** spermatheca.

apophysis with a small projection oriented distoventrally (Figs 15A, 18A). Conductor kidney-shaped, translucent theca. Embolus beak-shaped, stout (Figs 15A–B, 17B).

Vulva: Epigyne with obscure plate margins (Figs 16A, 17A). Spermathecae round, separated from each other (Fig. 16B). Copulatory duct short and simple (Fig. 16B).

Male (holotype): Total length 1.00, carapace 0.40 long, 0.44 wide, clypeus 0.05, sternum 0.30 long, 0.25 wide, coxae IV separated by 1.5 times their width. Posterior median eyes separated by less than half their diameter. Macrosetae: Leg I: patella d 2, tibia d 2, p 1; Leg II: patella d 1, tibia d 1, p 1, r 1; Leg III: patella d 2. Metatarsal trichobothria: Tm I: 0.27; Tm II: 0.38; Tm III: 0.36. Leg measurements: I 1.10 (0.31, 0.13, 0.25, 0.23, 0.18); II 0.84 (0.25, 0.06, 0.20, 0.20, 0.13); III 0.66 (0.18, 0.11, 0.13, 0.13, 0.11); IV 0.76 (0.19, 0.13, 0.19, 0.14, 0.11).

Female (one of paratypes): Total length 1.00, carapace 0.63 long, 0.48 wide, clypeus 0.05, sternum 0.30 long, 0.30 wide, coxae IV separated by 1.5 times their width. Posterior median eyes separated by less than half their diameter. Macrosetae as in male. Metatarsal trichobothria: Tm I: 0.32; Tm II: 0.38; Tm III: 0.29. Leg measurements: I 1.09 (0.32, 0.20, 0.24, 0.25, 0.18); II 1.02 (0.25, 0.19, 0.23, 0.20, 0.15); III 0.75 (0.19, 0.11, 0.13, 0.18, 0.14); IV 0.91 (0.25, 0.13, 0.21, 0.18, 0.14).

Genus *Ogulnius* O. Pickard-Cambridge, 1882

Ogulnius O. Pickard-Cambridge, 1882: 432. Type species *Ogulnius obtectus* O. Pickard-Cambridge, 1882.

Ogulnius hapalus sp. n.

urn:lsid:zoobank.org:act:2CE2BCE0-15BC-488A-A363-872B6BA232F0
http://species-id.net/wiki/Ogulnius_hapalus
Figs 19–21

Material examined. Holotype: CHINA, Yunnan: Menglun Town: Xishuangbanna Botanical Garden, 21°55.035'N, 101°16.500'E, elevation ca 558 m, 22 July 2007, primary tropical seasonal rain forest, fogging, G. Zheng (IZCAS), 1 male.

Paratypes: [same data as holotype] (IZCAS), 2 males, 6 females.

Etymology. This specific name describes the softness and fragility of this species. The Latin origin is ‘hapalus’ meaning ‘delicate and tender’; adjective.

Diagnosis. Though lack of one genetic feature, which is fourth legs are longer than the first legs (subequal in females), other generic characteristics of *Ogulnius* can be seen in this species: tapering whip-like embolic apophysis in males (Fig. 19C), transverse grooves on epigyne in females, separated and juxtaposed posterior median eyes (Coddington 1986). Males distinguished from other described *Ogulnius* species by the shape of median apophysis and the proportion of embolic apophysis. The median apophysis in *O. hapalus* is similar to that in *O. gloriae* (Coddington 1986: fig. 99): mesally wide, with a projection oriented distoventrally (Fig. 19A). The embolic apophysis is proportionately longer than that in *O. barbandrewsi* (Miller et al. 2009: fig. 5F). The Females distinguished by the routing of copulatory ducts and the peanut-shaped spermathecae. The fold made by the copulatory ducts is bending outwardly (Fig. 20B), instead of in-

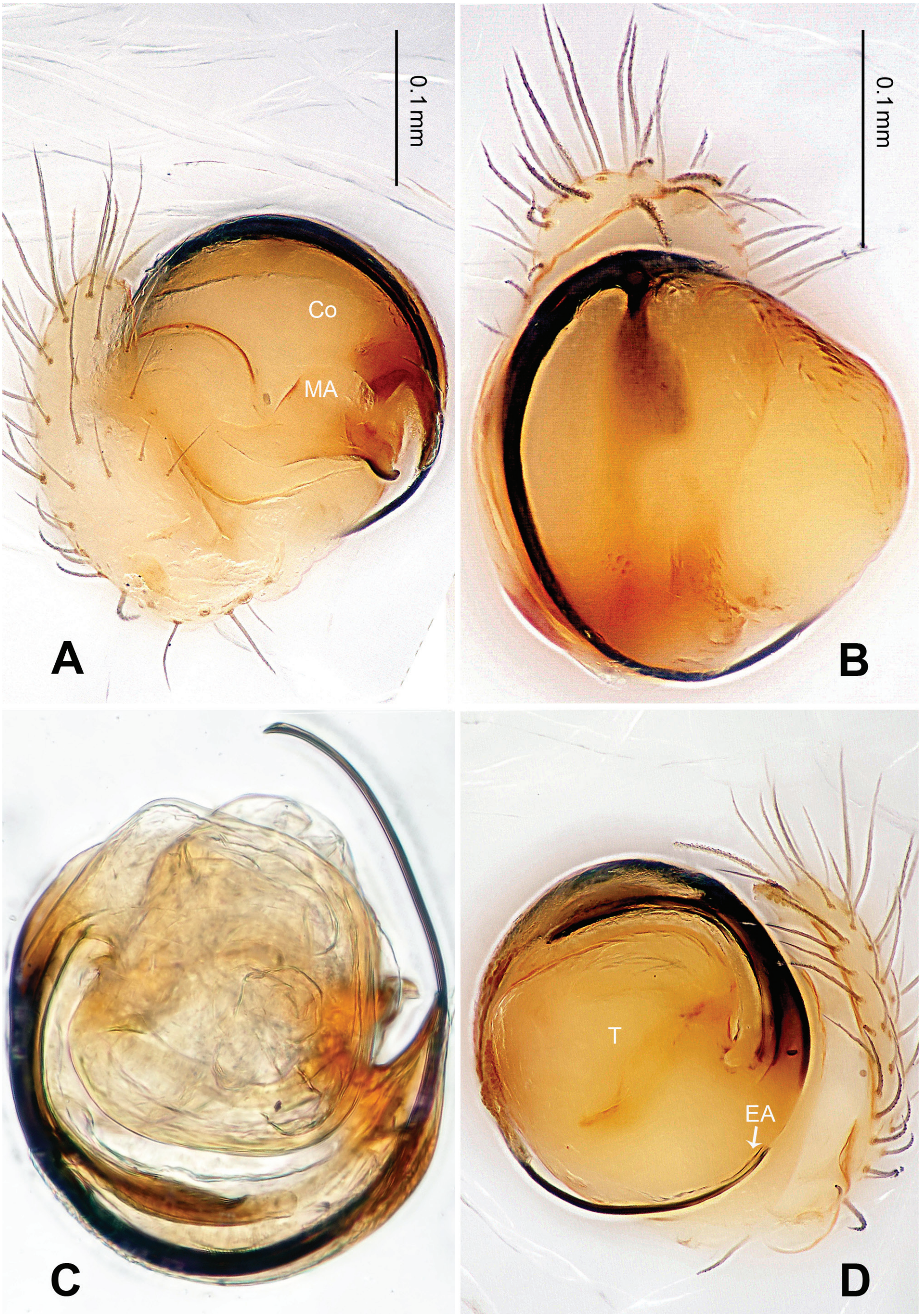

Figure 19. *Ogulnius hapalus* sp. n., male holotype. **A** Pedipalp, prolateral view **B** Pedipalp, ventral view **C** Embolic division, retrolateral view **D** Pedipalp, retrolateral view. **Co** conductor; **EA** embolic apophysis; **MA** median apophysis **T** tegulum. Scale bars: **D** as **A, C** as **B**.

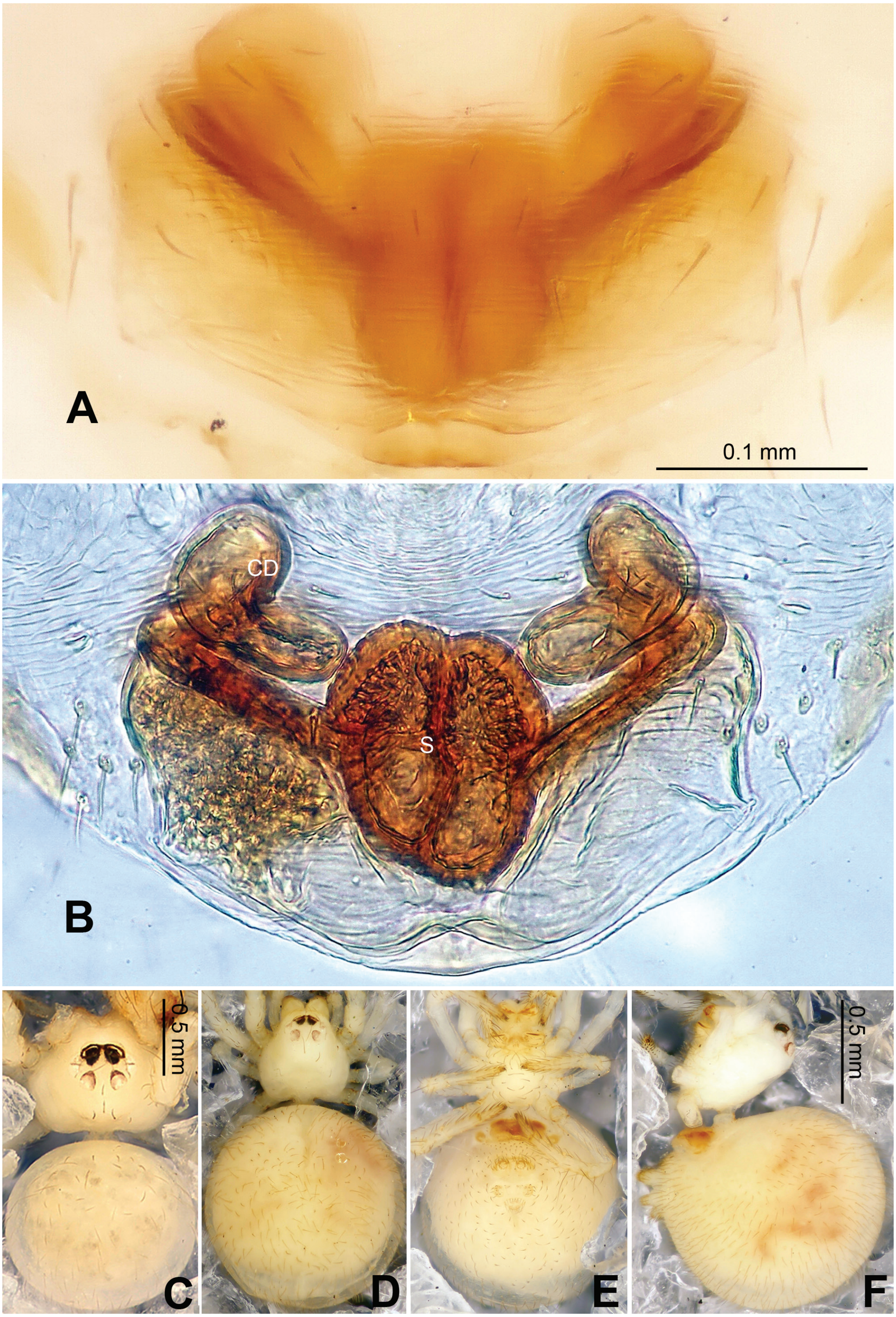

Figure 20. *Ogulnius hapalus* sp. n., male holotype (**C**) and female paratype (**A–B, D–F**). **A** Epigyne, ventral view **B** Vulva, dorsal view **C** Male habitus, dorsal view **D** Female habitus, dorsal view **E** Female habitus, ventral view **F** Female habitus, lateral view. **CD** copulatory duct; **S** spermatheca. Scale bars: **B** as **A, D, E** as **F**.

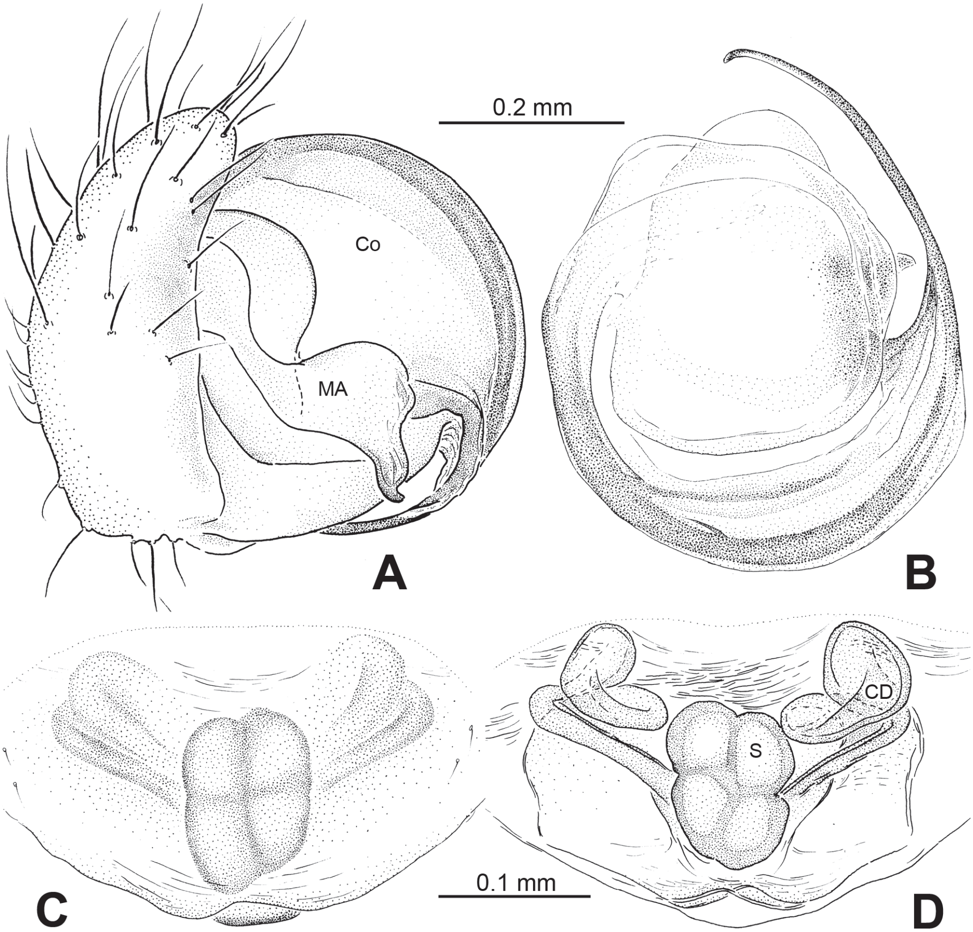

Figure 21. *Ogulnius hapalus* sp. n., male holotype (**A–B**) and female paratype (**C–D**). **A** Pedipalp, prolateral view **B** Embolic division, retrolateral view **C** Epigyne, ventral view **D** Vulva, dorsal view. **CD** copulatory duct; **Co** conductor; **MA** median apophysis; **S** spermatheca.

wardly as in *O. barbandrewsi* (Miller et al. 1986: fig. 3D). The posterior lip of epigyne in *O. hapalus* concave in stead of convex as in *O. pullus* (Brignoli 1981: fig.1).

Description. Carapace pale yellow. Sternum ivory. Legs pale yellow, semi-transparent. Abdomen pale with soft, translucent cuticle.

Male pedipalp: Patella with strong sinuous macroseta. Tibia with one trichobothrium. Paracymbium slim with filiform projection distally. Median apophysis curvy, mesally wide, with apex oriented distoventrally (Figs 19A, 21A). Conductor a translucent theca covering about two thirds length of the long filiform embolic apophysis (Figs 19C–D).

Vulva: Epigyne with transverse groove and a concave posterior margin (Fig. 20A). Spermathecae peanut-shaped, juxtaposed (Fig. 20B). Copulatory ducts bend downwardly at top and wide at entrance (Figs 20B, 21B).

Male: Total length 1.00, carapace 0.50 long, 0.40 wide, clypeus 0.09, sternum 0.25 long, 0.25 wide, coxae IV separated by 2.00 times their width. Posterior median eyes separated by 1.5 times their diameter. Macrosetae: Leg I: patella d 1, tibia d 1, p 1; Leg II: patella d 1, tibia d 1; Leg III: patella d 1, tibia d 1; Leg IV: patella d 1, tibia d 1. Metatarsal trichobothria: Tm I: 0.23; Tm II: 0.19; Tm III: 0.27. Leg measurements: I 1.00 (0.30, 0.18, 0.20, 0.20, 0.12); II 0.87 (0.26, 0.12, 0.20, 0.16, 0.13); III 0.57 (0.11, 0.10, 0.11, 0.15, 0.10); IV 0.64 (0.15, 0.10, 0.14, 0.15, 0.10).

Female: Total length 1.41, carapace: 0.50 long, 0.44 wide, clypeus 0.23, sternum 0.30 long, 0.25 wide, coxae IV separated by 2.00 times their width. Posterior median eyes separated 1.5 times their diameter. Macrosetae as in male. Metatarsal trichobothria: Tm I: 0.25; Tm II: 0.21; Tm III: 0.27. Leg measurements: I 0.95 (0.20, 0.25, 0.15, 0.20, 0.15); II 0.82 (0.25, 0.12, 0.15, 0.15, 0.15); III 0.62 (0.12, 0.10, 0.15, 0.15, 0.10); IV 0.90 (0.30, 0.15, 0.15, 0.20, 0.10).

Genus *Theridiosoma* O. Pickard-Cambridge, 1879

Theridiosoma O. Pickard-Cambridge, 1879: 193. Type species *Theridiosoma argenteolum* O. Pickard-Cambridge, 1879 (= *T. gemmosum* (L. Koch, 1878)).

Theridiosoma plumaria sp. n.

urn:lsid:zoobank.org:act:34DDB1DE-B435-4A41-8EF7-A40B43ACC9E0
http://species-id.net/wiki/Theridiosoma_plumaria
Figs 22–23

Material examined. Holotype: CHINA, Hainan: Mt. Jianfengling National Nature Reserve: Tianchi watershed 18°44.383'N, 108°51.062'E, elevation ca 888 m, 19 July 2007, S. Li (IZCAS), 1 male.

Paratype: CHINA: Hainan: Mt. Bawangling National Nature Reserve, 5 kilometers past Dongerjianchazhan, 19°05.186'N, 109°11.802'E, elevation ca 1010 m, 25 July 2007, S. Li (IZCAS), 1 male.

Etymology. The specific name was taken from the Latin word 'plumarius' which means 'of feathers'. It refers to the plumose branching of its conductor theca (Figs 22B–C); adjective.

Diagnosis. Males, similar to *T. gemmosum* (L. Koch) (Coddington 1986: figs 134, 135), distinguished from any other known male *Theridiosoma* from Asia by the following characters: broader, slightly groovy median apophysis with an acuminated tip, and the exposed branchings of embolic apophysis (Fig. 22A).

Description. Carapace yellow tan. Sternum yellow with brown margins. Legs yellow. Abdomen tan with sparse silver specks and symmetric dark grey patches.

Male pedipalp: Patella with strong macroseta. Tibia with two trichobothria. Paracymbium hooked with pointed distal end. Tegulum large with tuberculate mesal lobe

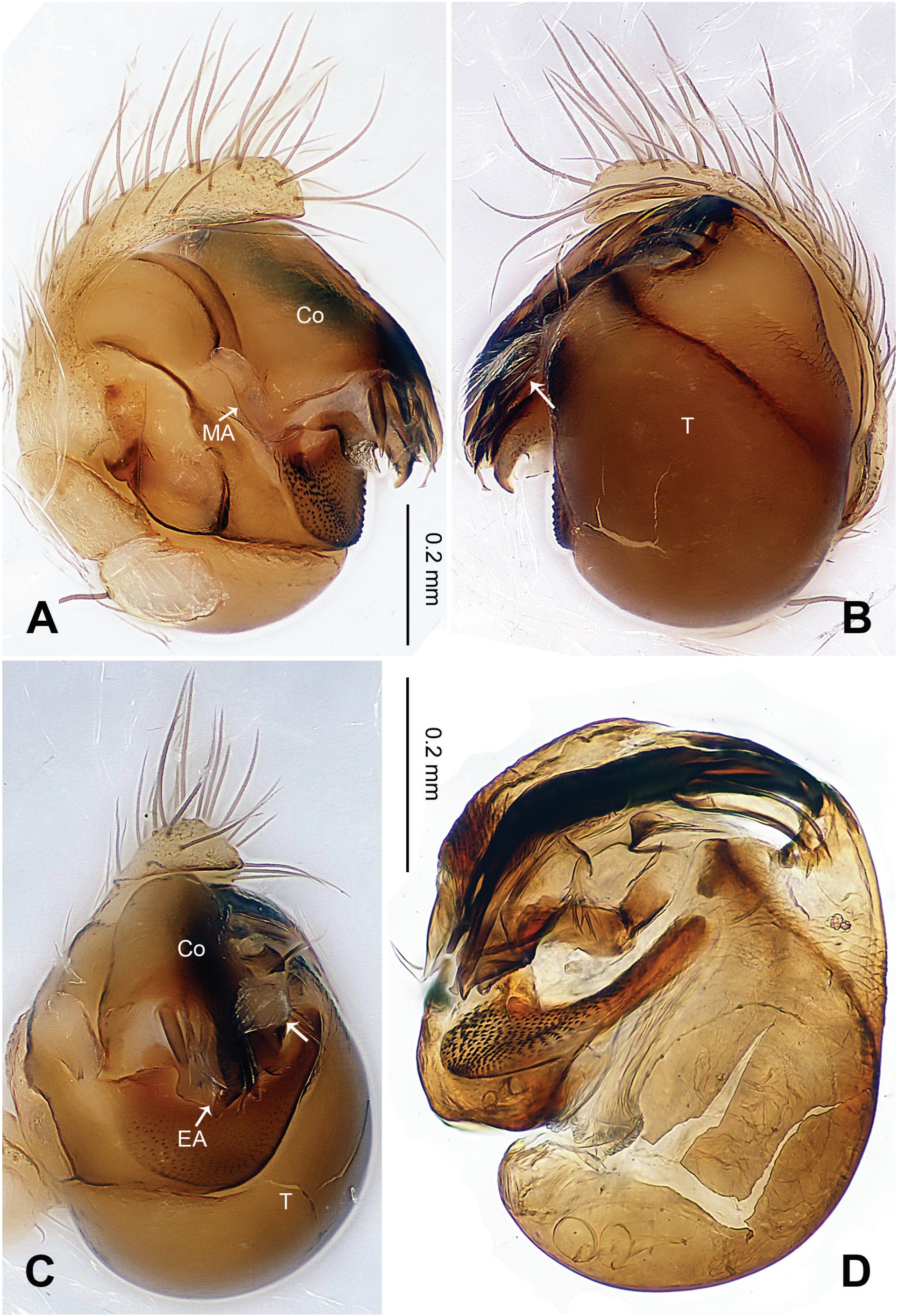

Figure 22. *Theridiosoma plumaria* sp. n., male holotype. **A** Pedipalp, prolateral view **B** Pedipalp, retrolateral view **C** Pedipalp, ventral view **D** Embolic division, retrolateral view. **Co** conductor; **EA** embolic apophysis; MA median apophysis; **T** tegulum. Scale bars: **B, C** as **A**.

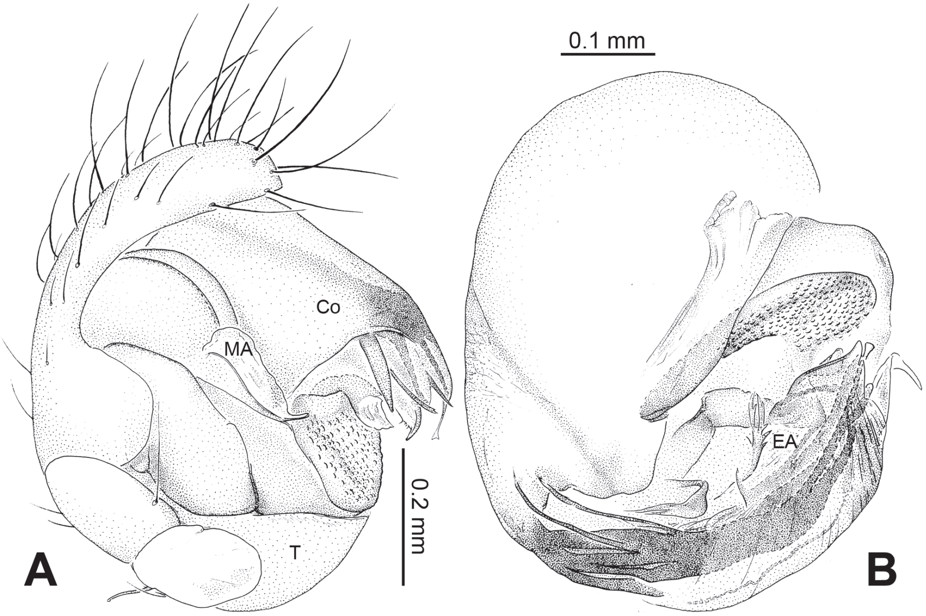

Figure 23. *Theridiosoma plumaria* sp. n., male holotype. **A** Pedipalp, prolateral view **B** Embolic division, retrolateral view. **Co** conductor; **EA** embolic apophysis; **MA** median apophysis; **T** tegulum.

(Figs 22A, D). Median apophysis a curved lobe attenuate distally. Conductor a translucent theca covering fragmented embolic apophysis, with plumose branching and erect tip near tegulum (Fig. 22B). Embolic apophysis fragment tips protruding out of the conductor (Figs 22A–C). Embolic apophysis fragments long, slim (Figs 22D, 23B).

Male: Total length 1.60, carapace 0.80 long, 0.80 wide, clypeus 0.20, sternum 0.40 long, 0.40 wide, coxae IV separated by their width. Posterior median eyes separated by less than half their diameter. Macrosetae: Leg I: femur p 1, patella d 1, tibia d 1, p 1, r 1; Leg II: femur r 1, patella d 1, tibia d 1, p 1, r 1; Leg III: patella d 1, tibia p 1, r 1, metatarsus p 1; Leg IV: patella d 2, tibia d 1. Metatarsal trichobothria: Tm I: 0.0.25; Tm II: 0.19. Leg measurements: I 3.16 (0.93, 0.35, 0.75, 0.75, 0.38); II 2.80 (0.88, 0.28, 0.63, 0.63, 0.38); III 1.66 (0.50, 0.18, 0.35, 0.38, 0.25); IV 1.83 (0.50, 0.25, 0.38, 0.45, 0.25).

Female unknown

Theridiosoma triumphalis sp. n.

urn:lsid:zoobank.org:act:958EEF84-677E-4E46-B673-AA78B5FF63E6
http://species-id.net/wiki/Theridiosoma_triumphalis
Figs 24–25

Material examined. Holotype: CHINA, Hainan: Mt. Jianfengling National Nature Reserve: Tianchi watershed, 18°44.383'N, 108°51.062'E, elevation ca 888 m, 19 July 2007, S. Li (IZCAS), 1 male.

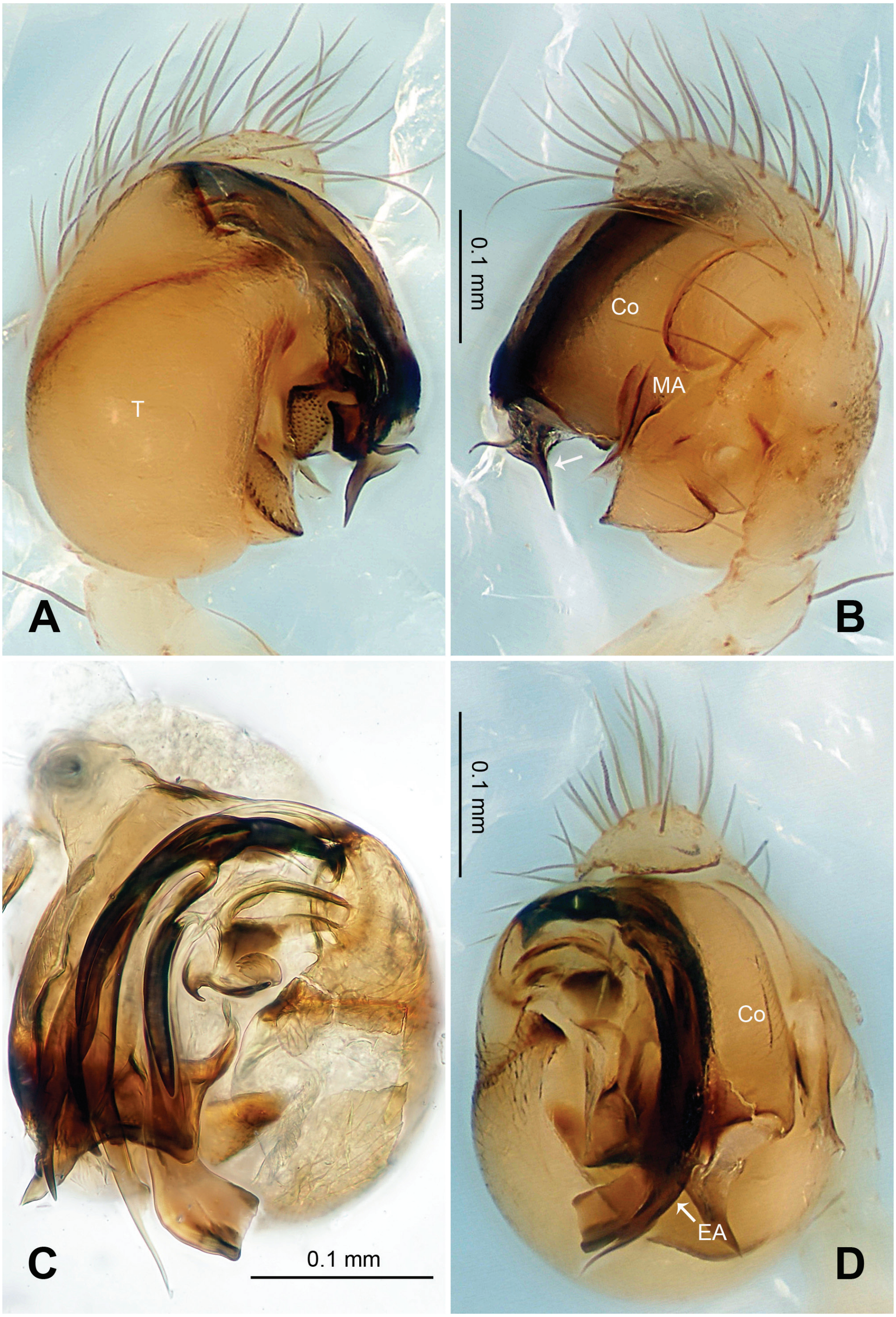

Figure 24. *Theridiosoma triumphalis* sp. n., male holotype. **A** Right pedipalp, prolateral view **B** Right pedipalp, retrolateral view **C** Embolic division, retrolateral view **D** Right pedipalp, ventral view. **Co** conductor; **EA** embolic apophysis; **MA** median apophysis; **T** tegulum. Scale bars: **B** as **A**.

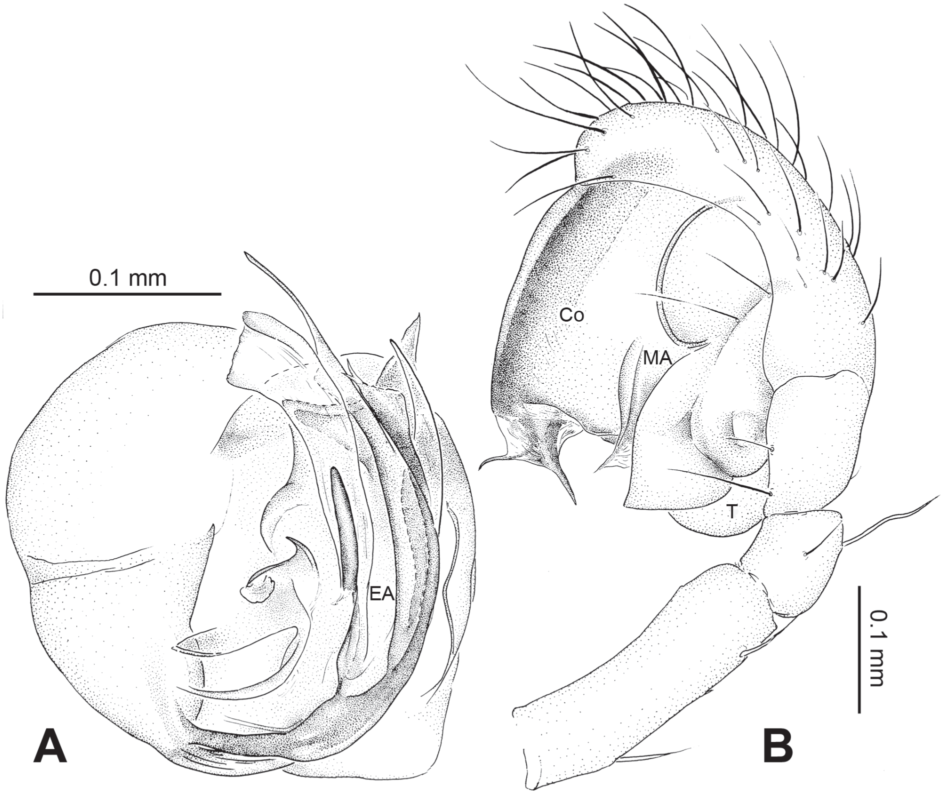

Figure 25. *Theridiosoma triumphalis* sp. n., male holotype. **A** Embolic division, retrolateral view **B** Right pedipalp, prolateral view. **Co** conductor; **EA** embolic apophysis; **MA** median apophysis; **T** tegulum.

Etymology. The specific Latin word 'triumphalis' meaning 'of victory' refers to the 'V'-shaped conformation made by the two embolic apophysis fragments (Figs 24A, B, 25B); adjective.

Diagnosis. Males distinguished from other described Asian *Theridiosoma* species by the shape of median apophysis: a small, curved projection with an attenuated tip extending distoventrally (Fig. 24B). Embolic apophysis fragmented, similar to *T. caaguara* (Rodrigues and Ott 2005: figs 4, 5), but different in details: four pieces of different shapes, the longest one with a whip-like tip, the longer one broad, with a blunt end (Fig. 24C).

Description. Carapace yellow tan. Sternum yellow with dark margins. Legs yellow. Due to poor preservation condition, abdomen too shriveled to make out its original color pattern.

Male pedipalp: Patella with strong macroseta. Paracymbium elongate with attenuated tip. Tegulum smooth with tuberculate ventral ridge. Median apophysis curved lobe with attenuated distal end. Conductor translucent theca covering most fragmented embolic apophysis, with a small rough ventral area (Fig. 24A). Two embolic apophysis fragment tips protruding out of the conductor tip to form a 'V'-shaped conformation (Fig. 24B). Embolic apophysis with four separate sclerotic fragments (Figs 24C, 25A).

Male: Total length 1.7, carapace 0.50 long, 0.50 wide, clypeus 0.09, sternum 0.31 long, 0.31 wide, coxae IV separated by their width. Posterior median eyes separated by less than half their diameter. Macrosetae: Leg I: femur r 1, patella d 1, tibia d 1, p 1; Leg II: patella d 1, tibia d 2, p 1; Leg III: tibia p 1; Leg IV: tibia d 1. Metatarsal trichobothria: Tm I: 0.21; Tm II: 0.27; Tm III: 0.20. Leg measurements: I 2.01 (0.63, 0.25, 0.50, 0.38, 0.25); II 1.76 (0.50, 0.25, 0.38, 0.38, 0.25); III 1.33 (0.30, 0.13, 0.15, 0.25, 0.15); IV 1.14 (0.38, 0.13, 0.25, 0.25, 0.13).

Female unknown

Theridiosoma vimineum sp. n.

urn:lsid:zoobank.org:act:7E3616F4-8E17-4E5D-9892-98A2860B8AC3
http://species-id.net/wiki/Theridiosoma_vimineum
Figs 26–27

Material examined. Holotype: CHINA, Yunnan: Menglun Town: Xingshuangbanna Botanical Garden, 21°55.428'N, 101°16.441'E, elevation ca 598 m, 19–26 May 2007, primary tropical seasonal rain forest, searching, G. Zheng (IZCAS), 1 male.

Etymology. The specific name is derived from Latin word ‘vimineus’ meaning ‘pliant’, refers to the long, pliant apophysis that protrudes from the conductor (Fig. 26B); adjective.

Diagnosis. Males similar to *T. semiargentum* (Simon) (Coddington 1986: figs 154,156), but different in the details of embolic apophysis fragments and the shape of median apophysis. The apophysis protruding from the conductor is longer and slimmer in *T. vimineum*, spur on the conductor is absent, and the median apophysis lacks a pointed hook at the tip.

Description. Carapace yellow. Sternum tan with dark margins. Legs yellow. Abdomen tan with light grey spots randomly distributed on the dorsal area.

Male pedipalp: Patella with macroseta. Tibia with one trichobothrium. Paracymbium elongate with sharp tip. Tegulum smooth with rough mesal lobe. Median apophysis slightly grooved, semi-transparent at the distal end (Figs 26B, 27B). Conductor translucent theca with a hooked end oriented proximally (Fig. 26A). A piece of long, flat embolic apophysis fragment with a attenuated tip protruding from the ridge of conductor and stretching toward median apophysis (Figs 26B, D). Embolic apophysis fragmented into long, slim bristles (Fig. 26C).

Male: Total length 1.75, carapace 0.95 long, 0.50 wide, clypeus 0.19, sternum 1.54 long, 0.35 wide, coxae IV separated by their width. Posterior median eyes separated by their diameter. Macrosetae: Leg I: femur d 1, patella d 2, tibia d 2, p 1; Leg II: patella d 2, tibia d 2, r 1; Leg III: patella d 1, tibia r 2; Leg IV: tibia d 1. Metatarsal trichobothria: Tm I: 0.23; Tm II: 0.20. Leg measurements: I 2.18 (0.68, 0.25, 0.50, 0.50, 0.25); II 1.86 (0.63, 0.20, 0.38, 0.40, 0.25); III 1.03 (0.35, 0.13, 0.15, 0.25, 0.15); IV 1.31 (0.38, 0.18, 0.30, 0.30, 0.15).

Female unknown

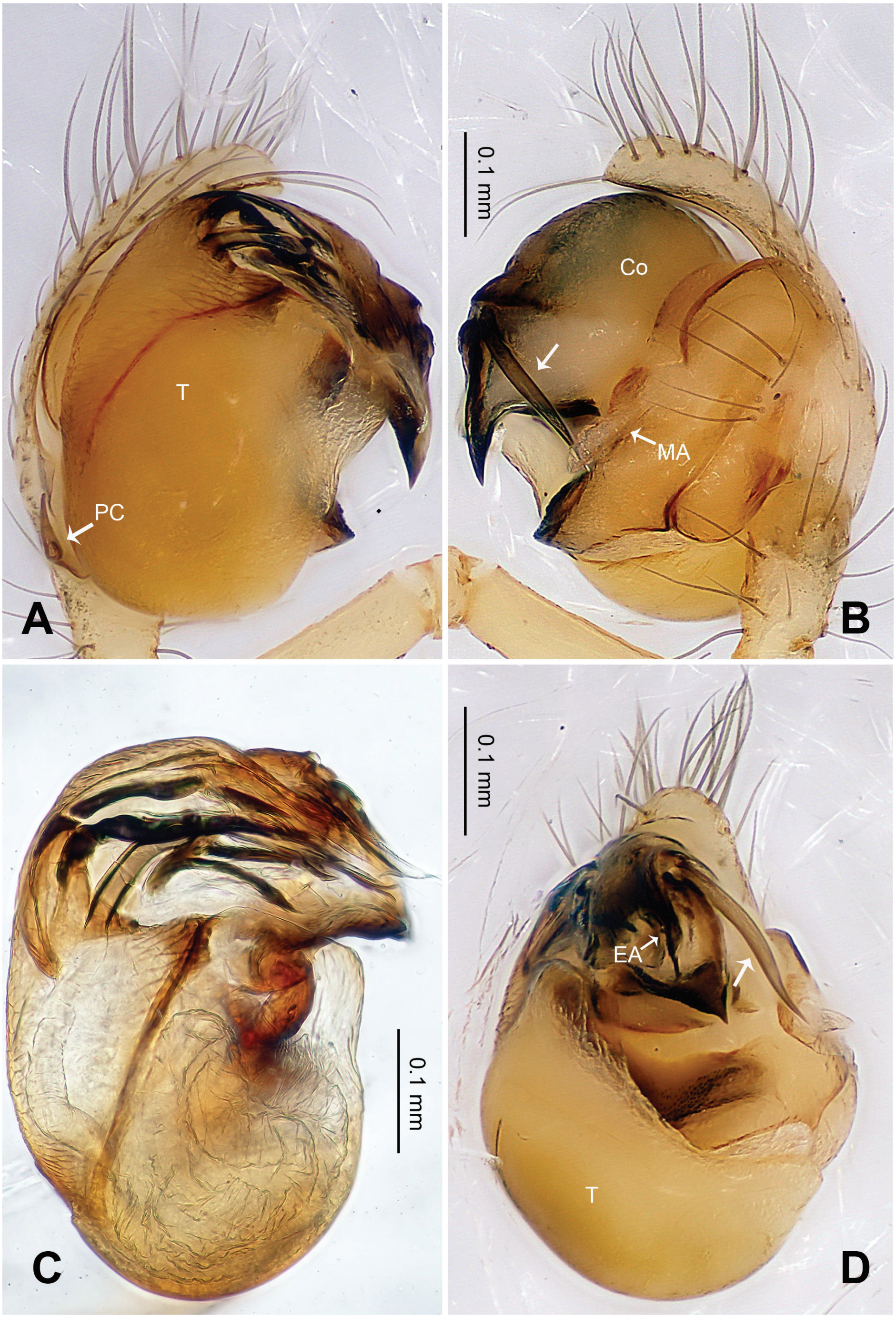

Figure 26. *Theridiosoma vimineum* sp. n., male holotype. **A** Right pedipalp, prolateral view **B** Right pedipalp, retrolateral view **C** Embolic division of right pedipalp, retrolateral view **D** Right pedipalp, ventral view. **Co** conductor; **EA** embolic apophysis; **MA** median apophysis; **PC** paracymbium; **T** tegulum. Scale bars: **A** as **B**.

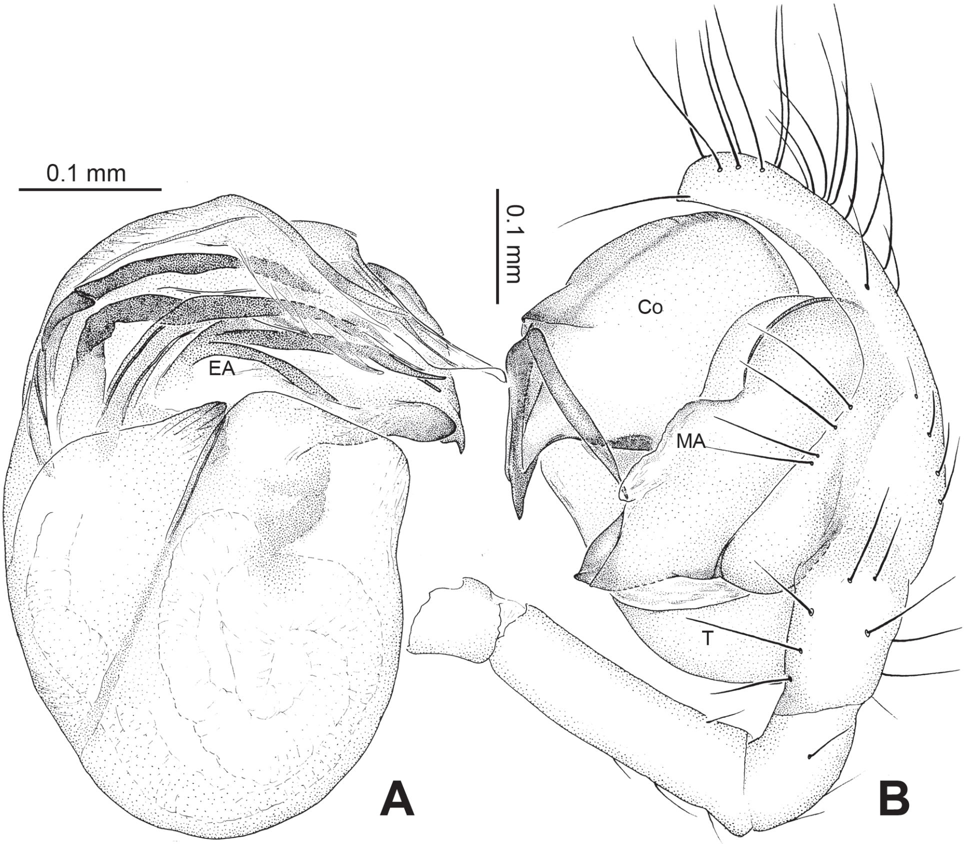

Figure 27. *Theridiosoma vimineum* sp. n., male holotype. **A** Embolic division of right pedipalp, retrolateral view **B** Right pedipalp, prolateral view. **Co** conductor; **EA** embolic apophysis; **MA** median apophysis; **T** tegulum.

Genus *Zoma* Saaristo, 1996

Zoma Saaristo, 1996: 51. Type species: *Zoma zoma* Saaristo, 1996.

Zoma fascia sp. n.

urn:lsid:zoobank.org:act:4FC78696-B0B2-413F-B8F1-A4FF9D25591F
http://species-id.net/wiki/Zoma_fascia
Figs 28–30

Material examined. Holotype: CHINA: Hainan: Mt. Bawangling National Nature Reserve, 5 kilometers past Dongerjianchazhan, 19°05.186'N, 109°11.802'E, elevation ca 1010 m, 25 July 2007, S. Li (IZCAS), 1 male.

Paratypes: CHINA: Hainan: Mt. Diaoluoshan National Nature Reserve, Diaoluoshan Resort, 18°43.766'N, 109°51.815'E, elevation ca 1010 m, 15 August 2007,

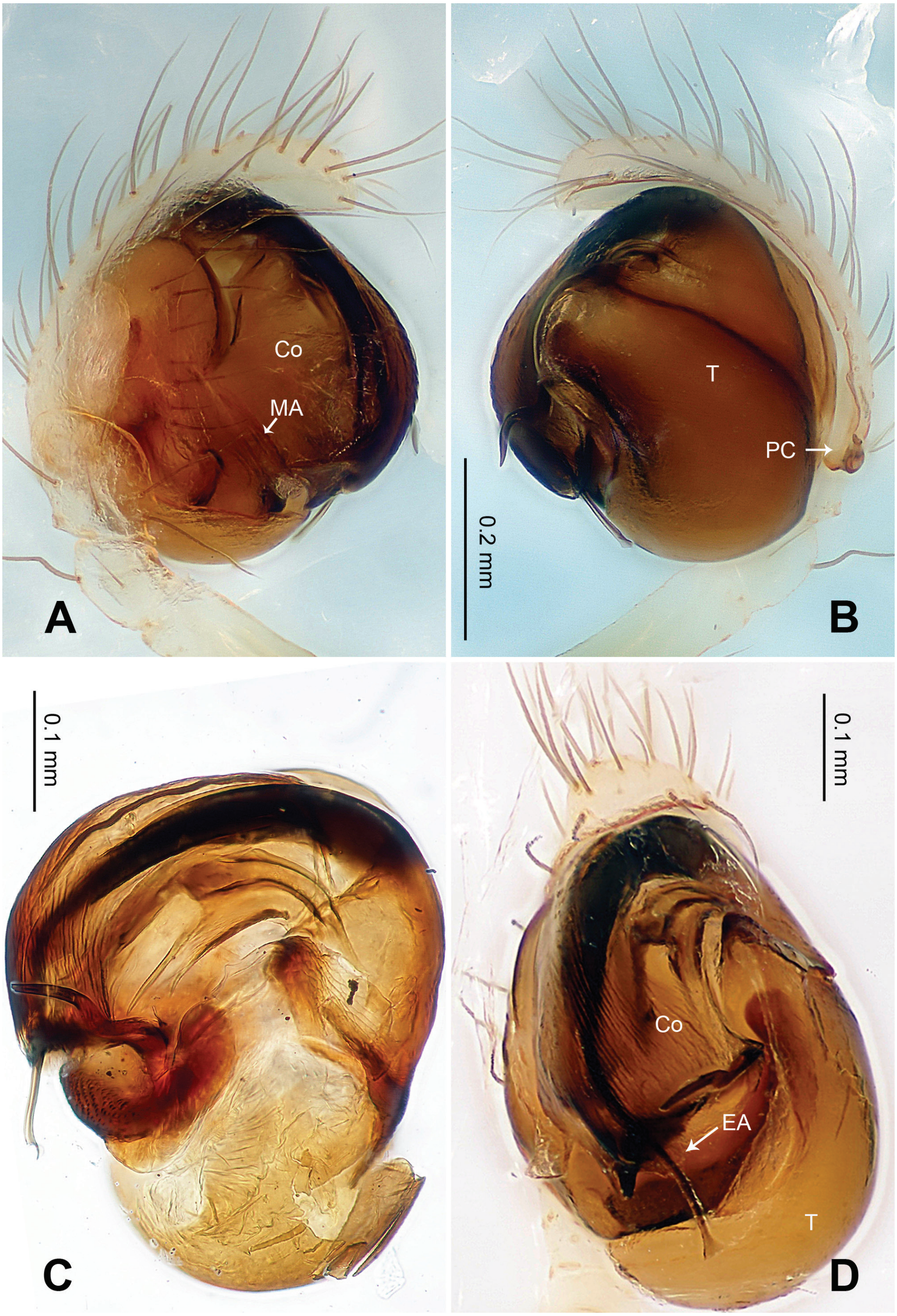

Figure 28. *Zoma fascia* sp. n., male holotype. **A** Pedipalp, prolateral view **B** Pedipalp, retrolateral view **C** Embolic division, retrolateral view **D** Pedipalp, ventral view. **Co** conductor; **EA** embolic apophysis; **MA** median apophysis; **PC** paracymbium; **T** tegulum. Scale bars: **A** as **B**.

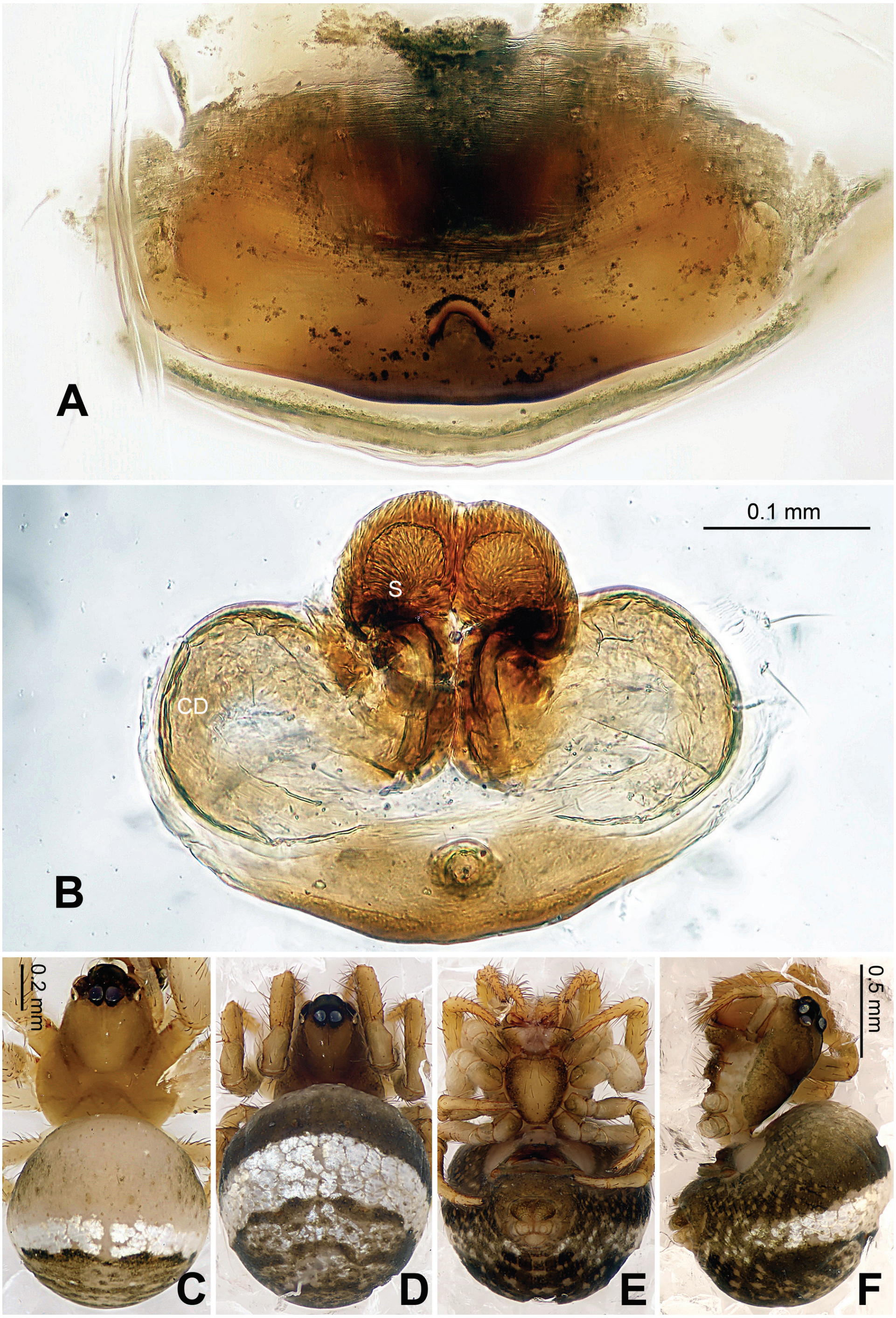

Figure 29. *Zoma fascia* sp. n., male holotype (**C**) and female paratype (**A–B, D–F**). **A** Epigyne, ventral view **B** Vulva, dorsal view **C** Male habitus, dorsal view **D** Female habitus, dorsal view **E** Female habitus, ventral view **F** Female habitus, lateral view. **CD** copulatory duct; **S** spermatheca. Scale bars: **A** as **B, D, E** as **F**.

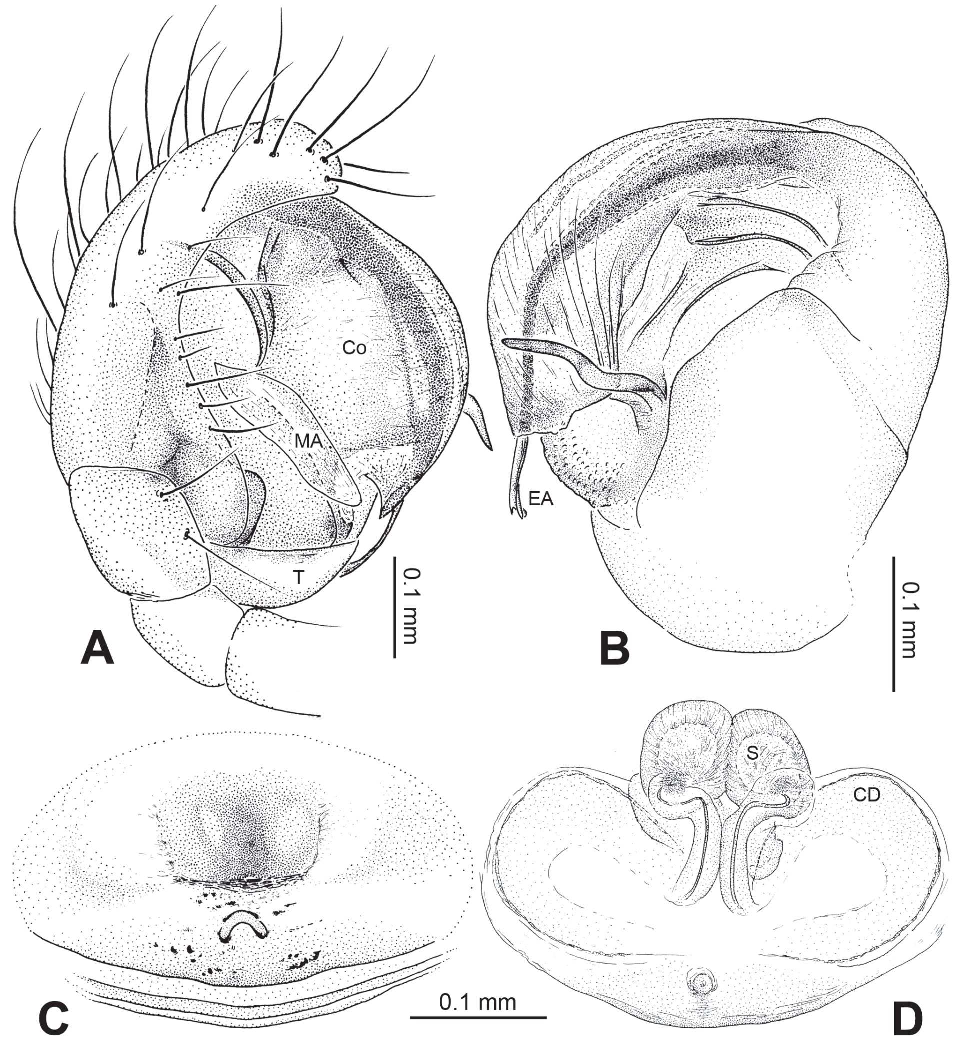

Figure 30. *Zoma fascia* sp. n., male holotype (**A–B**) and paratype female (**C–D**). **A** Pedipalp, prolateral view **B** Embolic division, retrolateral view **C** Epigyne, ventral view **D** Vulva, dorsal view. **CD** copulatory duct; **Co** conductor; **EA** embolic apophysis; **MA** median apophysis; **S** spermatheca. **T** tegulum.

S. Li (IZCAS), 1 female; Mt. Jianfengling National Nature Reserve, Huxiaolongyin scenery, on the mountain by the river, 18°45.159'N, 108°54.604'E, elevation ca 900 m, 20 July 2007, S. Li (IZCAS), 1 female; Mt. Limushan Provincial Nature Reserve, Qulinggulinyuan, 19°10.686'N, 109°44.490'E, elevation ca 654 m, 12 August 2007, C.X. Wang (IZCAS), 1 female; [same data as holotype] (IZCAS), 1 female; Mt. Jianfengling National Nature Reserve, east valley of Tianchi, 18°54.691'N, 108°51.588'E, elevation ca 811 m, 17 July 2007, S. Li (IZCAS), 1 female.

Etymology. The specific name comes from a Latin word 'fascia', which refers to the silver band on its abdomen; noun.

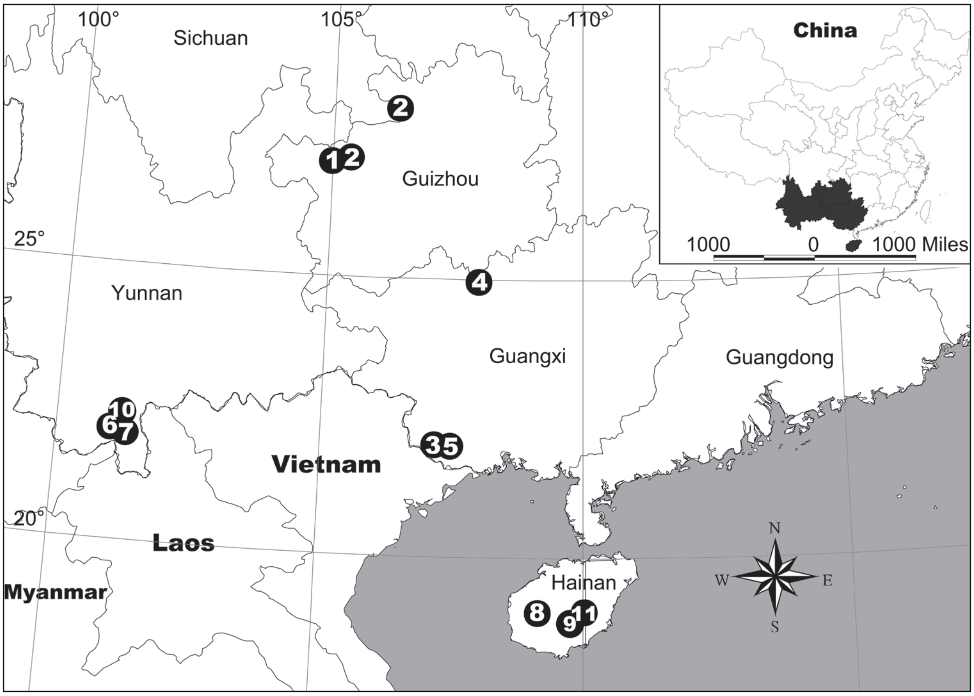

Figure 31. Locality records for eleven theridiosomatid spider species in China. **1** *Alaria chengguanensis* gen. n., sp. n. **2** *Baalzebub rastrarius* sp. n. **3** *B. youyiensis* sp. n. **4** *Karstia nitida* sp. n. **5** *K. prolata* sp. n. **6** *Menglunia inaffecta* gen. n., sp. n. **7** *Ogulnius hapalus* sp. n. **8** *Theridiosoma plumaria* sp. n. **9** *T. triumphalis* sp. n. **10** *T. vimineum* sp. n. **11** *Zoma fascia* sp. n.

Diagnosis. Males distinguished by the presence of a filiform embolic apophysis extending beyond the conductor tip and a 'Z'-shaped embolus (Figs 28B, D). Exposed portion of embolic apophysis is smaller compared to *Z. didaiyin* (Miller et al. 2009: fig. 10F).

Female distinguished from *Z. didaiyin* by the mildly convex posterior margin of the epigyne and the higher position of the spermathecae relative to the copulatory ducts (Figs 29A, B).

Description. Carapace brownish yellow in males, brown in females. Sternum yellow with dark brown margins. Legs yellow. Abdomen beige in males, dark grey in females with silver pecks forming a transverse belt.

Male pedipalp: Patella with macroseta. Tibia with one trichobothrium. Paracymbium hooked with short, pointed tip (Fig. 28B). Median apophysis lightly sclerotized, similar to *Z. didaiyin* (Miller et al. 2009: fig. 10D). Conductor translucent. Embolic apophysis filiform, with triangular tip (Fig. 28C).

Vulva: Epigyne a flat orange plate with a low median pit. Spermathecae subspherical, juxtaposed. Copulatory ducts follow simple curve (Fig. 29A, B) .

Male: Total length 1.52, carapace 0.72 long, 0.60 wide, clypeus 0.14, sternum 0.37 long, 0.31 wide, coxae IV separated by their width. Posterior median eyes separated by less than half their diameter. Macrosetae: Leg I: femur p 1, patella d 1, tibia d

1, p 1, r 1; Leg II: patella d 2, tibia d 3, v 2, r 1; Leg III: patella d 1, tibia d 1; Leg IV: patella d, tibia d 1. Metatarsal trichobothria: Tm I: 0.21; Tm II: 0.20; Tm III: 0.27. Leg measurements: I 2.19 (0.70, 0.25, 0.50, 0.47, 0.27); II 1.99 (0.63, 0.23, 0.44, 0.39, 0.30); III 1.16 (0.31, 0.23, 0.22, 0.23, 0.17); IV 1.45 (0.39, 0.21, 0.31, 0.31, 0.23).

Female: Total length 1.80, carapace 0.88 long, 1.00 wide, clypeus 0.18, sternum 0.50 long, 0.30 wide, coxae IV separated by their width. Posterior median eyes separated by less than half their diameter. Macrosetae as in male. Metatarsal trichobothria: Tm I: 0.30; Tm II: 0.19; Tm III: 0.27. Leg measurements: I 2.11 (0.63, 0.31, 0.47, 0.39, 0.31); II 1.97 (0.63, 0.31, 0.39, 0.39, 0.25); III 1.47 (0.47, 0.23, 0.31, 0.25, 0.21); IV 1.16 (0.31, 0.23, 0.23, 0.23, 0.16).

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A new species of *Centris* (*Centris*) (Fabricius) from northeastern Brazil, with taxonomic notes on *C.* (*C.*) *pulchra* Moure, Oliveira & Viana (Hymenoptera, Apidae)

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Abstract

We describe a new species of the bee genus *Centris*, *C.* (*C.*) *byrsonimae* Mahlmann & Oliveira **sp. n.**, whose name has appeared as a *nomen nudum* in the literature since 1985. Further, a new species group of *Centris* s.str. is proposed, the *pulchra* group, based on morphological characters, which comprises the species *C. pulchra* Moure, Oliveira & Viana, 2003 and *C. byrsonimae* **sp. n.**. Based on information from specimen labels studied and data from the literature, a list of plant species visited by the *pulchra* group is presented. The male genitalia and hidden metasomal sterna 7 and 8 of *C. pulchra* are described for the first time. Typographic errors pertaining to the paratype labels reported in the original description of *C. pulchra* are corrected. One female paratype of *C. pulchra* is designated herein as a paratype of *C. byrsonimae* **sp. n.** An updated list of species of *Centris* s.str. from northeastern Brazil is provided including references about geographic distributions as well as an identification key to the *pulchra* species group.

Keywords

Anthophila, Apoidea, bees, Centridini, Neotropical, taxonomy, Apinae

Introduction

The bee tribe Centridini (Apidae: Apinae) contains numerous robust, large to moderate-sized species, most of which are Neotropical and collect floral oils, principally from Malpighiaceae and Krameriaceae (Ayala 2002). A subgeneric classification based on a cladistic analysis was proposed by Ayala (1998), who recognized 12 subgenera in *Centris* Fabricius, two of which were described subsequently by Ayala (2002). According to Moure et al. (2012), the subgenus *Centris* is one of the most diverse containing 34 described species. According to Michener (2007), this subgenus occurs from Baja California, Mexico and southern Arizona to southern Florida, USA, and the Bahamas, and south through the Antilles and the continental tropics to Santa Catarina, Brazil. Only one species of the subgenus is exclusive to the Nearctic region, while six occur in both the Nearctic and Neotropical regions, and the remaining 27 species are exclusively distributed in the neotropics (Moure et al. 2012). In northeastern Brazilian nine nominal valid species are known for the subgenus (Table 1).

Table 1. List of species of *Centris* (*Centris*) occurring in northeastern Brazil, including the states where they have been recorded.

Species	State[†]	Reference
C. aenea Lepeletier, 1841	MA	Moure et al. (2012)
	CE	Moure et al. (2012)
	RN	Moure et al. (2012); Vivallo and Zanella (2012)[‡]
	PB	Vivallo and Zanella (2012)[‡]
	BA	Moure et al. (2012); Vivallo and Zanella (2012)[‡]
	SE	Silveira and Mendonça (2005)
C. byrsonimae Mahlmann & Oliveira sp. n.	MA	Albuquerque (1986)
	CE	Paratype label
	BA	Moure et al. (2003)[§]
C. caxiensis Ducke, 1907	MA	Moure et al. (2012)
	RN	Vivallo and Zanella (2012)[‡]
	BA	Vivallo and Zanella (2012)[‡]
C. decolorata Lepeletier, 1841	MA	Moure et al. (2012); Vivallo and Zanella (2012)[‡]
	BA	Moure et al. (2012)
C. flavifrons (Fabricius, 1775)	MA	Albuquerque (1986)
	BA	Vivallo and Zanella (2012)[‡]
	SE	Silveira and Mendonça (2005)
C. nitens Lepeletier, 1841	BA	Viana and Santos (2002)
	SE	Silveira and Mendonça (2005)
C. pulchra Moure, Oliveira & Viana, 2003	BA	Viana (1999); Moure et al. (2003)[§]; Moure et al. (2012)

Species	State[†]	Reference
C. spilopoda Moure, 1969	MA	Albuquerque (1986)
	CE	Vivallo and Zanella (2012)[‡]
	BA	Vivallo and Zanella (2012)[‡]
C. varia (Erichson, 1849)	MA	Moure et al. (2012)
	RN	Vivallo and Zanella (2012)[‡]
	BA	Vivallo and Zanella (2012)[‡]

[†] States in North-South order / MA: Maranhão, CE: Ceará, RN: Rio Grande do Norte, PB: Paraíba, BA: Bahia, SE: Sergipe.

[‡] Records compiled by Vivallo and Zanella (2012).

[§] Cited as *Centris pulchra* [*partim*].

The present paper describes a new species of *Centris* s.str. from northeastern Brazil. *Centris byrsonimae* sp. n., whose epithet has appeared as a *nomen nudum* in the literature since 1985, is described and figured herein, finally validating the name for this species. Based on morphological characters, a new species group of *Centris* s.str. is proposed, the *pulchra* group, which currently comprises *C. pulchra* and *C. byrsonimae* sp. n. In addition, we provide an identification key to this group. A list of plant species visited by the *pulchra* group is provided based on information from specimen labels and a survey of the literature. The male terminalia of *C. pulchra* is described for the first time. Typographic errors reported from the paratype labels of *C. pulchra* in its original description were discovered during the course of this work and herein they are corrected. One female paratype of *C. pulchra* is designated as a paratype of *C. byrsonimae* sp. n.

Methods

We examined 30 paratypes (24♀♀, 6♂♂) and additional specimens of *C. pulchra* deposited in the Entomological Collection, Zoological Museum, Federal University of Bahia (MZUFBA), Salvador, Bahia, Brazil. In addition we studied the specimen originally examined by Pe. Moure in 1985 and labeled by him as holotype of *C. byrsonimae* (DZUP: Federal University of Paraná, Curitiba, Paraná, Brazil) but until now undescribed. Additional material was borrowed from the Entomological Collection of the Studies on Bees Laboratory (LEACOL), Federal University of Maranhão, São Luís, Maranhão, Brazil. General morphological terminology follows Engel (2001) and Michener (2007), with the standard abbreviations as follows: F1, F2, etc.– antennal flagellomeres; T1 to T7 and S1 to S8 – metasomal terga and sterna, respectively. In addition we have used the abbreviation SL for scape length. The upper and lower interocular distances were measured using the shortest distance between the compound eyes in frontal view. The mandibular teeth were numbered from the apex to the base of the mandible. All measurements are given in millimeters (mm). Label information from separate labels are segregared by double slashes,"//". Typographic errors from paratype labels as reported in the original description of *C. pulchra* were corrected and the corrections identified with brackets, "[ ]". Floral records for *pulchra* species group were based on information from specimen labels and the literature. Additionally, a label reporting the host plant of the holotype of *C. byrsonimae* sp. n. was included. Photomicrographs were prepared using a Leica M165C stereomicroscope coupled with a Leica DFC295 and a Leica Application Suite V4.1 Interactive Measurements, Montage.

Systematics

Tribe Centridini Cockerell & Cockerell, 1901
Genus *Centris* Fabricius, 1804
Subgenus *Centris* Fabricius, 1804

Pulchra species group

Diagnosis. Herein we propose the *pulchra* species group as a distinct lineage within *Centris* s.str., comprising for the moment two species: *C. pulchra* and *C. byrsonimae* sp. n. This species group is characterized by the clypeus largely yellow with two longitudinal dark brown streaks located in the upper half; a narrow band of whitish and dense bristles bordering the posterior border of T2–T4, extended to the sides and narrowed in the middle, but not interrupted; by the maxillary palpus reduced to four palpomeres; the mandibles with five teeth, the most basal substantially smaller and located in the lower inner edge of the mandible; and the secondary basitibial plate yellow, but only slightly elevated (merely inflated), not projecting over the basal plate.

Comments. In the identification keys of Ayala (in Michener 2007) and Silveira et al. (2002), the species of the *pulchra* group do not fit well into *Centris* s.str. based on four characters: (1) the maxillary palpus is 5- or 6-segmented, (2) the mandible 3- or 4-toothed, (3) the basitibial plate with a defined secondary plate with sharp projecting margins, and (4) the clypeus with yellow or white markings in the form of an inverted T or Y. Although the *pulchra* group differs in these four characters and indicated in the key as diagnostic for the subgenus *Centris*, *C. pulchra* and *C. byrsonimae* sp. n. can be retained there based on the unique character of the subgenus: the long, slender, apical projection of the male gonocoxite, extending parallel to the gonostylus (Michener 2007); this gonocoxal projection bearing giant branched setae. In regard to parasitism by *Mesonychium asteria* (Smith, 1854) (Apinae: Ericrocidini) in nests of *C. pulchra* reported by M.C. Ramos (pers. comm. in Rocha-Filho et al. 2009), this was probably a mistake. According to Marina C. Ramos (pers. comm. 2012) the parasitism observed was of an unidentified species of *Mesoplia* Lepeletier de Saint Fargeau (Apinae: Ericrocidini) in nests of *C. byrsonimae* sp. n. She observed adults of *Mesoplia* sp. emerging from brood cells of *C. byrsonimae* sp. n. nesting in the ground.

***Centris* (*Centris*) *byrsonimae* Mahlmann & Oliveira, sp. n.**

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http://species-id.net/wiki/Centris_byrsonimae
Figures1–12; 19–22

Centris (*Paremisia*) *byrsonimae*; Albuquerque, 1986: 119 [*nomen nudum*]; Albuquerque and Mendonça 1996: 47, 49, 53 [*nomen nudum*].

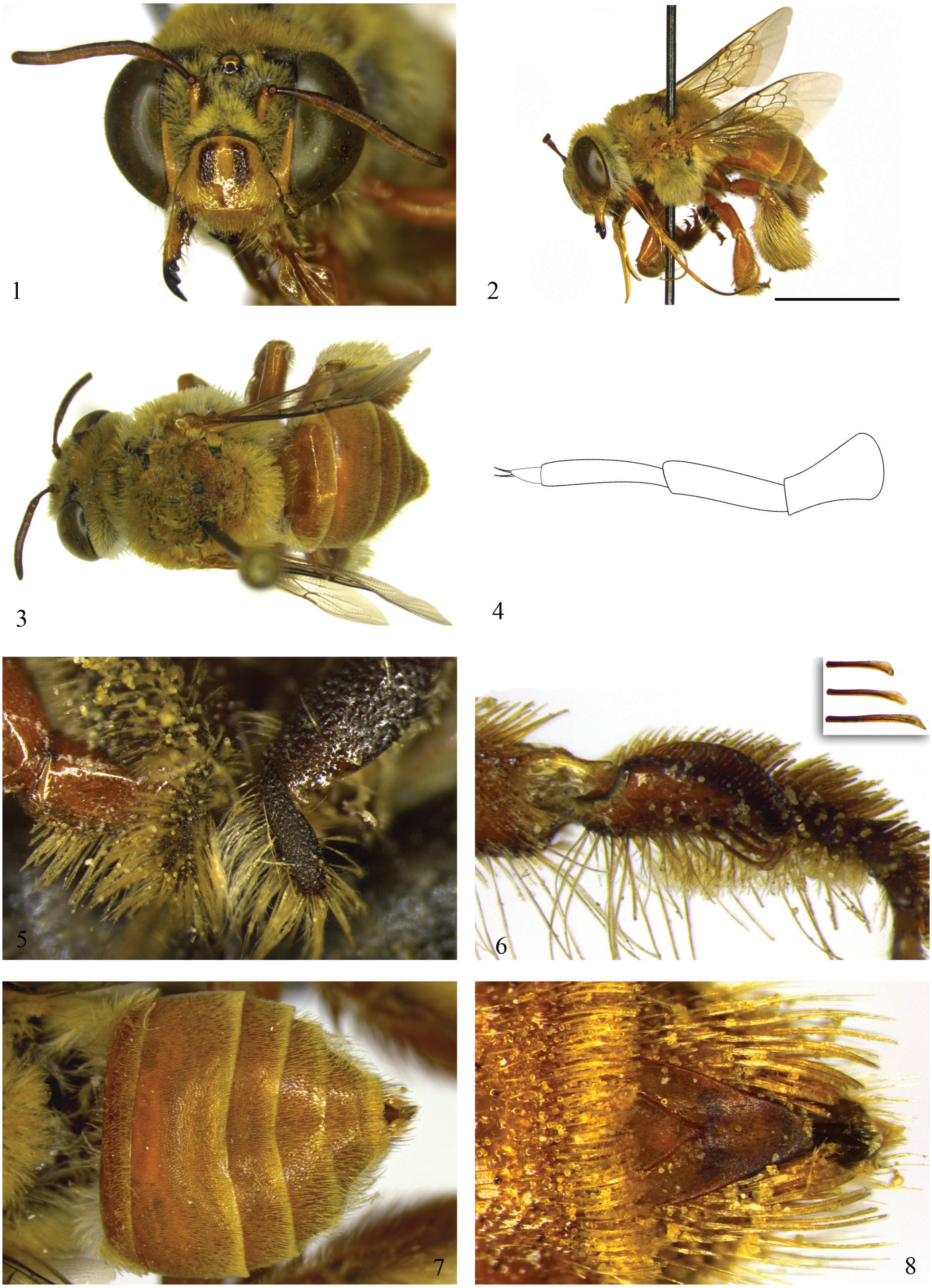
Centris byrsonimae; Ribeiro et al. 2008: 167 [*nomen nudum*]; Rêgo 2008: 23 [*nomen nudum*, photo on Murici flower].

Centris aff. *pulchra*; Rosa 2009: 65.

Holotype. ♀, São Luís, MA, Brasil, 15.ix.1984, Albuquerque *Leg.* // Coletada na flor, *Byrsonima crassifolia*: Malpighiaceae // Holótipo // *Centris byrsonimae* Moure, 1985, Holotype // *Centris birsonimae* Moure, 1986 // Hr 15:00–16:00 // Holotype ♀ *Centris byrsonimae* Mahlmann & Oliveira, 2012. The specimen is in excellent condition and is deposited in DZUP.

Allotype. ♂, Alótipo // Barreirinhas, MA, Brasil, 09.viii.1991, Brito & Mendonça // Pl. N.017, 10–11h // *Centris* sp.2*, C. byrsoni.* Mou. // Allotype ♂ *Centris byrsonimae* Mahlmann & Oliveira, 2012. The specimen is deposited in MZUFBA.

Paratypes. (13♀♀, 3♂♂): Parátipo // Barreirinhas, MA, Brasil, 19.xi.1991, Brito & Mendonça // Pl. N.006, 9–10h // *C. byrsonimae* // Coletada em *Banisteriopsis* sp.: Malpighiaceae (**1**♀, LEACOL); Parátipo // São Luis, MA, Brasil, 21.x.1984, Albuquerque *Leg.* // Hr. 10:00–11:00 // Moure, 1985, Paratype // Coletada em *Byrsonima crassifolia* (L.) Kunth: Malpighiaceae (**1**♀, LEACOL); Parátipo // São Luis, MA, Brasil, 21.x.1984, Albuquerque *Leg.* // Hr. 7:00–8:00 // Paratype // Coletada em *Byrsonima crassifolia* (L.) Kunth: Malpighiaceae (**1**♀, LEACOL); Parátipo // São Luis, MA, Brasil, 19.viii.1984, Albuquerque *Leg.* // Hr. 10:00–11:00 // *Centris byrsonimae //* Moure, 1985, Paratype // Coletada em *Byrsonima crassifolia* (L.) Kunth: Malpighiaceae (**1**♀, MZUFBA); Parátipo // Ilha de Curupu, MA, Br., 14.viii.1999, Sousa & Martins *Leg.* // Pl.N.006, Hr. 13:14, 62 (**1**♀, LEACOL); Parátipo // Urbano Santos, MA, Brasil, 03°12'28"S, 43°24'12"W, 27.viii.2005, 6:00–7:00, Mendes FN, *Leg.* // 795 // Coletada em *Byrsonima umbellata* Mart. ex A.Juss.: Malpighiaceae (**1**♀, LEACOL); Parátipo // Urbano Santos, MA, Brasil, 03°12'28"S, 43°24'12"W, 27.viii.2005, 7:00–8:00, Mendes FN, *Leg.* // 800 // Coletada em *Byrsonima umbellata* Mart. ex A.Juss.: Malpighiaceae (**1**♀, LEACOL); Parátipo // Urbano Santos, MA, Brasil, 03°12'28"S, 43°24'12"W, 10.ix.2005, 9:00–10:00, Mendes FN, *Leg.* // 849 // Coletada em *Byrsonima umbellata* Mart. ex A.Juss.: Malpighiaceae (**1**♀, MZUFBA); Parátipo // Barreirinhas, MA, Brasil, 09.viii.1991, Brito & Mendonça // Pl. N.017, 10–11h // *Centris* sp.2 // *Centris byrsonimae* Moure, MS, Det. Camargo, 1992 (**1**♂, LEACOL); Parátipo // Barreirinhas, MA, Brasil, 22.viii.1992, Brito & Mendonça // Pl. N.064, 11–12h (**1**♂, LEACOL); Parátipo // Barreirinhas, MA, Brasil, 21.viii.1992, Brito & Mendonça // Pl. N.064, 12–13h (**1**♂, MZUFBA); Parátipo // Brasil, Ceará, Horizonte, 10.ix.2011, Rede Entomológica, 9h, P. Andrade *Leg.* // Coletada na flor, *Anacardium occidentale* L.: Anacardiaceae // 544 (**1**♀,



Figures 1–8. Photomicrographs and illustration of female of *Centris* (*Centris*) *byrsonimae* Mahlmann & Oliveira sp. n. / **1–3** and **7–8** holotype (DZUP) **5–6** paratype (MZUFBA). **1** Facial aspect **2** Lateral habitus, scale 0.5 cm **3** Dorsal habitus **4** Maxillary palpus **5** Procoxae **6** Probasitarsus with combs for collecting floral oil **7** Metasoma **8** Pygidial plate.

MZUFBA); idem // 546 (**1**♀, MZUFBA); Parátipo // Brasil, Ceará, São Gonçalo do Amarante, Praia do Pecém, xi.2008, T. Mahlmann & Y. Antonini *Leg.* // Favízia 001153 (**1**♀, Snow Entomological Collections, University of Kansas Natural History Museum--SEMC, Lawrence, Kansas, USA); Parátipo // Brasil, Bahia, Camaçari, 04.xi.2008, J.F. Rosa e equipe *leg.*//987, Litoral Norte, Ponto 1, 04.xi.2008, 9:20–10:20, *Byrsonima sericea*, Rosa, JF; Monteiro, D; Silva, MD; Oliveira JFL *leg.* // sp.11 (**1**♀, MZUFBA); Parátipo // Brasil, Bahia, Salvador, Abaeté, 05.xi.1996, 11:15hs, B.F. Viana *Leg.* // Coletada na flor: *Byrsonima teopteridifolia* Juss [*Byrsonima microphylla* A.Juss.], Planta N°1 // Abaeté, SSa, Ba, 5.xi.1996, N, pl:01, 11:15 // 21 // 2330 // Paratype ♀, *Centris pulchra* Moure, Oliveira & Viana, 2003 (**1**♀, MZUFBA). All specimens with the same Paratype yellow labels: Paratype *Centris byrsonimae* Mahlmann & Oliveira, 2012.

Diagnosis. This species is quite similar to *C.* (*C.*) *pulchra* but differs by its smaller body size (ca. 10.6); the largely honey-brown integument (Figs. 2, 7); metallic blue iridescence almost imperceptible on metasomal terga; T1–T5 interlay covered by pale pubescence including the yellowish pubescence, largely golden on apical margin of T5 (Fig. 7); inner surface of probasitarsus with the combs for collecting floral oil, on distal half of posterior margin with three distinct strongly spatulate setae, curved on the inner surface and wider on its apex (Fig. 6); and the gonocoxal projection covered by dense, giant branched setae on the inner surface, forming a distinct fringe of plumose hairs longer than the gonocoxal projection itself (Figs. 19–21).

Description. ♀: *Structure*: Total body length 10.6; forewing length 7.1; head length 2.9, width 4.4; clypeus length 1.3, width 1.8; labrum length 0.7, width 1.2; scape length 0.6; F1 length 0.7; F2 length 0.2; F3 length 0.3; diameter of the anterior ocellus 0.3; ocellocular distance 0.4 (1.1x lateral ocellar diameter); upper interocular distance 2.1; lower interocular distance 2.0; metasomal width 4.2 (measured on T2). Clypeus convex with a smooth bottleneck in upper third from tentorial foveae; labrum semicircular. Maxillary palpus with four palpomeres (Fig. 4), 1st palpomere bulged and 0.5× shorter than subsequent two palpomeres, 4th palpomere much shorter than others (0.3× smaller than 2nd and 3rd). Mandibles with four normal teeth and one internal basal denticle separated from 3rd by a distance equivalent to 2× its length (Fig.1). Posterior margin of procoxae with a broad process (Fig.5), projected ventrally over mesepisternum and covered with long plumose pubescence. Basitibial plate with distinct secondary plate, primary plate concave and oval, secondary plate only slightly elevated but not projecting over primary plate; upper pygidial plate relatively long and narrow with its apex away from apex of lower plate by approximately 0.8× SL; inferior plate gently depressed from sides to middle and flat on apical third, ending in a point (Fig.8).

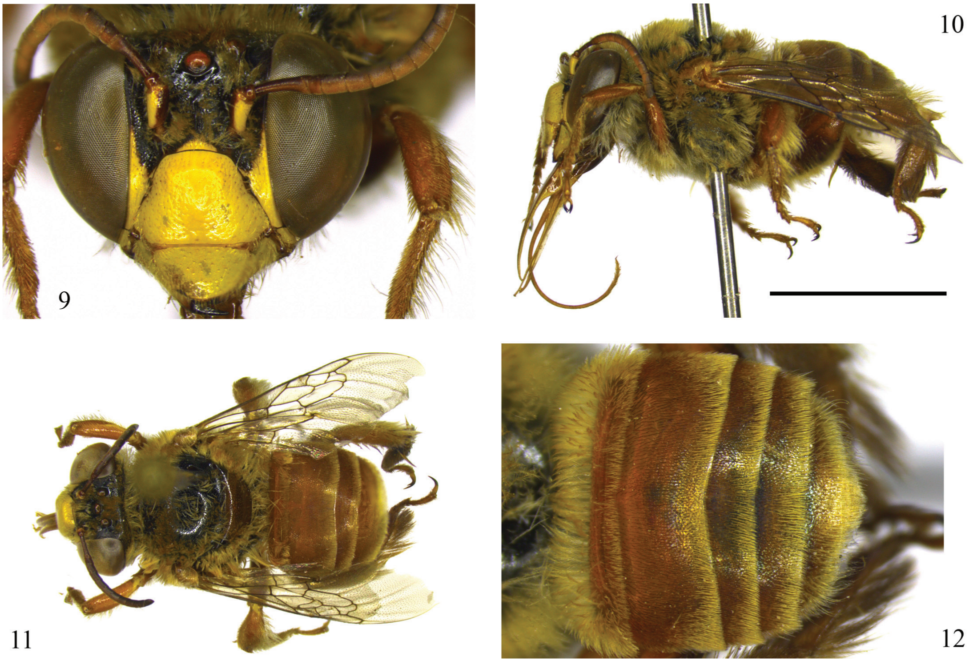
Coloration: Integument predominantly honey brown with metallic blue highlights almost imperceptible on metasoma (Fig. 7); head and mesosoma dark brown, mesoscutellum brownish. Yellow marks: clypeus, except two divergent wide dark brown stripes, located on upper half of clypeus and above separated from each other by distance equivalent to lateral ocellar diameter; labrum; basal 2/3 of mandibles;

malar area; very short narrow triangle on supraclypeal area; paraocular stripe ventrally wider, widest at level of tentorial fovea, narrowing upward and gradually ending at median level of compound eyes; wide stripe on lateroposterior surface of scape; small yellow marks on base of tibiae, most developed on secondary basitibial plate on metatibia; on protibia yellow marks followed by long dorsolateral stripe. Tegulae translucent honey colored; wing membrane slightly yellowish, with little brownish streak in basal third of marginal cell, with very thin arched transverse vein on apical third of first submarginal cell; brown venation slightly yellowish at pterostigma and base of wings; primary basitibial plate honey translucent; metallic blue reflections almost imperceptible on T2–T5.

Pubescence: In general pale and yellowish, with mostly whitish hairs as follows: lower surface of face and gena, ventral portion of mesepisterna, metepisterna, propodeum, base of metasoma and sterna; reddish bristles only on inner surface of tarsi, mostly visible on basitarsi; mesepisterna with plumose hairs restricted to upper half, dorsoventral surface covered by simple setae more widely spaced; lower 2/3 of ventral surface of procoxae covered by extremely thick, curved, yellow-whitish setae, decreasing in length toward posterior border, upper portion of procoxae covered by plumose hairs; outer surface of mesocoxae covered by simple bristles, upper margins with plumose hairs 0.5x smaller; probasitarsus with long line of bristles (2× SL) on outer dorsolateral surface, shortening toward apex and interspersed by a dense band of short plumose hairs, inner surface with few short bristles sparsely distributed; inner surface of probasitarsus, on distal half of posterior margin, with combs for collecting floral oils with three distinct and strongly spatulate setae, curved toward inner surface and wider at apex (Fig. 6); outer surface of mesobasitarsus with dense, short, plumose pubescence interspersed with simple bristles longer and sparser; metatibiae and metabasitarsus with thicker, milky white bristles; T2–T4 entirely covered by pale yellow, short and sparse setae, longer and denser on sides of terga and near posterior border, contrasting with hairiness of discal terga but not forming distinct band of yellowish bristles (Fig. 7); apical margin of T5 with long fringe of golden branched bristles (0.5× SL); S2–S5 with dense apical fringe, with hairs of central stripe slightly longer; fringe of S5 curved and with rachis relatively longer.

Sculpturing: Dense but of moderate size: on vertex spacing 1/2 of puncture width, with cariniform spaces between punctures, slightly smoother on supraclypeal area; midline of clypeus with integument smooth and polished, interspersed by very few punctures; punctures most evident on the side slopes of clypeus and labrum. Punctures obscured by pilosity on mesosoma and metasoma, mostly fine and spaced on sides of propodeum, and finer and piligerous on terga.

♂: *Structure*: Total body length 10.8; forewing length 7.7; head length 2.7, width 4.1; clypeus length 1.2, width 1.7; labrum length 0.8, width 1.2; scape length 0.6; F1 length 0.7; F2 length 0.2; F3 length 0.3; diameter of the anterior ocellus 0.3; ocellocular distance 0.3 (1.3× lateral ocellar diameter); upper interocular distance 2.0; lower interocular distance 2.3; metasoma width 4.2 (measured on T2). Similar to female



Figures 9–12. Photomicrographs of male of *Centris* (*Centris*) *byrsonimae* Mahlmann & Oliveira sp. n. / **9–11** allotype (MZUFBA) **12** paratype (MZUFBA) **9** Facial aspect **10** Lateral habitus, scale 0.5 cm **11** Dorsal habitus **12** Metasoma.

except as follows: mandibles with three normal teeth and one basal denticle on inner margin; basitibial and pygidial plates absent. S7 and S8 as in figure 22: S7 about as long as wide as measured at base, approximately 2/3 of S8 length and covered by setae on its lateral areas and apex; apical margin of S7 indented; median projection of S8 slightly uniformly tapering to apex; dorsal surface and apical 1/3 of S8 covered by long branched setae, apex covered by simple, shorter erect setae. Genitalia as in figures 19–21: dorsal surface of gonocoxite with small basal edge, internal surface covered by long, dense pilosity; gonocoxal projection covered by dense, long branched setae on inside surface forming distinct fringe of plumose hairs longer than gonocoxal projection itself; gonostylus covered by short setae.

Coloration: Metallic blue–greenish reflections more visible than in female at T2–T5 (Fig. 12); clypeus without two divergent dark brown stripes on upper half (Fig. 9).

Pubescence: Similar to female but mesepisterna fully covered by dense plumose hairs; ventral surface of pro- and mesocoxae covered by plumose hairs only, procoxae with plumose hairs markedly longer, denser and recurved; probasitarsus without long line of long bristles; inner surface of probasitarsus without combs for collecting floral oils; outer surface of mesobasitarsus without velvet, dense, short plumose pubescence; external surface of metabasitarsus covered by dark-brown setae; base of metapretarsal claws with pair of thin, simple setae almost as long as pretarsal claws; pilosity of T1 denser and longer than remaining terga; T2–T5 with band of yellowish setae more distinctive and wider than in female (Fig. 12); margin of T5 without long fringe of golden branched bristles.

Sculpturing: Midline of clypeus with integument mostly smooth and polished, interspersed by very few punctures.

Etymology. The specific epithet was originally given by Dr. Jesus S. Moure in 1985 when he identified the material collected by Dra. Patrícia Maia C. de Albuquerque for her dissertation, using the generic name of the most common host plant for this bee species (*Byrsonima crassifolia* L. Rich: Malpighiaceae). Unfortunately, while Moure placed the name on labels of specimens he never published a description of the species or put into writing those characters from which he based his conclusions. In 2003, after the publication of *C. pulchra,* Moure invited the second author of the present paper to describe with him this new species after a restudy of all paratypes of *C. pulchra* and other specimens from Maranhão deposited in LEACOL, including the male specimens, are re-examined. However, Moure died in June 2010 before the paper was completed. Thus, despite the fact that he recognized the novelty of the species, his name is not included as a coauthor given that he did not review or approve any version of this manuscript. Nonetheless, we retained the name he intended as well as the specimen he selected as the holotype. Such an epithet also seems to be a good choice given that it has been used before in the literature.

Comments. Although *C. byrsonimae* sp. n. is quite similar to *C. pulchra*, it can be differentiated from that species by the integument predominantly honey-brown (mostly dark brown in *C. pulchra*); *C. byrsonimae* with metallic blue highlights almost imperceptible on metasomal terga, marked in *C. pulchra*. The pubescence in general is yellowish, especially on the disc of the terga and the apex of T5, with an apical fringe of golden bristles at the apex of T5; in *C. byrsonimae* sp. n. T2–T4 are entirely covered by pale, short yellow and sparse setae on the disk of the terga but not forming a distinct band of bristles on the posterior border, while in *C. pulchra* the discs of T2–T4 are covered by dark-brown setae contrasting with the narrow and dense bands of whitish bristles bordering the posterior edge of the terga extending to the sides and narrowed in the middle, but not interrupted, and contrasting also with the hairiness of the disc of the terga. On the mesepisterna of *C. byrsonimae* sp. n. the plumose hairs are restricted to the upper half, while in *C. pulchra* they are distributed on the dorsoventral surface; the lower 2/3 of the ventral surface of the procoxae are covered by extremely thick, curved yellow-whitish setae (the upper portion covered by plumose hairs) in *C. byrsonimae* sp. n. while in *C. pulchra* this structure has only plumose hairs; the inner surface of the probasitarsus with secondary combs for collecting floral oils is modified, with three distinct, strongly spatulate setae in *C. byrsonimae* sp. n. while in *C. pulchra* these setae are thick but not modified (Figs. 6, 16); the pygidial plate of both species is doubled but in *C. byrsonimae* sp. n. the upper plate is relatively longer (Fig. 8); the lower plate of the pygidial plate is slightly depressed from the sides to the middle and flat on the apical third contrasting with *C. pulchra* in which this depression is notably more pronounced and convex in the apical third (Fig.18). The male of both species are quite similar but in *C. byrsonimae* sp. n. the pubescence is markedly yellowish while in *C. pulchra* it is whitish; the metallic highlights are most visible and bluish in *C. pulchra* and almost imperceptible and greenish in *C. byrsonimae* sp. n.; the base of the metapretarsal claws have a pair of thin simple setae in *C. byrsonimae* sp. n. while in *C. pulchra* there is a tuft of long dense plumose hairs. In addition, the male terminalia is quite different as shown in figures 19–26.

Floral records. Table 2

Table 2. Floral records for *C. pulchra* (Cp.) and *C. byrsonimae* sp. n. (Cb.), with respect to the sex of the floral visitor recorded. Botanical classification follows that of the *Flora do Brasil* (2012).

Botanic Species	**Cp.**	**Cb.**	**References**	**State**
Anacardiaceae				
Anacardium occidentale L.	-	♀	Paratype label	CE
Fabaceae				
Chamaecrista ramosa (Vog.) I & B var. *ramosa*	♀	-	Moure et al. (2003)	BA
Galactia remansoana Harms	?	-	Pigozzo and Viana (2010)	BA
Mimosa xiquexiquensis Barneby	?	-	Rodarte et al. (2008)	BA
Stylosanthes viscosa (L.) Sw.	♀	-	Moure et al. (2003)	BA
Krameriaceae				
Krameria bahiana B. Simpson	♀♂	-	Moure et al. (2003)	BA
Lamiaceae				
Eriope blanchetii (Benth.) Harley	♀	-	Moure et al. (2003)	BA
Lythraceae				
Cuphea brachiata Koehne	♀♂	-	Moure et al. (2003)	BA
Malpighiaceae				
Banisteriopsis sp.	-	♀	Albuquerque 2012 (pers. comm.)	MA
Byrsonima blanchetiana Miq.	?	-	Rodarte et al. (2008)	BA
Byrsonima chrysophylla Kunth	-	?	Ribeiro et al. (2008)	BA
Byrsonima crassifolia (L.) Kunth	-	♀	Albuquerque (1986)	MA
Byrsonima microphylla A.Juss.	-	♀	Moure et al. (2003)[†]	BA
Byrsonima sericea DC.	-	♀	Rosa (2009)[‡]	BA
Byrsonima umbellata Mart. *ex* A. Juss.	-	♀	Albuquerque 2012 (pers. comm.)	MA
Malvaceae				
Waltheria cinerescens A.St.-Hil.	♀♂	-	Moure et al. (2003)	BA
Ochnaceae				
Ouratea rotundifolia (Gardner) Engl.	♀	-	Moure et al. (2003)	BA
Turneraceae				
Turnera calyptrocarpa Urb.	?	-	Rodarte et al. (2008)	BA

[†] Cited as *Byrsonima teopteridifolia* and *Centris pulchra* [*partim*] by Moure et al. (2003)

[‡] Cited as *Centris* aff. *pulchra*

Centris (*Centris*) *pulchra* Moure, Oliveira & Viana, 2003

http://species-id.net/wiki/Centris_pulchra
Figures 13–18, 23–26

Centris (*Centris*) *pulchra* Moure, Oliveira & Viana, 2003 [*partim*]; Rocha-Filho et al. 2009: 301 [parasitism record, in error]; Pigozzo and Viana 2010: 105, 109 [floral record]; Vivallo and Zanella 2012: 5, 7, 9, 11, 12 [key, *partim*]; Moure et al. 2012 [catalogue].
Centris (*Paremisia*) *pulchra*; Viana, 1999: 638 [checklist, *nomen nudum*]; Viana and Santos, 2002: 147 [*nomen nudum*, *partim*]; Viana and Kleinert 2005: 7 [checklist, *partim*]; Viana and Kleinert 2006: 58 [floral records, *partim*]; Rodarte et al. 2008: 307 [floral records].

Remarks. One female specimen originally designated by Moure et al. (2003) as paratype of *C. pulchra* is actually an individual of the species described above as *C. byrsonimae* sp. n. and is selected as a paratype of that species (Parátipo ♀ // Brasil, Bahia, Salvador, Abaeté, 05.xi.1996, 11:15hs, B.F. Viana *Leg.* // Coletada na flor: *Byrsonima teopteridifolia* Juss, Planta Nº1 // Abaeté, SSa, Ba, 5.xi.1996, N, pl:01, 11:15 // 21 // 2330 // Paratype ♀, *Centris pulchra* Moure, Oliveira & Viana, 2003). For this female paratype a mistake was made in reporting the identification of the host plant in the original description. The plant identification was subsequently corrected by the specialist who first identified the botanical species considered presently as *Byrsonima microphylla* A.Juss. (F.O. da Silva and B.F Viana 2012, pers. comm.). Moure et al. (2003) listed six male paratypes, probably a typographic mistake due the fact that one specimen with the label (Parátipo // Brasil, Bahia, Salvador, Abaeté, 11.ix.1996, 13:35hs, B.F. Viana *Leg.* // Coletada na flor: *Waltheria cinerescens* St. Hil, Planta Nº22 // Abaeté, SSa, Ba, 11.ix.1996, N, pl:22, 13:35 // 21, ♂ // 2319 // Paratype ♂, *Centris pulchra* Moure, Oliveira & Viana, 2003) is a male, giving a total of 22♀♀ and 7♂♂ paratypes for *C. pulchra* in MZUFBA. Two other typographic mistakes were observed about the labels as recorded in the original description of *C. pulchra* . The data for these two paratypes are corrected here: (Parátipo // Brasil, Bahia, Salvador, Abaeté, 01.ix.1996, 12:20hs, B.F. Viana *Leg.* // Coletada na flor: *Eriope blanchetii* (Benth) Harley, Planta Nº10 // Abaeté, SSa, Ba, 01.ix.1996, N, pl:10, 12:20 // 21 // 2328 // Paratype ♀, *Centris pulchra* Moure, Oliveira & Viana, 2003) and (Parátipo // Brasil, Bahia, Salvador, Abaeté, 13.iv.1996, 14:20hs, B.F. Viana *Leg.* // Coletada na flor: *Cuphea branchiata* Koehne, Planta Nº3 // Abaeté, SSa, Ba, 13.iv.1996, N, pl:03, 14:20 // 21, ♂ // 2317 // Paratype ♂, *Centris pulchra* Moure, Oliveira & Viana, 2003).

Diagnosis. Total body length 13.9. Integument brown-blackish, except legs and metasoma ferruginous; metallic blue highlights on T2 – T5, mostly marked on T5 (Fig. 17); distal edge of terga with a band of whitish setae; most part of basal area of T2–T4 with black bristles. Inner surface of probasitarsus with combs for collecting floral oil, on distal half of posterior margin, with setae unmodified (Fig. 16). Male geni-

Figures 13–18. Photomicrographs of female of *Centris* (*Centris*) *pulchra* Moure, Oliveira & Viana, 2003/ **13–14** and **16–18** paratype (MZUFBA) **15** additional material (MZUFBA). **13** Facial aspect **14** Lateral habitus, scale 0.5 cm **15** Procoxae**16** Probasitarsus with combs for collecting floral oil**17** Metasoma **18** Pygidial plate.

talia with pubescence relatively spaced, apical projection of gonocoxite with a fringe of short, unbranched bristles, about 1/2 length of projection itself (23–25).

Male S7, S8 and genitalia as in figures 23–26: S7 notably wider than long, approximately 1/5 of length of S8; edge of S7 strongly angular, forming two distinct lobes, these covered with erect bristles; median projection of S8 with a strong median strangulation, apical 1/3 enlarged; dorsal surface of S8 covered by erect bristles, apical 1/3 covered by longer branched bristles curved laterally, apex with shorter simple erect bristles. Dorsal surface of gonocoxite with a large basal edge strongly keeled,

Figures 19–26. Photomicrographs of male terminalia of *Centris* (*Centris*) *byrsonimae* Mahlmann & Oliveira sp. n. (19–22, allotype/MZUFBA) and *Centris* (*Centris*) *pulchra* Moure, Oliveira & Viana 2003 (23–26, additional material/MZUFBA). **19, 23** Genital capsule, dorsal view **20, 24** Genital capsule, lateral view **21, 25** Genital capsule, ventral view **22, 26** Seventh and eighth metasomal sternum.

internal border covered by short dense pilosity; apical projection of gonocoxite relatively short, its apex distant from gonostylus apex and covered internally by a fringe of simple setae shorter than projection; gonostylus covered by short bristles sparsely distributed (Figures 23–25).

Floral records. Table 2

Key to species of the *pulchra* species group

1 Female **2**

\- Male **3**

2(1) Integument predominantly dark brown to black (Figs. 14, 17); inferior 2/3 of ventral surface of procoxae with tufts of long plumose hairs, interspersed by very thin, long, simple hair, superior portion of coxae practically glabrous; discs of T2–T4 covered by dark brown to black setae, contrasting with whitish fringe of hairs on posterior border; probasitarsus with secondary unmodified combs for collecting floral oil (Fig. 16)..... ***Centris pulchra* Moure et al.**

\- Integument predominantly honey brown (Figs. 2, 7); inferior 2/3 of ventral surface of procoxae covered by extremely thick, curved, yellow-whitish setae, decreasing in length toward posterior border, superior portion of coxae covered by plumose hairs; T2–T4 entirely covered by yellowish short and sparse setae most longer and denser on sides of terga and near posterior border, contrasting with hairiness of disc of terga but not forming a distinct band of whitish bristles; probasitarsus with secondary combs for collecting floral oil modified, with three distinct strongly spatulate setae, curved toward inner surface and with enlarged apex (Fig. 6) ....***Centris byrsonimae*** **sp. n.**

3(1) Base of metapretarsal claws with tuft of long, dense plumose hairs; apical projection of gonocoxite covered internally by a fringe of simple setae shorter than projection (Figs. 23–25).......................... ***Centris pulchra*** **Moure et al.**

\- Base of metapretarsal claws with a pair of long thin simple setae; apical projection of gonocoxite covered internally by a very distinct fringe of branched setae longer than projection (Figs. 19–21) ....***Centris byrsonimae*** **sp. n.**

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RESEARCH ARTICLE

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Description of *Trichodryas slipinskii* sp. n. from China (Coleoptera, Dermestidae, Trinodinae)

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Abstract

Trichodryas slipinskii **sp. n.** from Yunnan Province of China is described and illustrated. A key to the known species of this genus is provided.

Keywords

Taxonomy, new species, Coleoptera, Dermestidae, *Trichodryas*, China

Introduction

The small dermestid genus *Trichodryas* Lawrence & Ślipiński, 2005 contained only two described Malaysian species before our work, *T. esoterica* Lawrence & Ślipiński, 2005 and *T. lawrencei* Háva, 2008. According to Lawrence and Ślipiński (2005), the genus (based on unnamed specimens) is known from the Malay Peninsula, Borneo, Java and the Sulu Archipelago, but likely to be more widely distributed in this region. In this paper we describe a new species, *T. slipinskii* sp. n. from Yunnan Province of China. The genus *Trichodryas* is reported from China for the first time.

Material and methods

The type series was collected using Malaise traps during the project Living Landscapes China. Types are deposited in the Institute of Zoology, Chinese Academy of Sciences, Beijing, China.

Standard measurements were made following Háva (2008), as follows:

BL	body length (measured from the anterior margin of head to the apex of the elytra).
BW	body width (measured between two anterolateral humeral calli).
PL	pronotum length (measured from the top of the anterior margin to scutellum).
PW	pronotum width (measured between the two posterior angles of pronotum).

All measurements are given in millimeters.

Results

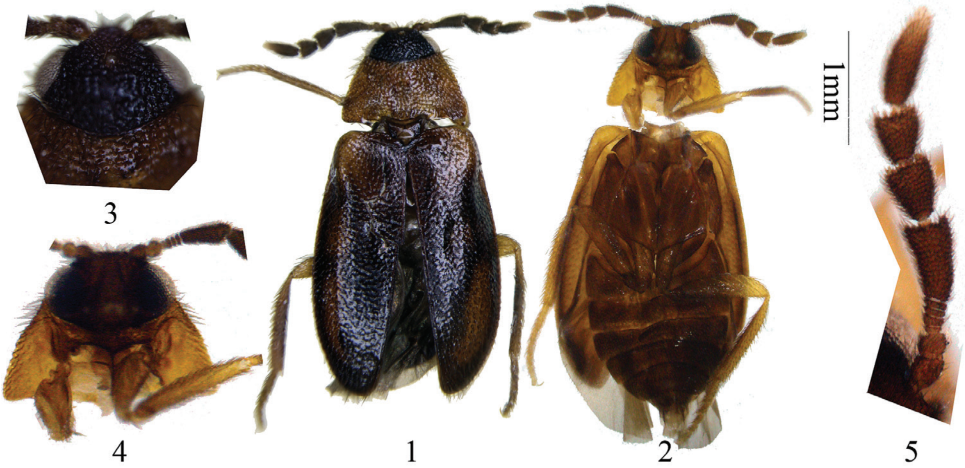
Trichodryas slipinskii sp. n.

urn:lsid:zoobank.org:act:FBFA1674-9B3A-4D57-A5D7-04296A7501DC
http://species-id.net/wiki/Trichodryas_slipinskii
Figs 1–9

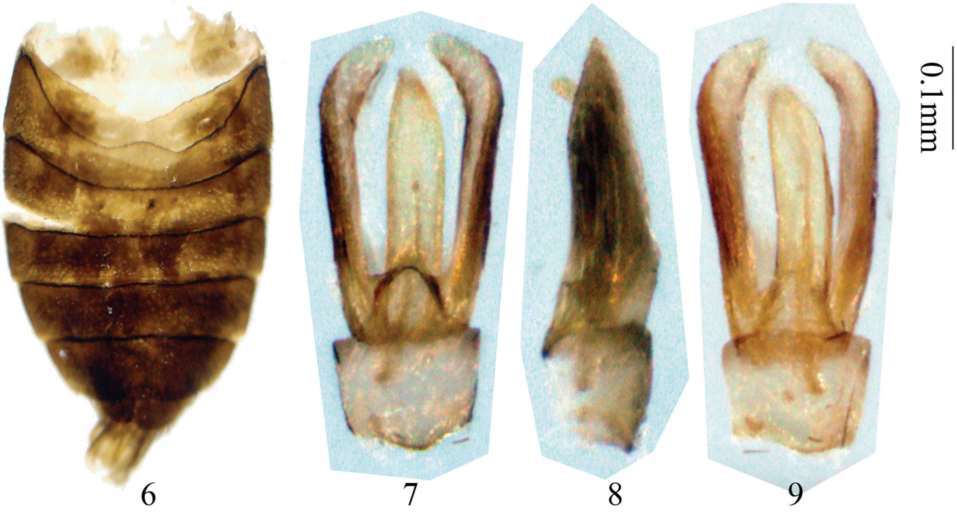
Type material. Holotype, male, with original label "Mandian I/3B, 16.03.2009", China, Yunnan, Jinghong, Nanban River Watershed National Natural Reserve, Mandian (Forest), 22.12961°N, 100.66612°E, alt. 746 m, 16.III.2009, leg. Lingzeng Meng, IOZ(E) 1905892; paratype, 1 male (dissected), with original label "Naban II/3B1, 16.03.2009", China, Yunnan, Jinghong, Nanban River Watershed National Natural Reserve, Nanbanchachang (Forest), 22.15810°N, 100.66543°E, alt. 729 m, 16.III.2009, leg. Lingzeng Meng, IOZ(E) 1905891. "B" in the original label means the method is Malaise traps. Holotype and paratype are deposited in Institute of Zoology, Chinese Academy of Sciences, Beijing, China.

Description. Body measurements: BL 3.0–3.2 mm, BW 1.1–1.2 mm, PL 0.5–0.6 mm, PW 1.0–1.1 mm. Head black, pronotum and anterior portions of elytra yellowish-brown, remaining portions of elytra, underside and antennae dark brown to black, legs light-brown. All parts covered by brown setation.

Head very coarsely punctate. Compound eyes very large, white in color, with microsetation; median ocellus well developed, yellow-brown in colour (Fig. 3). Antennae (Fig. 5) relatively long, extending well beyond base of prothorax, with 10 antennomeres, with dense brown setation; scape slightly longer than wide, pedicel shorter and slightly transverse; funicle with 4 very short and transverse antennomeres (antennomeres III to VI); antennal club with 4 antennomeres (antennomeres VII to X), each one longer than funicle, first three club segments gradually expanded and widest at apex; terminal antennomere (antennomere X) longest, antennomere VII second longest; antennomere VIII shorter than



Figures 1–5. *Trichodryas slipinskii* sp. n. **1–2** Habitus, holotype, from Yunnan, China. **1** dorsal view **2** ventral view **3** head, dorsal view, showing median ocellus **4** head and prothorax, ventral view, with right procoxa removed, showing procoxal cavity and prosternal intercoxal process **5** antenna. **1–2** scale 1 mm, **3–5** not to scale.



Figures 6–9. Male abdomen and aedeagus of *Trichodryas slipinskii* sp. n. **6** male abdomen, in ventral view **7–9** aedeagus **7** ventral view **8** lateral view **9** dorsal view. **6** not to scale, 7–**9**. scale 0.1 mm.

antennomere VII but longer than antennomere IX; length/width ratio of antennomere X 3.33, much slender than antennomere VII, VIII and IX, which is about 1.67, 1.22 and 1.12 respectively; antennomere X widest at about middle and narrowly rounded apically; ratio of antennomere lengths: 6.5:4.5:1:1.5:1:1:15:11:9.5:20; length/width ratios: 1.08:0.82:0.33:0.37:0.25:0.25:1.67:1.22:1.12:3.33. Pronotum (Figs 1, 4) 0.53 times as long as wide, widest posteriorly; sides straight, converging from base to apex; lateral carinae complete, without raised bead; apical edge truncate, anterior angles oblique, posterior angles slightly acute; posterior edge bisinuate, so that median rounded lobe is formed between two emarginations; disc moderately coarsely punctate with a pair of broad basal impressions. Prosternum (Fig. 4) in front of coxae short, prosternal process complete, very strongly narrowed at base, apex finely acute; procoxal cavities widely open externally, closed internally.

Elytra (Fig. 1) 1.96 times as long as wide and 4.58 times as long as pronotum, widest at apical third; sides slightly diverging and then apically converging and independently rounded; disc relatively flat, steeply sloping laterally, slightly so posteriorly, with a broad, lateral depression in apical third; punctation finer than on pronotum but moderately dense. Epipleura (Fig. 2) gradually narrowed posteriorly and extending almost to apex. Mesoventrite (Fig. 2) slightly transverse, without procoxal rests, not separated by sutures from mesepisterna; mesoventral process moderately long. Abdomen (Fig. 6) about 1.3 times as long as wide, with six ventrites, the first two of which are connate; ventrite 1 laterally about 1.3 times as long as ventrite 2, but at midline much shorter behind large metacoxal cavities; intercoxal process represented by a slightly broadly rounded projection; ventrites 2–4 subequal in length, 5 slightly longer and rounded. Legs light-brown with stout, light-brown setation. Tarsi simple.

Aedeagus (Figs 7–9) with basally angulate phallobase; long, narrow, apically attenuated parameres, which curve mesally at apex, and somewhat shorter, apically attenuated penis with short basal struts attached to base of parameres. Penis curve ventrally (Fig. 8).

Female. Unknown.

Differential diagnosis. The new species *Trichodryas slipinskii* sp. n. differs from both described congeners in only 10-segmented antennae and its larger size.

Distribution. China: Yunnan Province.

Etymology. Patronymic, species is dedicated to Prof. Adam Ślipiński (CSIRO, Australia).

Remarks. Háva (2008) provided an incorrect illustration of the antenna of *T. esoterica* as it does not correspond to the illustration and description in Lawrence and Ślipiński (2005). According to the measurements of *T. esoterica* by Lawrence and Ślipiński (2005) and the picture of *T. lawrencei* by Háva (2008), the ratio of antennomere lengths is a good way to separate these species.

Lawrence and Ślipiński (2005) pointed out that there are definitely only 10 antennomeres in the specimen of undescribed *T.* sp. from Kalimantan Barat and probably in the unknown *T.* sp. from the Sabah as well. The antennae of the two specimens from Yunnan described above definitely are 10-segmented.

Key to species of the genus *Trichodryas* Lawrence & Ślipiński, 2005

1 Antennae with 10 antennomeres, funicle (antennomere III to VI) with 4 very short and transverse antennomeres; pronotum yellowish-brown; antennomere VII much shorter than antennomere X; length/width ratio of antennomere X 3.33; body length 3.0–3.2 mm; China: Yunnan .... ***T. slipinskii* sp. n.**

– Antennae with 11 antennomeres, funicle (antennomere III to VII) with 5 very short and transverse antennomeres; Malaysia..**2**

2 Antennomere VIII much shorter than antennomere XI; length/width ratio of antennomere XI 2.64; pronotum and anterior portions of elytra yellowish-brown; body length 2.9 mm; Malaysia: Cameron Highland, Gunong Beranban rainforest................................***T. esoterica* Lawrence & Ślipiński, 2005**

– Antennomere VIII subequal to antennomere XI; length/width ratio of antennomere XI 2.83; pronotum and elytra all dark-brown; body length 2.57 mm; Malaysia: Sabah, Balu, Punggul Resort env...........***T. lawrencei* Háva, 2008**

Acknowledgements

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RESEARCH ARTICLE

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Beronaphaenops paphlagonicus, a new anophthalmous genus and species of Trechini (Coleoptera, Carabidae) from Turkey

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Abstract

Beronaphaenops **gen. n.** *paphlagonicus* **sp. n.**, a new remarkable, eyeless species of Trechini is described from Asian Turkey (type locality: cave Eşek Çukuru Mağarası 2, Milli Park Küre Dağlari, Pinarbasi District, Kastamonu Province). This specialized, troglobite species is characterized by a very peculiar combination of features, including several autapotypic features: mentum tooth large, long and porrect, at distal position reaching or slightly exceeding the level of epilobes, rather slanting ventrally, deeply bifid at the tip; short and fragile paraglossae, hardly surpassing the anterior margin of ligula; absence of posterolateral setae of the pronotum; absence of posterior discal pore in elytral stria 3; apical stylomere shortened, with basal part unusually broadened. The systematic position of the genus amongst the trechine beetles from the peri-Pontic area is discussed. A key to the Anatolian genera of the tribe is prepared.

Keywords

Coleoptera, Carabidae, Trechini, taxonomy, new genus, new species, Turkey

Introduction

Up to now 19 species of blind Trechini have been recorded from Anatolia, belonging to 6 genera (Vigna Taglianti 1980; Casale and Vigna Taglianti 1999; Moravec et al. 2003). In consideration of the size of this landmass, its relief and suitable habitats it includes, this is astonishingly a small number compared to the numerous species and genera documented for the faunas of two next-door regions, the Balkan Peninsula and the Caucasus (Belousov 1998; Moravec et al. 2003; Quéinnec 2008; Lohaj and Lakota 2010; Casale et al. 2012). Maybe this fact is a consequence of still unexplored underground communities in the region considered. But, an ecological explanation connected with a specific geological history seems more probable. Casale and Vigna Taglianti (1999: 303) supposed the unfavorable pressure of former climatic conditions in Anatolia has been "*lower in modifying markedly the adaptive features of carabids to the subterranean environment, being the cave super-specialized taxa almost absent*", in contrast to that in other Mediterranean areas.

It is worth noting that the blind Trechini from the area in question belong to three phyletic lines (Jeannel 1928; Casale and Laneyrie 1983; Casale and Vigna Taglianti 1999; Belousov 1998). Nine species, namely seven ones of *Anillidius* Jeannel, 1928 and by single species of *Pontodytes* Casale & Giachino, 1989 and *Troglocimmerites* Ljovuschkin, 1970, belong to the *Nannotrechus* complex. The *Neotrechus* lineage includes two species of the monotypic genera *Kosswigia* Jeannel, 1947 and *Sbordoniella* Vigna Taglianti, 1980. Finally, the phyletic line of *Duvalius* counts eight species in Anatolia. On the other hand, it is oddly enough that no representative of the former *Aphaenops* series (sensu Jeannel 1928; Casale and Laneyrie 1982) was found in Asia Minor up to now (see also Belousov and Koval 2009: 164), since many taxa of it inhabit the adjacent Balkan Peninsula, Crimea and the Caucasus Major. Recently, authors published evidences that this phyletic series represents a polyphyletic assemblage of genera not related to each other (Faille et al. 2010; Faille et al. 2011). The series is now restricted only to the "Pyrenean clade", including *Aphaenops* Bonvouloir, 1862, *Hydraphaenops* Jeannel, 1926 and *Geotrechus* Jeannel, 1919. Some other aphaenopsoid genera have no close affinity with this clade being probably offshoots of other lineages. For example, *Doderotrechus* Vigna Taglianti, 1968 seems to be a derivative of the line of *Duvalius* Delarouzée, 1859, whereas *Apoduvalius* and *Speotrechus* belong perhaps to two or more independent lineages related to *Trechus* Clairville, 1806. Unpublished studies on some Alpine and Dinaric subterranean genera, previously placed within the *Aphaenops* series, concluded they may have different origin (Casale A, Faille A, personal communication). According to Casale and Jalžić (1999: 141), *Croatotrechus* Casale & Jalžić, 1999 has no close relationships with other aphaenopsoid genera, and may be it is a sprout of the *Trechus pulchellus* species group. Using the methods of the classic taxonomy, Monguzzi (2011) arrived to the conclusion that *Allegrettia* Jeannel, 1928, together with *Italaphaenops* Ghidini, 1964, is closer to the phyletical line of *Duvalius* than to that of *Aphaenops*.

In the course of a Bulgarian-Turkish cave expedition in the mount of Küre Dağlari during the summer of 2008, my colleague and former director of the National Museum of Natural History Sofia (NMNHS), Dr. Petar Beron was able to collected small series of cave-dwelling blind trechines. After a careful examination, it became evident that this sample should be treated as representing a new species belonging to unknown genus, which combination of characters places it best within a distinct line probably close to a few Balkan taxa of the former *Aphaenops* series.

The discovery of this remarkable species is of an exceptional interest for both the trechine taxonomy and biogeography of the Ponto-Mediterranean region. Hence, the purpose of this report is to introduce this important discovery into science. The new trechine beetle is below described and illustrated, and its systematic position is discussed.

Material and methods

Prior to be dissected, a photograph of the holotype and drawings of the labrum, clypeus, pronotum, elytra, and protarsomeres were taken using stereoscopic microscope Olympus SZ 60. Afterwards, another specimen was dissected as mouthparts and genitalia were removed, placed into glycerin on a glass slide and outlined using stereoscopic microscope Carl Zeiss Jena Technival 2. At the end, the dissected body parts and the female genital structures were placed in euparal on the same label where a female paratype is glued. The male genitalia were put in a plastic microvial with glycerin for permanent storage pinned to beneath the holotype specimen from whom they were extracted. All the measurements were made mounted on an Olympus SZ 60 stereoscopic microscope.

In general, the morphological terminology follows Jeannel (1926, 1928). Looking for the systematic position of the new genus, we use states of characters traits of great importance, which are often used as generic features in the systematic of Trechini (Jeannel ibid., Casale and Laneyrie 1982). The terms "setae" and "microsetae" (without quotation marks) are used instead "macrochaetes" and "microchaetes" (Quéinnec 2008, Lohaj and Lakota 2010). The term "aphaenopsoid" indicates taxa formerly referred to the *Aphaenops* phyletic line (sensu Jeannel 1928; Casale and Laneyrie 1982). Abbreviations: MHNG (Muséum d'histoire naturelle, Genève, Switzerland); NMNHS (National Museum of Natural History Sofia).

Taxonomic part

Beronaphaenops gen. n.

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http://species-id.net/wiki/Beronaphaenops
Figs 1–17

Type species. *Beronaphaenops paphlagonicus* Guéorguiev sp. n., by monotypy

Diagnosis. An anophthalmous trechine genus of uncertain affinity, possessing morphological features in common with the representatives of the former *Aphaenops* line, such as: eyes completely atrophied; front of head with 2-3 supraorbital setae from each side; apical recurrent stria joining stria 5; preapical pore of apical triangle situated on the apical anastomosis of striae 2 and 3; umbilicate series of elytra aggregate or not; protibia entirely pubescent, without longitudinal groove on the external face; male

Figure 1. *Beronaphaenops* gen. n. *paphlagonicus* sp. n. Photo of habitus, holotype. Scale bar: 1 mm.

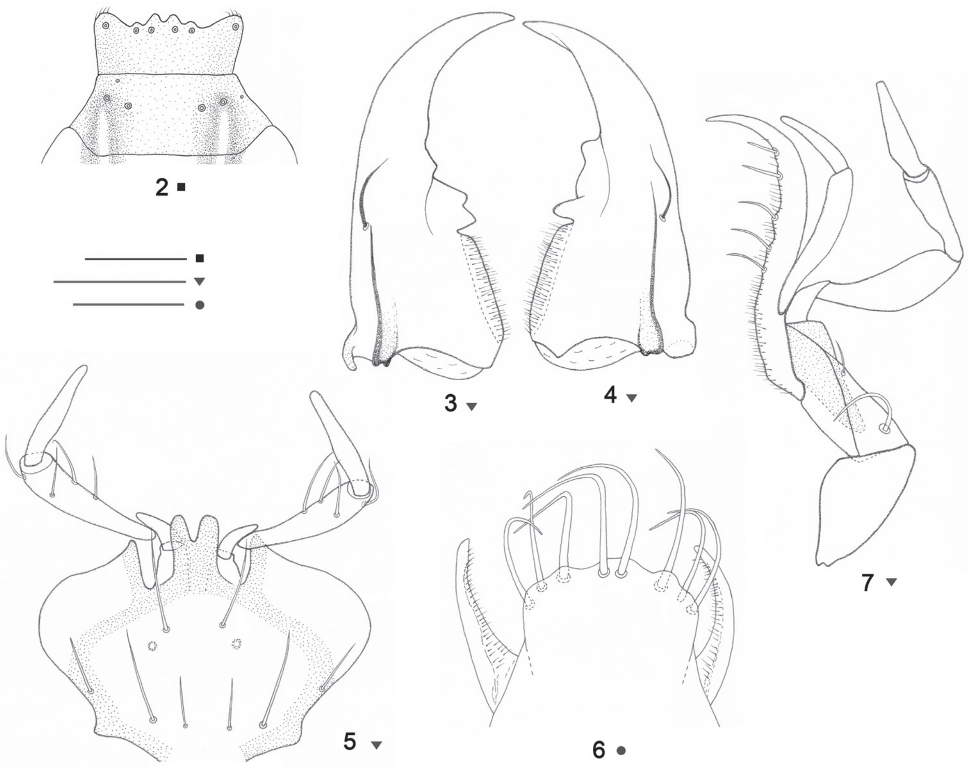
protarsi with first two tarsomeres dilated; aedeagus with inner sac (endophallus) armed with an asymmetrical copulatory piece and/or sclerotised scales in an “anisotopic” position (i.e. displaced laterally within the aedeagus).

The new taxon is unique among all hitherto known genera of Trechini in the following set of characters: integument pubescent; retinacle of left mandible bidentate, retinacle of right mandible tridentate; two pair of supraorbital setae; frontal grooves complete; labium fused; mentum tooth porrect, rather slanting ventrally, deeply bifid at the tip; submentum with row of six prebasilar setae; paraglossae short and fragile, hardly surpassing the anterior margin of ligula; pronotum without basolateral setae at the posterior angles; single discal setigerous puncture in stria 3, situated at the level of fourth pore of humeral umbilicate series; apical triangle of pores complete, preapical pore larger and rather removed from other two pores, external apical pore situated inwards, not close to the recurrent stria; umbilicate series of elytra not aggregate, all but two pores (ones 2 and 8) situated inwards, at discal, not marginal position; humeral umbilicate group consisting of four setigerous pores, as first one situated just before the level of second pore; protibia entirely pubescent, without longitudinal external groove; aedeagus with straight apex, poorly differentiated basal bulb, sagittal carina, and an “anisotopic”, well differentiated copulatory piece surrounded of a field of sclerous scales; apical stylomere of the ovipositor shortened, with basal part unusually broadened and two rather large ensiform setae on tergal position.

The new taxon is also readily distinct from all hitherto known Anatolian genera of Trechini including eyeless species, i.e. *Anillidius*, *Duvalius*, *Koswigia*, *Pontodytes*, *Sbordoniella*, *Troglocimmerites*, in both the pronotum without basolateral setae at the posterior angles and elytra with single discal setigerous puncture in stria 3.

Description. Body elongate, head and pronotum narrow, hind body oval, clearly convex on the dorsum (Fig 1). Integument thin, translucent (as being depigmented), moderately shiny; short, sparse and uniform pubescence presents on both the dorsal and ventral surfaces, tibiae and tarsi densely pubescent. Microsculpture distinctly impressed on the head and elytra, consisting of isodiametric and transverse meshes on head and isodiametric meshes on the elytra, almost indistinct on the pronotum. Colour from reddish-brown on the head and pronotum to yellowish on the elytra and appendages; ventral part of the body more or less lighter than the respective parts of dorsum. Appendages long and slender.

Head elongate, evidently longer than wide, strongly constricted at the neck; frontal grooves complete, extending onward onto the clypeus, deep along the apical three-fourth of the head where outwardly sinuate, somewhat shallow at the level of posterior supraorbital seta, and again deeper downhill along the collar constriction; eyes perfectly wanting, each one replaced by short, concave, slanting suture; praeocular traits present; genae convex; two pair of supraorbital setae on lines convergent posteriad, the posterior setae being within the frontal grooves. Clypeus subhexagonal (Fig. 2), surface covered besides some normal hairs, with four large basic setae, the outer setae being rather longer than the inner ones, one or two additional microsetae situated at marginal apical and lateral positions, as long as the inner basic

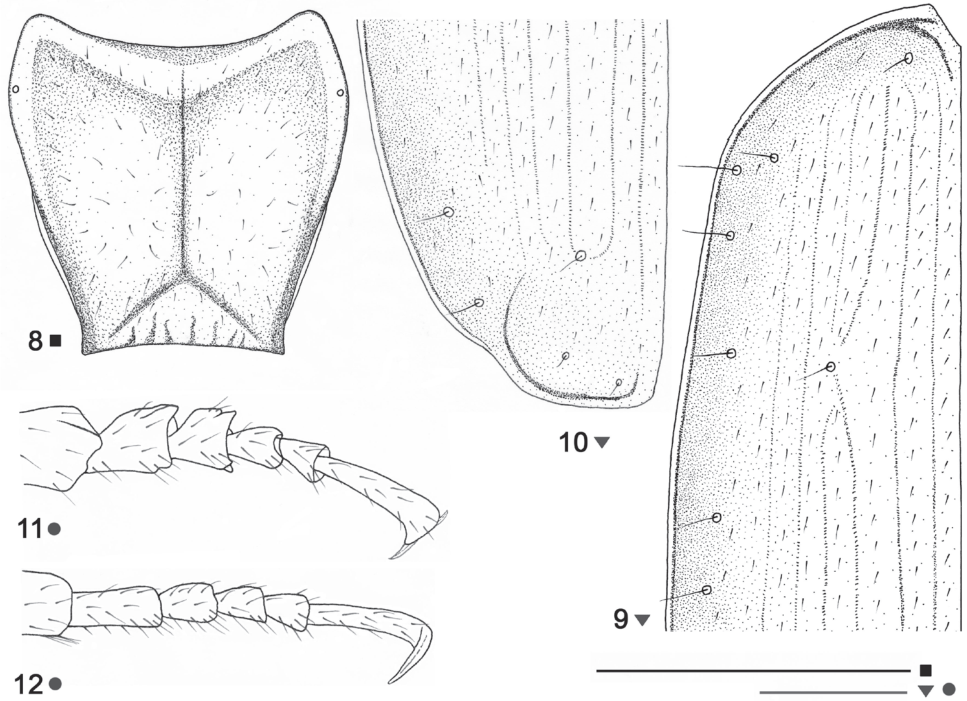


Figures 2–7. *Beronaphaenops* gen. n. *paphlagonicus* sp. n. **2** Labrum and clypeus in dorsal aspect, holotype. **3** Left mandible in dorsal aspect, paratype ♀ **4** Right mandible in dorsal aspect, paratype ♀**5** Labium in ventral aspect, paratype ♀ **6** Apical part of ligula in ventral aspect, paratype ♀ **7** Left maxilla in ventral aspect, paratype ♀. Scale bar **2, 3, 4, 5,** 7= 0.3 mm; **6**: 0.1 mm.

setae; frontoclypeal sulcus more or less distinct. Labrum transverse (Fig. 2), apically slightly dilated, with six apical setigerous pores, inner and medial pairs of setae situated closer to each other than medial and outer pairs; anterior margin wavy, with a three or five distinct concavities, the middle one much deeper than the outer ones. Mandibles long but fairly stout (Figs 3–4), bidentate, with sharply hooked apices; retinacle of the left mandible bidentate, retinacle of the right mandible tridentate. Labium (Fig. 5) completely fused as no trace of labial suture clear between the mentum and submentum; mentum with pair of setae, median tooth large, long and porrect (at distal position reaching or slightly exceeding the level of epilobes), rather slanting ventrally, deeply bifid at the tip as denticles somewhat divergent onward; submentum with a transverse row of six setae, inner and outer pair of setae shorter than the medial one; ligula slightly broadened apically (Fig. 6), its anterior margin wavy, more pronouncedly in the middle, with eight setae of nearly equal length, two middlemost at ventral position and six lateral at dorsal position, paraglossae short, fragile, transparent, slightly curved and covered with microtrichia dorsolaterally, hardly surpassing the anterior margin of ligula; labial palpus slender (Fig. 5), with penultimate segment quadrisetose, gradually dilated towards the apex, about one-third as long as ultimate segment. Maxillae long and fine (Fig. 7), each with arcuate and sharply pointed lacinia, inner margin of lacinia with 5-6 stout setae at distal position and numerous smaller hairs at medial and proximal position; maxillary palpus entirely glabrous and asetose, slender, ultimate segment fusiform, as long as penultimate one; stipes with two setae at lateroventral position. Antennae filiform, very long and slender, posteriad not exceeding the middle of elytra.

Pronotum cordate (Fig. 8), short in relation with the elytra, wider than long, constricted towards the base, with maximum width at its second-fifth. Anterior margin concave, longer than the posterior one, fore angles prominent, round; posterior margin concave. Sides convex, round anteriad, straight, convergent posteriorly, hardly sinuate before the hind angles; hind angles pointed, projecting outside and turned upwards; lateral margins grooved and their extremities reflexed upward throughout. Anterolateral setae present, posterolateral ones absent. Disc smooth, slightly convex, midline well impressed, not reaching both the basal and apical margins; apical transverse impression less distinct, laterally reaching the anterior margin; basal transverse impression sharply impressed, laterally merging into the basal foveae. Scutellum small, triangular.

Elytra (Figs 1, 9–10) subovate, with shoulders obtuse though still marked, basal border absent. Sides narrower at the basis, slanting at shoulders, becoming wider posteriorly, with maximal width at the third-fourth, round at apex; lateral grooves moderately reflexed upward, and becoming flat at the apical sixth. Disc convex; striae superficial and more or less obliterated at the sides and apically, striae 2 and 3 forming an apical anastomosis, stria 8 fragmentary, not deepening posteriorly; scutellar stria absent; apical recurrent stria well-defined, subparallel to the suture, joining stria 5; intervals flat, each one with single longitudinal row of hairs in the middle; stria 3 with single (? anterior) discal setigerous puncture before the middle, at the level of the fourth pore of humeral umbilicate series; apical triangle of pores complete, the preapical pore as developed as the discal one, on the apical anastomosis of striae 2 and 3, more distant from the apex than from the suture, larger and rather removed from other two apical pores, the internal apical pore somewhat closer to the apex than to the suture, the external apical pore lies inward, at the recurrent stria field, not near to the recurrent stria, closer to the apex than to the suture. Umbilicate series of elytra consisting of 8 pores, not aggregate, very peculiar in disposition, six pores situated inwards, at discal, not marginal position; humeral umbilicate series consisting of four setigerous pores, the first one distant from the marginal gutter, slightly before the level of the second pore, which laying at the marginal gutter, the third pore slightly remote from the gutter, the fourth pore widely distant from both the other pores of humeral group and the gutter, the distance between third and fourth being larger than that between the first and third; two pairs of pores each of the middle and apical groups of umbilicate series not closely set together, the distance between the pores of each group being smaller than the distance between the sixth and seventh, the distance between the pores of the middle umbilicate series almost twice smaller than the distance between the pores



Figures 8–12. *Beronaphaenops* gen. n. *paphlagonicus* sp. n. **8** Pronotum, holotype **9** Anterior part of left elytron, paratype ♀ **10** Posterior part of left elytron, paratype ♀ **11** Male protarsus in dorsal aspect, paratype ♂ **12** Female protarsus in dorsolateral aspect, paratype ♀. Scale bar **8**: 1 mm; **9, 10**: 0.5 mm; **11, 12**: 0.3mm.

of the apical umbilicate series; fifth pore more remote inward than sixth one, seventh pore rather remote inward, the eight pore near to the marginal gutter. Wings absent.

Thorax and lateral sides of abdominal sternites smooth, middle parts of the sternites pubescent, sternites 3-5 each with pair of setigerous punctures; anal sternites with a pair of setae in the males, with two pair of setae in the females.

Legs long and slender; protibia straight, densely pubescent, without longitudinal groove on the external face; tarsi thin, densely pubescent, without modified appendages underneath; protarsi with segments 1 and 2 strongly dilated and inwardly denticulate (more in the first segment, less in the second one), furnished beneath with sexual adhesive appendages in the males (Fig. 11), same segments in the females without such characterization (Fig. 12), segment 1 of the protarsi shorter than segments 2-4 together and clearly shorter than segment 5 in the males, while segments 1 of protarsi hardly shorter than segment 5 in females; both the mesotarsi and metatarsi with segment 1 almost as long as segments 2-4 together and rather longer than segment 5 in the two sexes.

Aedeagus (Figs 13–15) with straight apex and poorly differentiated basal bulb in lateral aspect, thinner to the apex, moderately wide at basal and medial parts; sagittal carina moderately large, round; ventral margin straight apically, slightly concave at the middle; dorsal margin little convex with preputial bulge before the basal part; apical orifice very large, reaching the basal part of aedeagus; basal orifice small, flat, weakly differentiated; aedeagus slightly asymmetrical in dorsal aspect, with left side concave at the middle, apex widely round. Inner sac (endophallus) with an "anisotopic", well differentiated, large copulatory piece surrounded of a field of sclerous scales, situated in the medial and distal parts of the aedeagus; copulatory piece double, its ventral branch partially visible at left lateral aspect, same longer in dorsal aspect than in the lateral one, V-shaped, with dorsal branch well visible from above, more chitinized proximally, ventral branch less evident as sunken in compact chitin. Parameres elongate and thick, each one with four apical setae, the distal three large and long, the proximal one smaller, left paramere with additional minute seta in medial position.

Ovipositor consisting of large valvifer and two-segmented stylus (Fig. 16). Valvifer nearly twice larger than the stylus, with more chitinized, glabrous internal margin and less chitinized, pubescent (17-20 setae visible) external margin in sternal position. Basal stylomere of stylus larger than the apical one, with three marginal setae at central sternal position and two bigger ones distally, one on the sternal face, another on the tergal face; apical stylomere subtriangular, with two rather large ensiform setae (as long as or longer than the half length of stylomere) on tergal position, and sensorial fovea bearing two minute nematiform setae on sternal position.

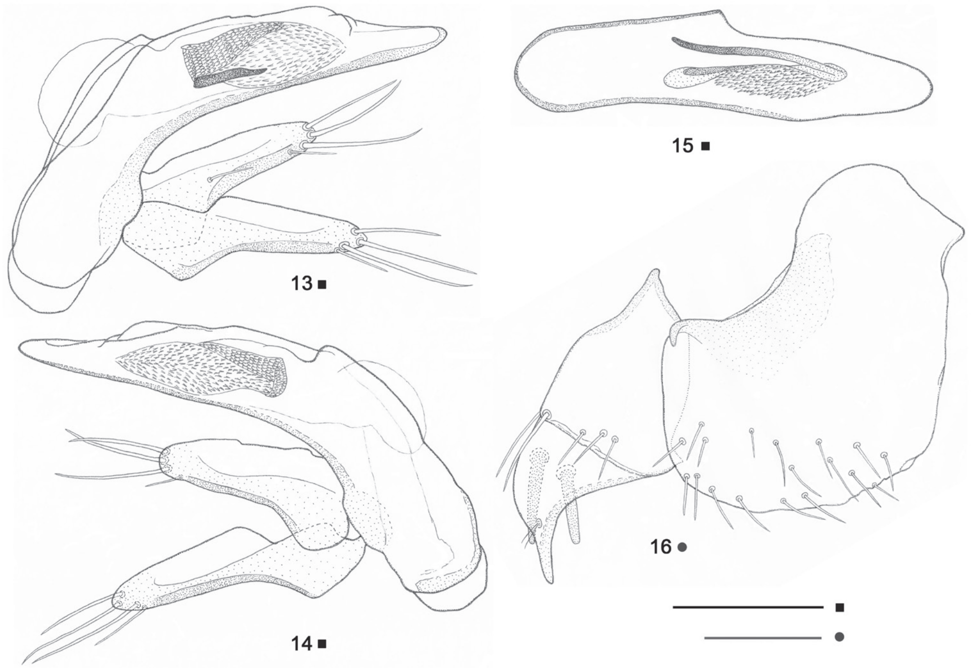
Etymology. The generic epithet is a compound word, based on the family name of the collector, Dr. Petar Beron, remarkable Bulgarian biospeleologist and discoverer of numerous troglobiont invertebrates new for the science, and *Aphaenops* (meaning "without visible eyes"). It is treated as a Latin masculine.

Affinities. In order to look for the systematic position of the new genus, the last is compared with different genera of blind Trechini from the Anatolian Peninsula and adjacent areas of the Balkan, Crimea, and Caucasus.

For the semi-aphaenopsoid shape of body and first two protarsomeres dilated in the males, *Beronaphaenops* gen. n. *paphlagonicus* sp. n. superficially resembles taxa of *Duvalius*, but the former is markedly distinct from the latter in: the integument of body covered by short and sparse pubescence; labium completely fused; pronotum without posterolateral setae at the hind angles; single discal pore in elytral stria 3; humeral group of umbilicate series of elytra not aggregate; "anisotopic" position of the copulatory piece of aedeagus.

The new genus is also easily distinct from the representatives of the *Nannotrechus* complex (sensu Belousov 1998) in the following series of characters: front, temples and vertex of head without parietal and temporal microsetae; labium completely fused; pronotum without posterolateral setae at the hind angles; single discal pore in elytral stria 3; humeral group of umbilicate series not aggregate; male protarsus with first two segments dilate. Hence, a relationship between the new taxon and representatives of this Caucasian lineage is almost unlikely.

The Anatolian genera *Kosswigia* and *Sbordoniella*, related each other (Casale and Vigna Taglianti 1999), belong to the *Neotrechus* series (sensu Casale and Laneyrie



Figures 13–16. 13 *Beronaphaenops* gen. n. *paphlagonicus* sp. n. Aedeagus in left lateral aspect, holotype. **14** Aedeagus in right lateral aspect, holotype **15** Aedeagus in dorsal aspect, holotype**16** Left ovipositor in ventral aspect, paratype ♀. Scale bar **13, 14, 15**: 0.2 mm; **16**: 0.1 mm.

1983). They share some traits with *Beronaphaenops* gen. n.: labium completely fused; submentum with row of 6 setae; humeral group of umbilicate series of elytra not aggregate, as distance between the humeral umbilicate pores 3 and 4 nearly twice longer than that between pores 2 and 3; protibia entirely pubescent, without longitudinal groove on the external face; "anisotopic" position of the copulatory piece of aedeagus. However, the new taxon differs from its Anatolian neighbors in: the specific structure of the mentum, including deeply bifid tooth; pronotum without posterolateral setae at the hind angles; single discal pores in elytral stria 3; male protarsus with first two segments dilated; segment 4 of protarsi and mesotarsi without ventral modification (the state of this character unknown in *Sbordoniella*). At present, it is not clear if this partial resemblance is a result of common origin or of convergent evolution. In spite of the geographical nearness, the listed differences display a significant phyletic diversion between the species from the Küre Dağlari Mt. and those from the Western Taurus.

Regarding the Balkan eyeless Trechini, there are genera from two lineages, which may have remote affinity with the remarkable beetle from Turkey. Among the other groups of the *Neotrechus* series, an essential affinity of the East Alpine genus *Orotrechus* J. Müller, 1913 with the new genus makes impression. Both genera share the following states: labium fused; mentum tooth bifid; pronotum without posterolateral setae at the hind angles (but a reduced posterolateral seta is found in some species from the former genus); apical triangle of pores complete, with external apical pore migrated inwards (i.e. situated at the recurrent stria field, not close to the recurrent stria); umbilicate series of elytra not aggregate; protibia entirely pubescent, without longitudinal external groove; "anisotopic" position of the copulatory piece of aedeagus. Despite all, the new genus is distinct from *Orotrechus* in: single discal pores in elytral stria 3; male protarsus with first two segments dilated; number of the apical setae on parameres. It is very difficult to say, if the explained above similarity is a result of common origin. The lost of the setae in elytral stria 3 is an apotypy in *Beronaphaenops* gen. n. However, being a simple morphological regression, this trait is of low phyletic weight. The number of dilated segments in the male protarsi may be also of little importance, since it varies within the limits of one and same lineage of Trechini (Casale and Giachino 1989, Belousov and Zamotajlov 1997). For instance, within the *Nannotrechus* complex, only the monotypic genus *Pontodytes* has two first dilated segments in the males, while all other genera have first segment dilated. As well, the following transition is known among the Caucasian aphaenopsoid genera: male protarsus with 2 dilated segments (*Caucasorites shchurovi* Belousov & Zamotajlov, 1997 and *C. victori* Belousov, 1999) - same with two hardly dilated segments (*C. kovali* Belousov 1999) - same with 2 not dilated segments (all species of *Jeannelius* Kurnakov 1959, Belousov 1999).

The new genus and all the eleven Balkan aphaenopsoid genera known till now (Lohaj and Lakota 2010, Casale et al. 2012) share four important features (not enumerated below when listing similarities!): head with 2 (3) supraorbital setae from each side; apical recurrent stria joining stria 5; protibia entirely pubescent, without longitudinal groove on its external face (protibia sulcate only in *Albanotrechus* Casale & V.B. Guéorguiev, 1994); male protarsus with first two segments dilated. In addition, *Beronaphaenops* gen. n. shares with the most of these genera: pronotum without posterolateral setae at the hind angles and "anisotopic" conformation of the copulatory piece of aedeagus.

Among the Balkan genera of this ensemble, *Acheroniotes* Lohaj & Lakota, 2010, *Croatotrechus* Casale & Jalžić, 1999, and *Jalzicaphaenops* Lohaj & Lakota, 2010 together are remarkable for: their stalklike body; glabrous elytra with effaced humeri; submentum with row of 2-4 prebasilar setae; pronotum with posterolateral setae at the hind angles. Each of these Balkan taxa possesses a set of features, which additionally reveal the lack of relationships between them and the genus from Anatolia. *Acheroniotes* differs from the new taxon in: the frontal grooves incomplete; labium imperfectly fused; mentum without median teeth; four-five discal setae in elytral stria 3, as well additional microsetae in striae 3 and 5; humeral group of umbilicate series aggregated. *Croatotrechus* is remarkable for: the two discal setae in elytral stria 3; humeral umbilicate series with pore 4 situated at the middle of elytron length; segment 4 of the mesotarsi with long ventral appendage. *Jalzicaphaenops* is distinct from the new genus in: the labium imperfectly fused; mentum without median teeth; pronotum with a pair of setae on the disc near midline; two discal setae in elytral stria 3; humeral group of umbilicate series aggregated.

According to Casale et al. (2012), the North Dinaric genera *Dalmataphaenops* Monguzzi, 1993 and *Velebitaphaenops* Casale & Jalžić, 2012 may have common derivation. Both genera share some important traits: large size (10–14 mm); head and elytra glabrous; incomplete frontal grooves; submentum with row of 8–10 basilar setae; labium not fused; mentum tooth wide, slightly prominent, moderately bifid; humeral group of the umbilicate series aggregate; similar structure of the inner sac of aedeagus. These states are different or their polarity is opposite in *Beronaphaenops* gen. n. which exclude eventual relationships.

The genera *Minosaphanops* Quéinnec, 2008 and *Scotoplanetes* Absolon, 1913 are also stated as related each other (Quéinnec 2008: 160–161). These genera share some characters, which however are different in the new genus: stalklike body; mentum without median tooth; four or more discal setae in elytral stria 3; umbilicate series of elytra aggregate; reduced inward denticulation of segments 1–2 in the male. In addition, *Minosaphanops* has incomplete frontal grooves, labium imperfectly fused, and elytra with microsetae in striae 2 and 5, while *Scotoplanetes* possesses 3-6 discal setae in stria 5 and a rather different conformation of the aedeagus. Based on these facts, we do not suppose phyletic nearness between these two Balkan genera and *Beronaphaenops* gen. n.

Derossiella Quéinnec, 2008 differs from the new genus in: the stalklike shape of the body; completely glabrous integument; labium not fused; mentum tooth simple; umbilicate series of elytra not typically aggregated, as only pore 7 distant from marginal gutter (also, pore 1 of the humeral group set isolated from the other pores, while pores 2–4 equidistant); two discal setae on the site of elytral stria 3, and presence of two microsetae between the discal setae.

We exclude also direct affinity of the new taxon with *Adriaphaenops* Noesske, 1928, which include species with: stalklike body; incomplete, very short frontal grooves; teeth of right mandible reduced or vanished; labium not fused; mentum tooth simple; supraorbital setae more or less reduced; two discal setae in elytral stria 3. However, this genus partakes with the new genus: integument entirely pubescent; pronotum without posterolateral setae at the hind angles; umbilicate series of elytra not aggregated; “anisotopic” conformation of the copulatory piece of aedeagus.

Aphaenopsis J. Müller, 1913 is distinct from *Beronaphaenops* gen. n. in: the glabrous integument of body; incomplete frontal grooves; labium not fused; mentum tooth simple; ligula with prominent anterior process, which bears single long seta; elytra with two discal pores in stria 3; internal apical pore missing. The similarities between both genera are: submentum with 6 prebasilar setae; ligula with short and fragile paraglossae; pronotum without posterolateral setae at the hind angles; rather similar conformation of the umbilicate series of elytra (namely the disposition of the humeral pores 1-4 and similar distance between the pores of middle and apical groups); “anisotopic” conformation of the copulatory piece of aedeagus.

Albanotrechus Casale & V.B. Guéorguiev, 1994 differs from the new genus in: the glabrous integument (but sparse pubescence present on the temporae, abdominal sternites, and external intervals of elytra in the former); labium not fused; elytra with two discal pores in stria 3, as anterior one at the level of umbilicate pores 1-2, and posterior one just before the level of pore 5; external apical pore of the apical triangle near to apical recurrent stria; protibiae grooved and rugose on the external face; elongate aedeagus with apical lamella curved upward; apical stylomere with three moderately large ensiform setae on tergal position. On the contrary, the two genera share some important similarities: complete frontal grooves; mentum tooth bifid (moderately prominent in *Albanotrechus*, porrect in the new genus); submentum with 6 prebasilar setae; ligula with 8 setae on its anterior margin; paraglossae fragile and relatively short; pronotum without posterolateral setae at the hind angles; elytral shoulders not effaced; markedly similar conformation of the umbilicate series of elytra, especially the structure of the humeral umbilicate group (e.g.: pore 1 rather remote inwards, situated at or slightly before the level of second pore, pore 2 laying almost at the marginal gutter, pores 3 and 4 clearly remote from gutter, the distance between pores 3 and 4 larger than the distance between pores 2 and 3) and pore 8 situated near to the marginal gutter; "anisotopic" conformation of the copulatory piece of aedeagus. To all appearances, among the Balkan aphaenopsoid taxa, the new taxon shares most common traits with *Albanotrechus*. However, the phyletic distance between these two genera is obvious.

One Crimean and one Caucasian genus, respectively *Pseudaphaenops* Winkler, 1912 and *Meganophthalmus* Kurnakov, 1959, both postulated to be related each other (Jeannel 1960, Belousov and Koval 2009), share with the new taxon only a few features of importance, which exclude any relationships. *Pseudaphaenops* and *Beronaphaenops* gen. n. have male protarsus with first two segments dilate and protibiae pubescent and ungrooved on external face. These genera differ in the state of many important characters: structure of the labium (fused or not); number of setae on the submentum (6 or 8); integument of the elytra (pubescent or glabrous); state presence/absence of posterolateral setae on the pronotum; number of discal setae on elytra; aggregation of the humeral group of umbilicate series. *Beronaphaenops* gen. n. *paphlagonicus* sp. n. strongly differs from the species of *Meganophthalmus* Kurnakov, 1959 in: the entirely pubescent body (vs. pilosity available only on the anterior surface of protarsi in *Meganophthalmus* spp.); sub-triangular pronotum (vs. elongate pronotum); sub-ovoid shape of the elytra with maximal width posteriad (vs. ovoid shape of the elytra with maximal width anteriad, or at least in the middle as in *M. kravezi* Komarov, 1993); mentum tooth bifid (vs. mentum tooth simple); labium fused (not fused in *Meganophthalmus* spp.); number of the discal setae on elytra; humeral group of umbilicate series of elytra not aggregate; segment 4 of the protarsi and mesotarsi not modified ventrally (vs. segment 4 of the protarsi and mesotarsi with hyaline appendage ventrally).

The differences between the monotypic genus *Taniatrechus* Belousov & Dolzhanski, 1994, which has been postulated to be related to the Balkan *Pheggomisetes* Knirsch, 1923 (Belousov and Koval 2009), and the new genus are more than the traits they share. The Caucasian taxon is distinct from the Anatolian one in: the body entirely glabrous (excl. protibiae); temporae of head from each side with 6-10 supraorbital setae situated on the external side of frontal groove, laterad and on the low surface of genae; labium not fused; mentum tooth simple, hardly prominent or missing; submentum with a transverse row of 9-10 setae; pronotum very long and parallel-sided as posterolateral pores present; elytra with two discal setae in stria 3; segment 4 of protarsi and mesotarsi with hyaline appendage ventrally.

The genus *Jeannelius* Kurnakov, 1959 includes four species with first two segments of the protarsi not dilated in the males. This genus and *Beronaphaenops* gen. n. share only two similarities: mentum tooth bifid and submentum with 6 prebasilar setae. The differences between these taxa are more than the similarities. All species of the Caucasian genus share features, which clearly distinguish them from the new species: rather big species (7.5–10.2 mm; vs. 5.7–6 mm in *Beronaphaenops* gen. n. *paphlagonicus* sp. n.); entirely glabrous integument (excl. temples and protibia); labium not fused; humeral group of the umbilicate series of elytra aggregate (only first umbilicate pore placed on stria 7th); male protarsi with first two tarsomeres not dilated; segment 4 of the protarsi and mesotarsi with hyaline appendage ventrally.

The most recently described aphaenopsoid groups from the Caucasus are *Caucasorites* Belousov & Zamotajlov, 1997 and *Caucasaphaenops* Belousov, 1999, which for the moment seem more related to each other than each of them is to another genus of Trechini (Belousov 1999). Virtually, these genera and the new one do not share any important trait. To some extent, they resemble each other in the integument entirely pubescent. But, the rate of pilosity is different: the Caucasian species are densely pubescent, while the one from the Küre Dağlari Mt. is only sparsely pubescent. There are more differences between the two Caucasian genera and *Beronaphaenops* gen. n. The latter differs from the formers in: the head without parietal and temporal microsetae (vs. head with parietal or/and temporal microsetae distinct from the surrounding ordinary hairs); labium completely fused (vs. labium not fused); mentum tooth porrect, deeply bifid (vs. mentum tooth not projecting, simple or cleft at the apex); submentum with transverse row of 6 basic setae, without additional microsetae (vs. submentum with transverse row of 6-8 basilar setae and 4–5 additional microsetae); hind angles of the pronotum without basolateral setae (vs. pronotum with basolateral setae); elytra with single discal pore in stria 3, posterior one wanting (vs. elytra with two discal pores in stria 3 in *Caucasorites kovali* Belousov, 1999 and *Caucasaphaenops molchanovi* Belousov, 1999, or elytra with single, posterior discal pore in stria 3 in *Caucasorites shchurovi* Belousov & Zamotajlov, 1997 and *C. victori* Belousov, 1999); humeral group of the umbilicate series of elytra not aggregate (vs. humeral group of umbilicate series of elytra aggregate); segment 4 of the protarsi and mesotarsi without appendage ventrally (vs. segment 4 of the protarsi and mesotarsi with hyaline appendage ventrally).

Taking into consideration the weight of more important characters, we should note that *Beronaphaenops* gen. n. *paphlagonicus* sp. n. seems unrelated to any of the present trechine taxa from both the Crimean Peninsula and the Caucasus Major. All the aphaenopsoid genera from the last two areas have labium not fused, umbilicate series of elytra aggregate (only *Jeannelius* and *Taniantrechus* with umbilicate pore 1 positioned in stria 7), and segment 4 of the protarsi and mesotarsi with hyaline appendage ventrally.

There are at least five probable apotypies found in *Beronaphaenops* gen. n., e.g.: mentum tooth large, long and porrect (at distal position reaching or slightly exceeding the level of epilobes), rather slanting ventrally, deeply bifid at the tip (i); short and fragile paraglossae, hardly surpassing the anterior margin of ligula (ii); absence of posterolateral seta of the pronotum (iii); absence of posterior discal pore in elytral stria 3 (iv); apical stylomere of the ovipositor shortened, with basal part unusually broadened (v). These states are listed here, because they could be used eventually in a further quest for phylogenetic inferences or cladistic analysis.

In conclusion, the discussion in this section, as well as, a very peculiar diagnostic combination (see section Diagnosis) seem to us enough to place the new genus at the best after the Balkan taxa of the former *Aphaenops* series and before the *Neotrechus* series of Trechini. From among the peri-Pontic aphaenopsoid Trechini, the new genus shares most important features with *Albanotrechus*. On the other side, there is also a striking affinity with the East Alpine genus *Orotrechus*, which belong to the *Neotrechus* series. In any case, a very ancient origin of *Beronaphaenops* gen. n. from a "western" or North Aegeidean lineage could be possible. Actually, for the time being, the affinities of the new genus are not clear, and this is probably due to the numerous convergent characters shared by hypogean Trechini.

Beronaphaenops paphlagonicus **sp. n.**

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http://species-id.net/wiki/Beronaphaenops_paphlagonicus

Type material. Holotype ♂, labelled: "Turkey, Pinarbasi Distr., Milli Park Kűre Dağlari, cave Eşek Çukuru Mağarası 2, 14.VII.2008, P. Beron leg." [typeset] / "Holotype *Beronaphaenops* gen. n. *paphlagonicus* sp. n. B. Guéorguiev det. 2011" [red typeset] (NMNHS); paratypes 1 ♂, 3 ♀♀, labelled: "Turkey, Pinarbasi Distr., Milli Park Kűre Dağlari, cave Eşek Çukuru Mağarası 2, 14.VII.2008, P. Beron leg." [typeset] / "Paratype *Beronaphaenops* gen. n. *paphlagonicus* sp. n. B. Guéorguiev det. 2011" [red typeset] (MHNG; NMNHS).

Diagnosis. A medium sized trechine, included in *Beronaphaenops* gen. n., with pubescent integument, elongated head, complete frontal grooves, labrum serrate on the anterior margin, labium fused, mentum tooth large, long, and deeply bifid at the tip, pronotum short and narrow, without posterolateral setae, and with pointed hind angles, elytra with superficial striae, one discal pore in stria 3, umbilicate series not aggregate, aedeagus with straight apex and poorly differentiated basal bulb, apical stylomere short, broadened basally, with two large ensiform setae on tergal position.

Description. Medium sized, overall length (from the apex of longer mandible to the apices of elytra): 5.72–5.95 (mean 5.87) mm; maximum width: 1.88–1.98 (mean 1.91) mm. General shape as in Fig. 1. Integument thin, translucent, covered by short, rather sparse and uniform pubescence, tibiae and tarsi densely pubescent. Microsculpture distinct on the head and elytra, very fine, almost indistinct on the pronotum, consisting of isodiametric and transverse meshes on the head and isodiametric ones on the elytra. Colour reddish-brown on the head and pronotum to yellowish on the elytra and appendages.

Head rather elongate, 1.49–1.59 (mean 1.56) times as long as wide, 1.6–1.74 (mean 1.68) times as long as the pronotum, slightly narrow than the pronotum: 0.88-

0.93 (mean 0.91) times as wide as pronotum, clearly constricted at the neck; frontal grooves complete, extending onward onto the clypeus, deep along the apical three-fourth of the head where outwardly sinuate, somewhat shallow at the level of posterior supraorbital seta, and again deeper downhill along the collar constriction; genae convex. Antennae filiform, very long and slender, 0.63-0.65 times as long as overall body length, posteriad not exceeding middle of elytra.

Pronotum cordate, 1.15–1.21 (mean 1.19) times as wide as long, constricted towards the base. Anterior margin 1.24–1.27 times as wide as the posterior margin, 0.78–0.83 times wide as the pronotal maximum width, gradually concave towards the middle, the fore angles prominent, round. Posterior margin 0.63–0.65 times wide as the pronotal maximum width, concave inwards as the hind angles projecting back. Sides convex, round anteriad, straight, convergent posteriorly, hardly sinuate before the acute hind angles, which slightly projecting outside and turned upwards. Lateral margins grooved throughout, less anteriorly, more posteriorly, their extremities reflexed upward throughout, less anteriorly, more posteriorly. Anterolateral setae present, with length exceeding two-thirds of the pronotal side length, situated at the place of maximal pronotum width, posterolateral setae absent. Disc smooth, slightly convex, midline well impressed, not reaching both the basal and apical margins; apical transverse impression less distinct, continuous, laterally reaching the anterior margin, basal transverse impression sharply impressed, continuous, laterally merging into the small, but distinct basal foveae. Scutellum small, triangular.

Elytra subovate, 1.67–1.78 times longer than wide, 3.28–3.55 times as long as the pronotal maximum length, and 1.6–1.72 times wider than the pronotal maximum width. Sides narrow and slanting at the basis, becoming wider posteriorly, with maximal width at the third-fourth, round at the apex; lateral grooves reflexed moderately upward, becoming flat at the apical sixth; shoulders obtuse though still marked, basal border absent. Disc convex; striae superficial, more or less obliterated at the sides and apically, scutellar stria absent, apical recurrent one present; intervals flat, each one with single longitudinal row of hairs in the middle; stria 3 with single discal pore before the middle; apical triangle of pores complete; umbilicate series of elytra consisting of 8 pores, not aggregate.

Legs long and slender; protibia straight, densely pubescent, without longitudinal groove on the external face; tarsi thin, densely pubescent, segments 1 and 2 in the males strongly dilated and inwardly denticulate at the apices.

Male genitalia: as in Figs 13–15 (see also the genus description).

Female genitalia: as in Fig. 16 (see also the genus description).

Etymology. The specific epithet is a noun in the nominative singular in apposition. It honors Paphlagonia, an ancient country on the today's Kastamonu Province of Turkey.

Distribution. Up to now the new species is known only from its type locality, the cave Eşek Çukuru Mağarası 2 (Fig. 17). The cave is situated in the Küre Dağları Milli Parkı, a Turkish national park which includes a forested, well protected karstic area in the Küre Mountain. The most important distinctive feature of this karstic zone is

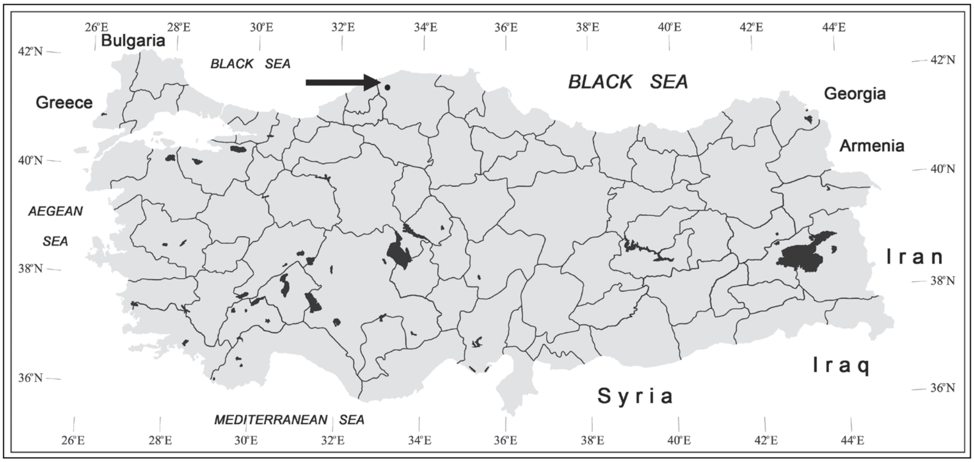

Figure 17. Administrative map of Turkey with black arrow and dot marking approximately the type locality of *Beronaphaenops* gen. n. *paphlagonicus* sp. n.

that it harbors old growth natural beech and fir forests, endemic plant species, forest ecosystems rich in biological diversity, as a result of being in the humid climatic zone. The climate in the inner part of the area is harsh.

Key to the Anatolian genera of Trechini

1 (2) Basal bead of elytra reaching scutellum or stria 1 .... **_Thalassophilus_ Wollaston, 1854**
2 (1) Basal bead of elytra lacking or reaching stria 3 at most.
3 (6) Eyes pilose, well developed with function ommatidia. Penultimate segment of labial palpomeres with more than four setae. Fore tibia with spine apically on outer side.
4 (5) Protibiae feebly grooved on external face. Larger size (ca. 3.8 mm) .... **_Neoblemus_ Jeannel, 1923**
5 (4) Protibiae ungrooved on external face. Smaller size (2.2-2.9 mm) .... **_Perileptus_ Schaum, 1860**
6 (3) Eyes glabrous, developed or atrophied. Penultimate segment of labial palpomeres with four setae. Fore tibia without spine apically on outer side.
7 (8) Anterior face of protibiae glabrous .... **_Trechus_ Clairville, 1806**
8 (7) Anterior face of protibiae pubescent, mostly in apical part.
9 (10) Apical recurrent stria joining stria 3. Pubescent species with well developed eyes. Submentum with a transverse row of 8-12 setae .... **_Trechoblemus_ Ganglbauer, 1892**
10 (9) Apical recurrent stria joining stria 5. Glabrous or pubescent species with rudimentary or absent eyes. Submentum with a transverse row of 6–9 setae.

11 (18) Humeral group of umbilicate series aggregate as four pores adjoining marginal gutter. Labium not fused (mentum separated by submentum by distinct labial suture).

12 (15) Head without parietal or/and temporal microsetae.

13 (14) Pronotum and elytra glabrous. Submentum with a transverse row of 6 setae. Male protarsus with first two tarsomeres dilated. Eight endemic species with scattered distribution in Anatolia throughout, with body size: 3.7–7.5 mm.. .... ***Duvalius* Delarouzée, 1859**

14 (13) Pronotum and/or elytra with very short and scattered pubescence. Submentum with a transverse row of 8 or more setae. Male protarsus with only first tarsomere dilated. Seven endemic species with scattered distribution in NW and SW Anatolia, with body size: 2.6–4.2 mm..... ***Anillidius* Jeannel, 1928**

15 (12) Head with parietal or/and temporal microsetae.

16 (17) Mentum tooth single, large and pointed. Head with parietal microsetae, without temporal ones. Male protarsus with first two tarsomeres dilated. One endemic species from Ordu Province, NE Anatolia, with size 3.2 mm......... .... ***Pontodytes* Casale & Giachino, 1989**

17 (16) Mentum tooth bifid. Head with both parietal and temporal microsetae. Male protarsus with only first tarsomere dilated. One endemic species from Artvin Province, NE Anatolia, with size: 2.8–3.1 mm .... ***Troglocimmerites* Ljovuschkin, 1970**

18 (11) Humeral group of umbilicate series not aggregate as some pores situated inwards, more or less distant from marginal gutter. Labium completely fused.

19 (22) Pronotum with pair of long posterolateral setae situated near hind angles. Male protarsus with only first tarsomere dilated. Mentum tooth simple.

20 (21) Head and elytra glabrous. Pores 1 and 4 of humeral group of umbilicate series rather distant from marginal gutter, pores 2 and 3 adjoining marginal gutter. Larger size (ca. 6 mm). One endemic species from Konya Province, SW Anatolia. .... ***Kosswigia* Jeannel, 1947**

21 (20) Head and elytra pubescent. Pores 3 and 4 of humeral group of umbilicate series little distant from marginal gutter, pores 1 and 2 adjoining marginal gutter. Smaller size (3.85–4.2 mm). One endemic species from Antalya Province, SW Anatolia.................... ***Sbordoniella* Vigna Taglianti, 1980**

22 (19) Pronotum without posterolateral setae situated near hind angles. Male protarsus with first two tarsomeres dilated. Mentum tooth bifid. One species from Kastamonu Province, NW Anatolia, with size: 5.7–6 mm .... ***Beronaphaenops* gen. n.**

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Santocellus (Neuroptera, Chrysopidae, Leucochrysini): taxonomic changes, new description, and a key to the species

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Abstract

Santocellus is a small Neotropical genus of leucochrysine lacewings that only recently was separated from *Leucochrysa*. Here, the features of the *Leucochrysa risi* Esben-Petersen holotype (a female) are described and shown to support the species' transfer to *Santocellus* and the continued retention of the genus *Santocellus* as separate from *Leucochrysa*. The valid name for the species becomes *Santocellus risi* (Esben-Petersen, 1933), **comb. n.**, and *Santocellus bullata* (Tauber, 2007) is recognized as a **syn. n.** of *S. risi*. Currently, this species is reported only from Peru. An illustrated key is provided for distinguishing the known species in the genus *Santocellus*.

Keywords

Santocellus, *Leucochrysa*, Neotropical, Leucochrysini, Peru

Introduction

The Neotropical genus *Santocellus* (Neuroptera: Chrysopidae, Leucochrysini) was recently differentiatied from other leucochrysine genera on the basis of a subtle, but consistent, suite of adult and larval traits (Tauber et al. 2008). Currently, the genus contains three species, all from South America: *Santocellus atlanticis* Tauber & Albuquerque, *Santocellus bullata* Tauber, and *Santocellus riodoce* Tauber. One of the species, *S. bullata* previously was known only from a single male collected in Peru – the holotype at the National Museum of Natural History, Washington DC (USNM) (Tauber 2007). During a recent visit to the Museum of Comparative Zoology (MCZ), a female specimen of this species was discovered; it also was from Peru. However, it had been identified by P. A. Adams as *Leucochrysa risi* Esben-Petersen. Subsequent examination of the *L. risi* type [= *Santocellus risi* (Esben-Petersen)] in the Zoological Museum of Copenhagen University (ZMCU) confirmed Adams' identification and the synonymy of *S. bullata* and *L. risi*.

Herein, the features of the previously unknown female are described and illustrated; the results are used to examine the consistency of the female features among *Santocellus* species. In addition, a key with illustrations for identifying *Santocellus* species is provided. Methods for staining the abdomen and making measurements were those used previously (see Tauber 2007).

Taxonomy

Santocellus risi **(Esben-Petersen, 1933), comb. n.**

http://species-id.net/wiki/Santocellus_risi
Figs 1–3, 4C, 4D, 5E, 5F

Leucochrysa risi Esben-Petersen, 1933: 119 [ZMCU, Holotype (by original designation), Figs 1–2; original description: "One specimen Pozuzo, Peru"]. Penny 1977: 23 [species list]; Núñez 1989: 70 [species list].

Leucochrysa (*Nodita*) *risi* Esben-Petersen. Listed in Oswald 2007 (previous publication of the name not confirmed).

Leucochrysa (*Leucochrysa*) *risi* Esben-Petersen. Brooks and Barnard 1990: 277 [subgeneric assignment, species list].

Leucochrysa bullata Tauber, 2007: 128 [USNM, Holotype (by original designation), Figs 4C, 5E, F; original description: "Peru. Madre de Dios: Manu: Aguajal, 5 km. S. Pakitza (12°7'S, 70°58'W) 250 m, 18-19-IX-1988, Flint & Erwin"]. Oswald 2007.

Santocellus bullata Tauber et al., 2008: 315 [transfer to *Santocellus*] **syn. n.**

Description of female. *Head, thorax, wings* (Figs 4C, 4D, 5E, 5F). Same as described for male (Tauber 2007, as *L. bullata*).

Female abdomen (Figs 1C, 2, 3). Segments 1–7 long, slender; tergites shallow [ratio length : width = 8.6 (T5), 7.5 (T6), 4.0 (T7)], with slightly rounded margins, with brown circular spot mesally; T8 shorter, rounded, without brown spot. Sternites deep [ratio length : width = 1.5 (S5), 1.0 (S6), 1.4 (S7)], with dorsal margins slightly depressed (concave) mesally; tergites, sclerites with numerous, long, thin setae, dense microsetae, without microtholi. Pleural region with microsetae, P7 with long, thin setae; spiracles small, simple, with unenlarged atria.

Figure 1. *Leucochrysa risi* Holotype [Female, Pasco, Peru; Zoological Museum of Copenhagen University; Photos by Niels P. Kristensen] **A** Head, thorax, dorsal **B** Head, frontal **C** Habitus, dorsal **D** Labels.

Female genitalia. Callus cerci round to slightly oval, 0.10–0.15 mm in diameter, with 19–21 relatively thin trichobothria (longest ~0.13 mm long); cupuliform bases of variable diameter. Tergite 9 + ectoproct rounded, fused dorsally, blunt posteriorly, elongate, ventral section on each side enlarged into pair of bulbous lobes extending well below gonapophyses laterales; enlargement covered with dense, stout, upward-curving setae. Gonapophysis lateralis not large, occupying approximately one-half of posterior margin of abdomen; surface covered with robust, stout setae, especially on ventral half; interior membranous area not greatly expanded. Colleterial gland transparent, delicate, ovoid, small, mostly within gonapophyses laterales and T9+ect, not extending anteriorly much beyond bursa, but with numerous elongate accessory glands attached distally, with transparent, membranous tubule connecting to small reservoir; transverse sclerification short, narrow, receiving short duct from reservoir. Entire geni-

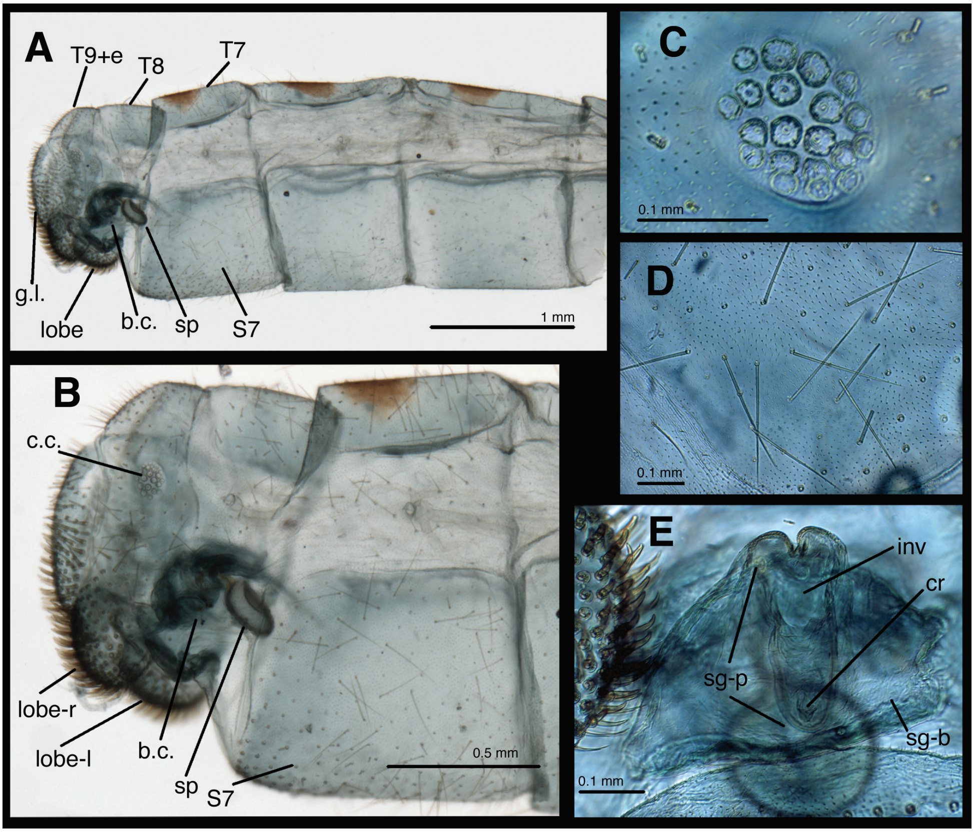

Figure 2. Female abdomen of *Leucochrysa risi* [Female (mature), Pasco, Peru]. **A** Segments A5 to A9+ectoproct, lateral **B** Segments A7 to A9+ectoproct, lateral **C** Callus cerci (trichobothria missing) **D** Abdominal integument **E** Subgenitale, posterior. Abbreviations: **b.c.** bursa copulatrix; **c.c.** callus cerci; **cr** crumena of subgenitale; **g.l.** gonapophysis lateralis; **inv**, invagination below distal lobes of subgenitale; **lobe** setose lobe at ventral margin of ectoproct; **lobe-l** lobe on left side of body; **lobe-r** lobe on right side of body; **sg-b** base of subgenitale; **sg-p** elongate ventral process of subgenitale; **sp** spermatheca; **S7** seventh sternite; **T7, T8** seventh and eighth tergites; **T9+e** fused ninth tergite and ectoproct.

tal structure small, not much larger than subgenitale. Bursa copulatrix membranous, broad basally (near subgenitale), tapering and extending slightly into region above S7, folded dorsally, with slight longitudinal depression dorsally, connected ventrally to spermatheca via elongate dorsal slit on spermathecal velum and bursal duct at proximal tip of velum. Bursal duct very short, slender. Bursal glands not seen. Spermatheca doughnut shaped, tucked within distal end of bursa, with small, sail-like velum dorsally, small, V-shaped invagination ventrally. Spermathecal duct attached dorsally to distal end of spermatheca, short, sclerotized, extending into and out of subgenitale, with ~three curves, closely attached to membranes of bursa and subgenitale; terminus with long, dense setae. Subgenitale broad basally, rounded distally, nestled between ventral lobes of ectoproct, narrow in lateral view, with shallow ventral fold at attach-

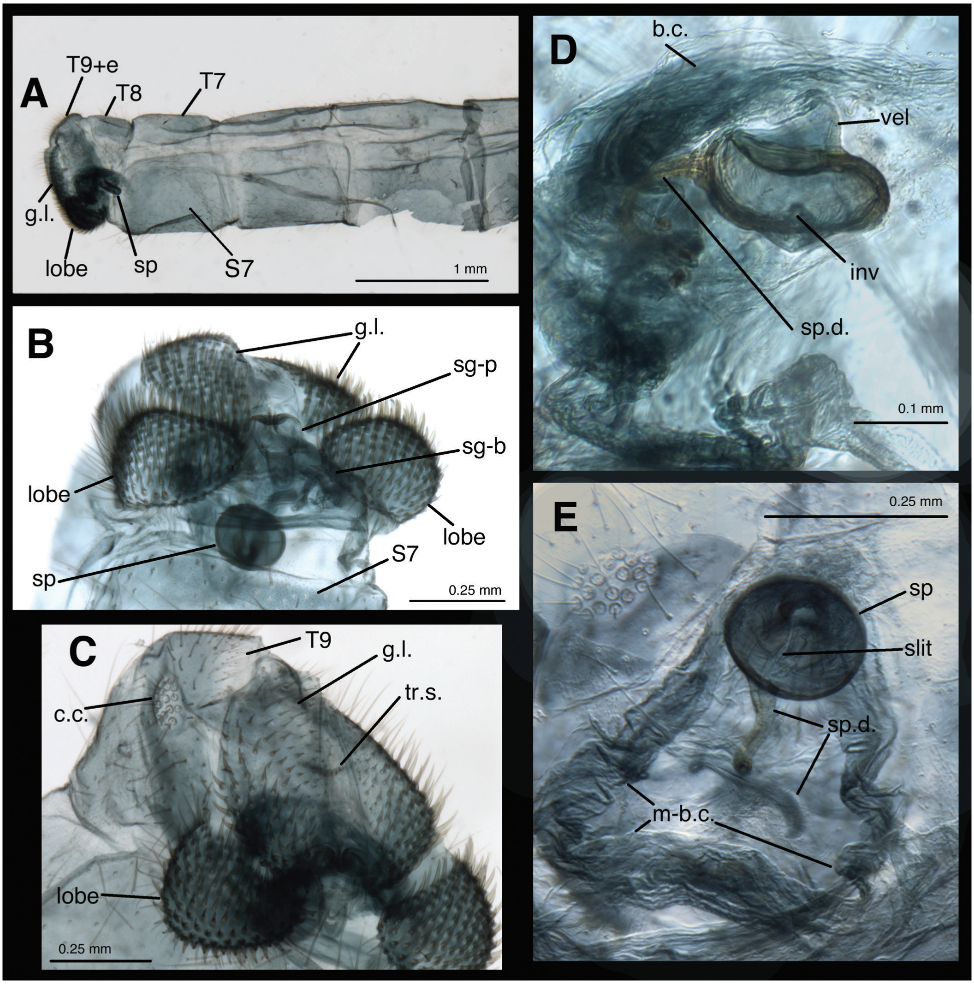

Figure 3. Female abdomen of *Leucochrysa risi* [Female (slightly teneral), Junin, Peru] **A** Segments A5 to A9+ectoproct, lateral **B** Abdominal terminus, posteroventral, showing enlarged, setose lobes on ventral margin of ectoproct. Note subgenitale nestled between left and right lobes, round spermatheca (with dorsal slit) above subgenitale **C** Abdominal terminus, ventrolateral, showing enlarged, setose lobes on ventral margin of ectoproct, setose surface of gonapophysis lateralis **D** Spermatheca below bursa copulatrix, lateral view **E** Spermatheca and spermathecal duct engulfed within membrane of bursa copulatrix, ventral view. Abbreviations: **b.c.** bursa copulatrix; **c.c.** callus cerci; **g.l.** gonapophysis lateralis; **inv** spermathecal invagination; **lobe** setose lobe on ventral margin of ectoproct; **m-b.c.** membrane of bursa copulatrix; **sg-b** base of subgenitale; **sg-p** elongate ventral process of subgenitale; **slit** slit in dorsal surface of spermathecal velum, opening to bursal duct above (not visible); **sp** spermatheca; **sp.d.** spermathecal duct; **S7** seventh sternite; **T7, T8** seventh and eighth tergites; **T9+e** fused ninth tergite and ectoproct; **tr.s.** transverse sclerite; **vel**, spermathecal velum.

ment to S7, slightly deeper fold above, terminal process flat, long, extending almost full length of subgenitale, with pair of lobes at base, shallow crumena at rounded tip; membrane above subgenitale with crescent-shaped, lightly sclerotized lamellae.

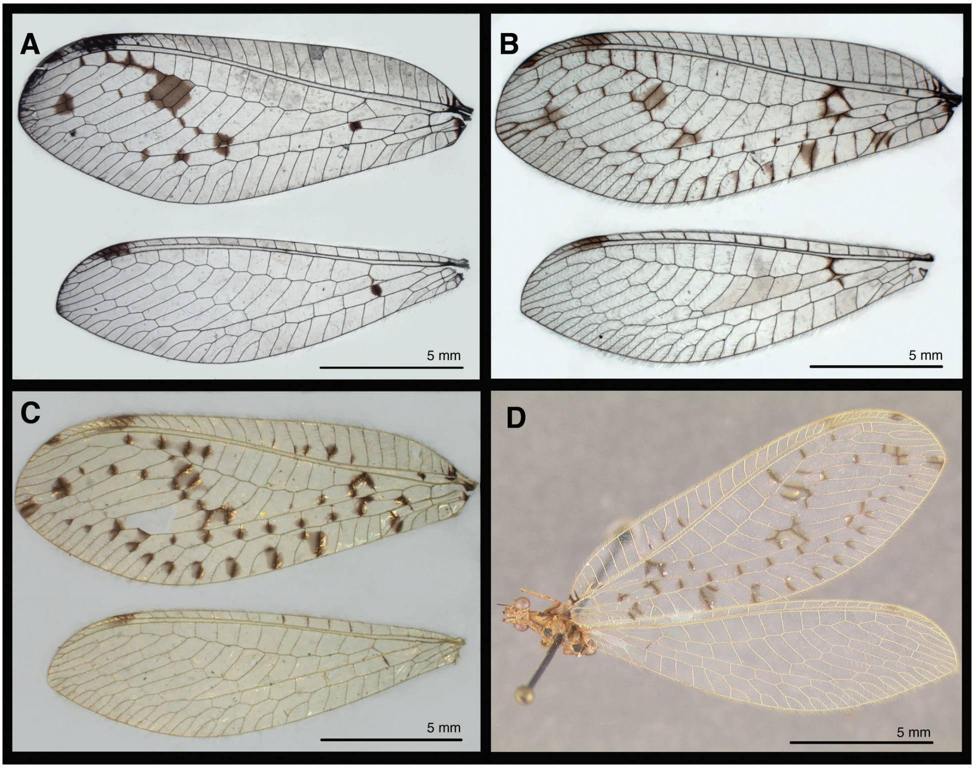

Figure 4. Wings of known *Santocellus* species. **A** *Santocellus atlanticis* [Female; Rio de Janeiro, Brazil] **B** *Santocellus riodoce* [Female; Espírito Santo, Brazil] **C** *Santocellus risi* [Male; Madre de Dios, Peru] **D** *Santocellus risi* [Female; Junin, Peru].

Specimens examined. Holotype (ZMCU) and a second female specimen (MCZ), with labels reading: [1] "El Campamiento Col. P?r?n? ["?" mine] PERU 1 July '20", [2] "Cornell Univ. Expedition Lot 569", [3] "Leucochrysa (or Nodita) risi Esb-Petersen 1932 det. P.Adams 1974". The locality data appear to refer to the Expedition's Camp at Perené in the province of Chanchamayo, Junin, Peru, elevation 696 m (Cornell University Insect Collection Voucher Lot Series, Lot 569).

Known distribution. Currently, this species is known only from three regions of Peru: Junin (~650 m) (new record), Pasco (~800 m) (Esben-Petersen 1933), and Madre de Dios (250 m) (Tauber 2007).

Comparison with other *Santocellus* species. The genus *Santocellus* was described on the basis of a distinctive suite of larval and adult (male and female) character states. However, *S. risi* (as *bullata*) was included in the genus only on the basis of its male characteristics (Tauber et al. 2008); both the female and the larvae were unknown when the genus was described. We now know that, in addition to the striking pustulate wings and unusual body markings that typify the species, *S. risi*

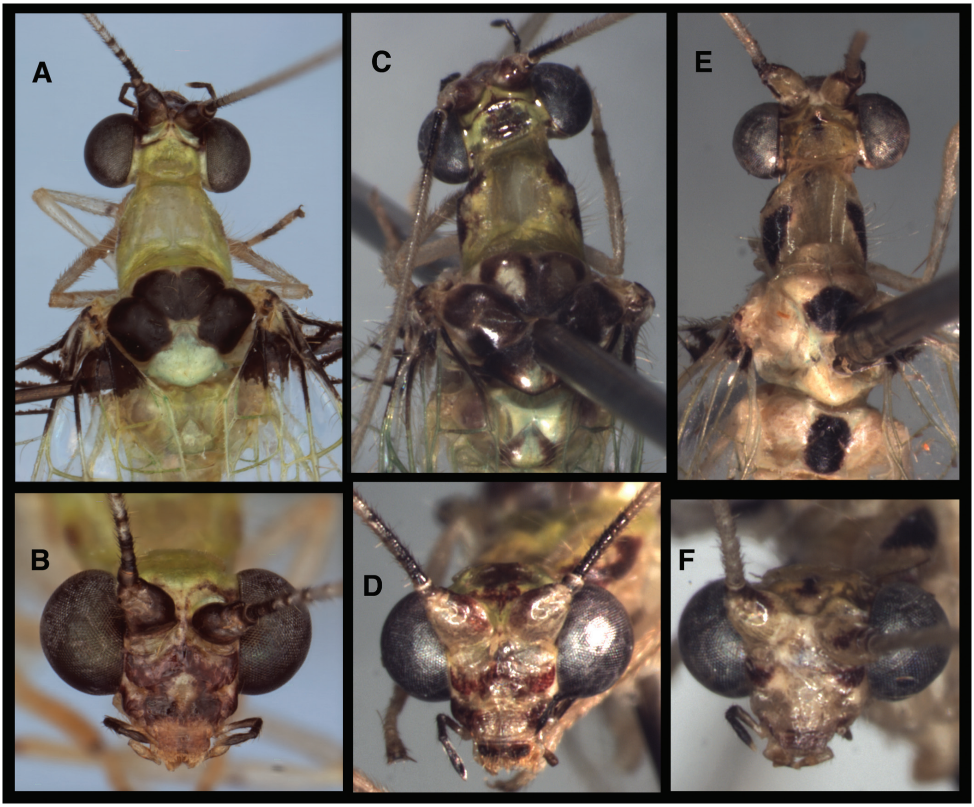

Figure 5. External features of known *Santocellus* species. Top row: Head and thorax, dorsal; Bottom row: Head, frontal **A, B** *Santocellus atlanticis* [Male; Rio Grande do Sul, Brazil] **C, D** *Santocellus riodoce* [Female; Espírito Santo, Brazil] **E, F** *Santocellus risi* [Male; Madre de Dios, Peru].

females have abdominal characteristics that are distinctive among the Leucochrysini (setose, bulbous lobes on the ventral margins of the ectoproct and unique, stout, curved setae). However, they also share a large set of female features with their congeners, *S. atlanticis* and *S. riodoce*: (1) a round, pillbox-shaped spermatheca with a shallow invagination; (2) a relatively short, lightly sclerotized spermathecal duct; (3) spermatheca with a sail-like velum that opens via a slit to a short bursal duct; (4) spermathecal/bursal complex relatively small, spermatheca nestled below the bursa copulatrix; (5) gonapophyses laterales relatively round and short; (6) colleterial gland bulbous, delicate, transparent, and with several elongate tubules attached to the distal end; (7) subgenitale with two, small to medium-sized, basal folds (at the attachment to the seventh sternite), with a ventral process that is elongate and flat, has a rounded distal margin, rounded lobes basally, and a shallow crumena. The expression of this set of features by the female of *S. risi* provides new support for keeping the genus *Santocellus* separate from *Leucochrysa*, and it offers strong evidence for retaining the species within the genus.

Key to *Santocellus* Species

The key below is intended for identification without dissecting the specimens. For species-specific differences in male and female terminalia, see Tauber 2007, Tauber et al. 2008, Figs 2 and 3 above).

1 Membrane surrounding numerous crossveins of forewing with pustulate swellings (Figs 4C, 4D); meso- and metanotum each with large, dark brown to black, mesal spot (Fig. 5E)...................................***risi* (Esben-Petersen)**

– Membrane of forewing smooth, without swellings (Figs 4A, 4B); mesonotum either largely or entirely dark brown to black, with or without light green areas (Figs 5A, 5C) **2**

2 Forewing with cells between Radial sector (Rs) and inner gradates 5-6 entirely filled with brown, Rs and all crossveins between Rs and Psm without dark clouding (Fig. 4A); mesoscutellum light green (Fig. 5A) .... ***atlanticis* Tauber & Albuquerque**

– Forewing with cells between Radial sector (Rs) and inner gradates 5-6 only partially filled with brown, Rs and first two crossveins between Rs and Psm with dark clouding (Fig. 4B); mesoscutellum largely brown, posterior with small light green spot (Fig. 5C).. ***riodoce* Tauber**

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RESEARCH ARTICLE

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Twentieth century occurrence of the Long-Beaked Echidna *Zaglossus bruijnii* in the Kimberley region of Australia

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Abstract

The monotreme genus *Zaglossus*, the largest egg-laying mammal, comprises several endangered taxa today known only from New Guinea. *Zaglossus* is considered to be extinct in Australia, where its apparent occurrence (in addition to the large echidna genus *Megalibgwilia*) is recorded by Pleistocene fossil remains, as well as from convincing representations in Aboriginal rock art from Arnhem Land (Northern Territory). Here we report on the existence and history of a well documented but previously overlooked museum specimen (skin and skull) of the Western Long-Beaked Echidna (*Zaglossus bruijnii*) collected by John T. Tunney at Mount Anderson in the West Kimberley region of northern Western Australia in 1901, now deposited in the Natural History Museum, London. Possible accounts from living memory of *Zaglossus* are provided by Aboriginal inhabitants from Kununurra in the East Kimberley. We conclude that, like *Tachyglossus, Zaglossus* is part of the modern fauna of the Kimberley region of Western Australia, where it apparently survived as a rare element into the twentieth century, and may still survive.

Keywords

Extinction, Kimberley, monotreme, Pleistocene survival, rock art, *Zaglossus*

Introduction

The egg-laying mammals, or monotremes (Monotremata), are the sister group to all other extant mammals and are known as living animals only from the Australian continent, incorporating the modern landmasses of Tasmania, Australia, and New Guinea, which share a continental shelf that is periodically united during times of lowered sea levels as a single continuous landmass ("Sahul" or "Meganesia"). There are two extant monotreme families. The platypus, Ornithorhynchidae, is represented by a single living genus and species, *Ornithorhynchus anatinus* (Shaw, 1799), a semi-aquatic monotreme distributed throughout eastern Australia from tropical Queensland south to Tasmania and Kangaroo Island. The echidnas, Tachyglossidae, are classified in two living genera, the smaller short-beaked echidna (genus *Tachyglossus*), represented by one species, *T. aculeatus* (Shaw, 1792), and the larger long-beaked echidnas (genus *Zaglossus*), with three living species currently recognized (Flannery and Groves 1998). *Tachyglossus aculeatus* is one of the most widely distributed Meganesian mammals, occurring in a wide range of habitats throughout Tasmania, Australia, and much of New Guinea. The long-beaked echidnas, today known only from New Guinea, are inhabitants of rainforests and subalpine meadows—*Z. bruijnii* (Peters and Doria, 1876), distributed in western New Guinea, *Z. bartoni* (Thomas, 1907a), distributed in central and eastern New Guinea, mainly at higher elevations, and *Z. attenboroughi* Flannery and Groves, 1998, reported to date only from the Cyclops Mountains (Flannery and Groves 1998, Groves 2005, Baillie et al. 2009), an outlying mountain range along the north coast of New Guinea (Figure 1).

Though *Tachyglossus* is regarded as the only extant echidna in Australia, until the late Pleistocene several additional tachyglossids, all larger than *Tachyglossus*, occurred in Australia. *Megalibgwilia owenii* (Krefft, 1868) (often called *M. ramsayi*, a junior synonym, in current literature) was a *Zaglossus*-sized echidna (estimated mass *circa* 10 kg, but more robust than *Zaglossus* and with a less elongate or downcurved rostrum) known from Pleistocene localities in New South Wales (Wellington Caves), South Australia (Naracoorte), Tasmania (Montagu Caves and King Island), and south-western Western Australia (Tight Entrance Cave) (Murray 1978b, Griffiths, Wells and Barrie 1991, Turney et al. 2008, Prideaux et al. 2010), indicating a distribution centered on more temperate regions of the continent. "*Zaglossus*" *hacketti* Glauert, 1914, the largest monotreme yet discovered (estimated mass *circa* 20 kg), is documented only from Pleistocene postcranial remains from south-western Western Australia (Mammoth Cave); its generic placement has always been provisional pending the discovery of cranial material or detailed comparative taxonomic study of tachyglossid postcrania (Griffiths et al. 1991, Long et al. 2002). Postcranial remains of a relatively gracile *Zaglossus*-sized echidna, provisionally referred to the living *Zaglossus bruijnii*, have been reported from the Pleistocene of South Australia (Henschke's Quarry Cave at Naracoorte) (Murray 1978a [but see Pledge (1980), who considered this more likely a "giant *Tachyglossus*"]), and Aboriginal rock art corresponding to *Zaglossus* (*Z.* cf. *bruijnii*) is compellingly recorded from Arnhem Land, Northern Territory (Murray and Chaloupka 1984, Lewis

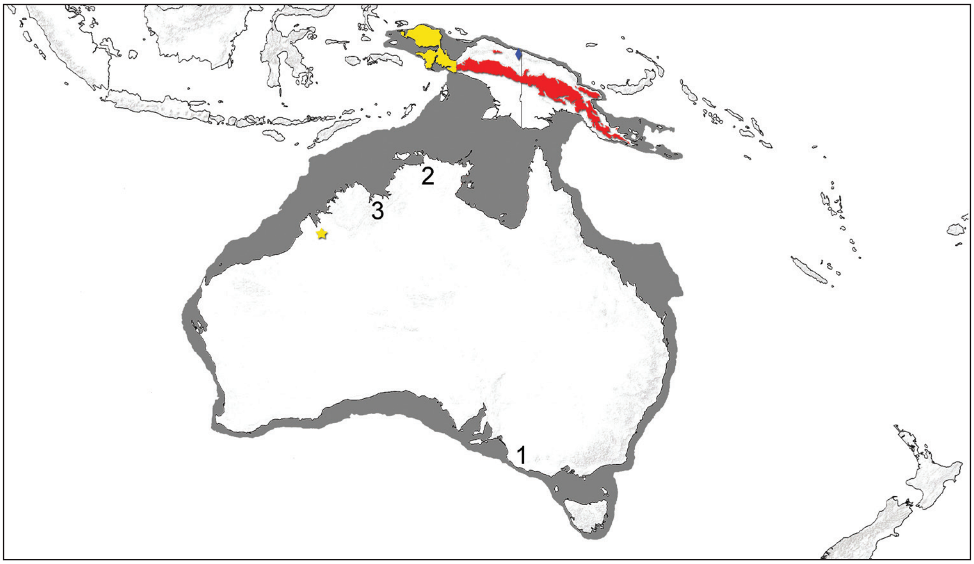


Figure 1. Map of the Greater Australian continent. Map includes an outline of the larger land mass know as "Sahul" or "Meganesia" that forms when the continental shelf (dark grey) is exposed during glaciation. Overlaid is the modern distribution of the three recognized species of *Zaglossus*: *Z. bartoni* (red), *Z. bruijnii* (yellow), and *Z. attenboroughi* (blue diamond), with the Kimberley record of *Z. bruijnii* highlighted by a yellow star. Other possible Australian records of *Zaglossus* cf. *bruijnii* are numbered by general locality: **1** Pleistocene fossil remains from Naracoorte, South Australia, referred to *Z.* cf. *bruijnii* by Murray (1978a) **2** Aboriginal rock art (probably late Pleistocene in age) from Arnhem Land, Northern Territory (see Figure 2) **3** Aboriginal reports of a second, larger echidna taxon, in addition to *Tachyglossus*, present in the East Kimberley (Kununurra, Western Australia) in recent (20th century) memory (see text).

1986, Chaloupka and Murray 1986) (Figure 2). Thus, at least four echidna species, *T. aculeatus, M. oweni, "Z." hacketti,* and *Z.* cf. *bruijnii*, constitute the known Quaternary tachyglossid fauna of the Australian continent south of New Guinea.

Here we report an overlooked modern museum specimen (skin, skull, and forelimb skeleton) of *Zaglossus* that was apparently collected in 1901 in the West Kimberley region of north-western Australia by the Australian naturalist and collector John T. Tunney (Figure 3). Based on an agreement between Lord L. Walter Rothschild, the eccentric naturalist who built up an astonishingly large personal collection of natural history specimens in his private museum in Tring (in the county Hertfordshire outside of London), and Bernard Henry Woodward, the London-born director of the Western Australian Museum in Perth, Tunney was commissioned by Rothschild to travel through some of the most remote areas of northern Australia in the first years of the twentieth century in order to collect butterflies, moths, mammals, and birds for Tring, and Aboriginal cultural artifacts for the museum at Perth. From April 1901 to November 1903, in a pioneering effort, Tunney collected natural history specimens and cultural artifacts along a transect that extended from the Pilbara Region in Western Australia to the South Alligator River in Northern

Figure 2. Australian rock art of *Zaglossus*. Photograph of an Aboriginal rock art illustration from Arnhem Land depicting the characteristic long and down-curved beak (and whitish head of some specimens) of *Zaglossus* (see Murray and Chaloupka 1984). Photograph by G. Chaloupka.

Territory, before returning to Perth (Thomas 1904a, Hartert 1905, Whittell 1954, Storr 1966, Gray 2003, Chadwick 2008). On this northern Australian expedition, Tunney obtained the first specimens of various mammals previously unknown to science, including the small dasyurid marsupial *Antechinus bellus* (Thomas, 1904a), the rats *Rattus tunneyi* (Thomas, 1904a) and *Rattus colletti* (Thomas, 1904c), and two larger mammals, both kangaroos—the Black Wallaroo *Macropus bernardus* (Rothschild, 1904) and Rothschild's Rock-Wallaby *Petrogale rothschildi* (Thomas, 1904b). Tunney also collected what were to become the type specimens of several other then-undescribed mammal taxa known by a few other museum specimens at the time, including the small dasyurid marsupial *Phascogale pirata* Thomas, 1904a; the West Kimberley and Northern Territory subspecies of the wallaroo (*Macropus robustus woodwardi* Thomas, 1901, and *M. r. alligatoris* Thomas, 1904a, respectively); and the Arnhem Land subspecies of the Nabarlek or Pygmy Rock-Wallaby, *Petrogale concinna canescens* Thomas, 1909.

Despite the importance of Tunney's mammalogical collections, no full report on these materials has ever been published. The most important account is M.R. Oldfield Thomas' (1904a) preliminary discussion written after receipt and early review of Tun-

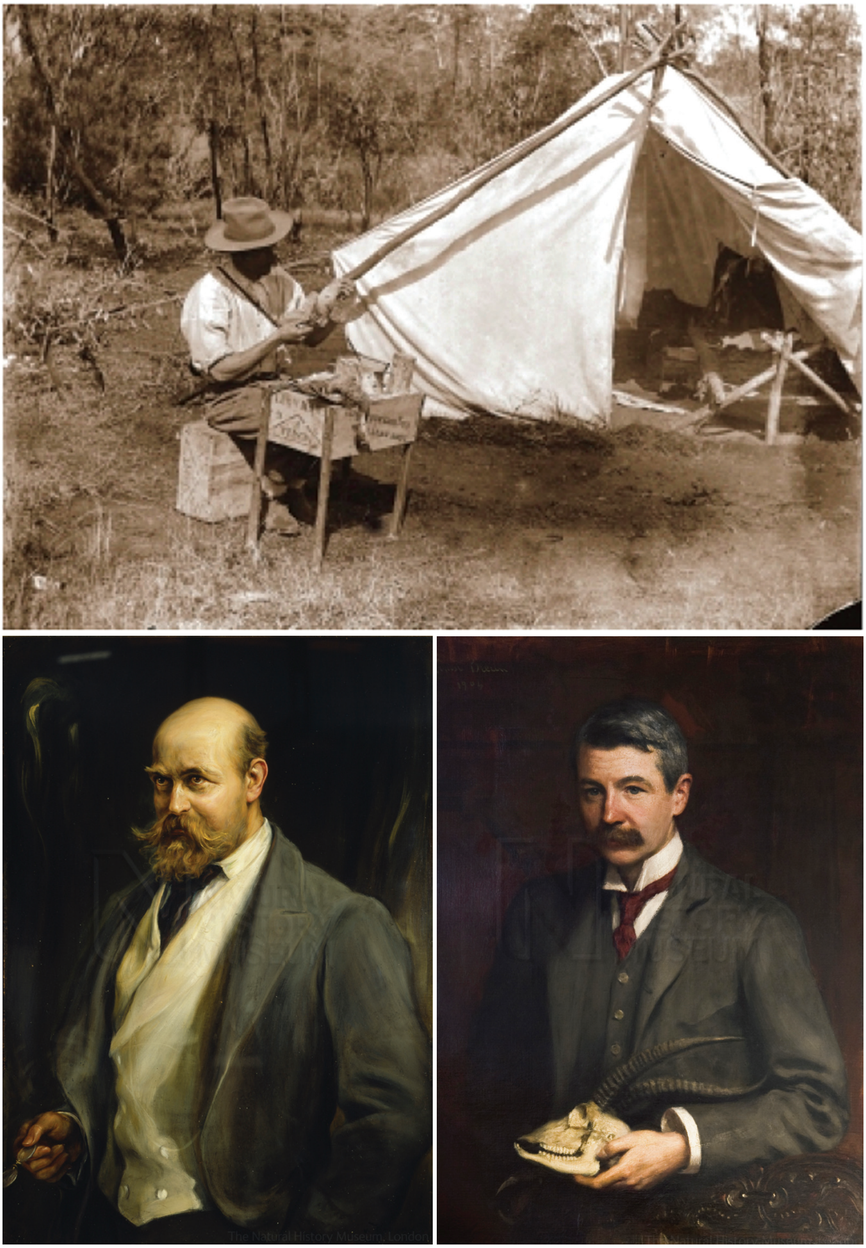


Figure 3. *Dramatis personae*. Clockwise from top: Australian natural history collector John T. Tunney (1871–1929), preparing specimens on the northern Australian expeditionary efforts during which his *Zaglossus* specimen was collected; M.R. (Michael Rogers) Oldfield Thomas (1858–1929), mammal taxonomist at the British Museum (Natural History), London, who studied the Tunney *Zaglossus* specimen; Lord L. (Lionel) Walter Rothschild (1868–1937), eccentric collector and naturalist who used his family fortune to amass a very large personal scientific collection, which became the Zoological Museum at Tring and included the Tunney *Zaglossus* specimen. Tunney portrait courtesy of the Western Australian Museum, Perth; Rothschild and Thomas portraits courtesy of the Natural History Museum, London.

ney's material received at the Tring Museum. (The Tunney collection was transferred, along with the rest of Rothschild's mammal collections, from Tring to the Natural History Museum, London, in 1939 following Rothschild's death in 1937.) One of the most important Tunney specimens that was never critically reported is what appears to be a north-western Australian specimen of *Zaglossus* collected in 1901, which we discuss here. This specimen challenges current thinking about the timing of extinction of the genus in Australia and offers new insight into northern Australian biogeography and the ecology of this critically endangered monotreme lineage.

Methods

Museums

Specimens discussed in this paper are stored in the collections of the American Museum of Natural History, New York , USA (AMNH); the Natural History Museum, London, UK (BMNH); the Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts, USA (MCZ); the Museum Zoologicum Bogor, Cibinong, Indonesia (MZB); the National Museum of Natural History, Smithsonian Institution, Washington, D.C., USA (USNM); and the Western Australian Museum, Perth, Australia (WAM).

Results

The Kimberley Zaglossus specimen

During a visit to the Natural History Museum, London, in 2009, the first author studied a museum skin of *Zaglossus bruijnii* (BMNH 1939.3315; Figures 4–9), bearing original tags from John T. Tunney, stored among supposedly unprovenanced specimens of *Zaglossus*. This skin also has an associated cranium, mandibles, and distal right forelimb elements, which were extracted from the study skin early in the twentieth century (see below). The tags record the collection of this specimen from Mount Anderson, an inland locality in the West Kimberley region of north-western Western Australia, on 20 November 1901 (Figure 7).

Tunney's typical tags (used by Tunney and some other collectors from the Western Australian Museum in Perth) were strong card tags preprinted with the following categories (see figure in Chadwick [2008]): (on one side of the card) "No." (i.e., field number), "Date" (i.e., date of collection), "Sex" (i.e., male or female), "Colour of Iris" (i.e., eye color, used by Tunney for birds, but generally not for mammals), "Colour of Leg" (used by Tunney for birds, but not for mammals), "Name" (given by Tunney either as the scientific or common name of the species), "Loc." (i.e., the collection locality); and (on the other side of the card) "Nature of Place where caught" (i.e., habitat), "Rare or Common" (i.e., an indication of abundance), "H + B." (i.e., length of head and body), "T." (i.e., length of tail), and "H. F." (i.e., length of hind foot).

Tunney's tag, written in his characteristic handwriting, and tied with thick sturdy string to the right hindfoot of the specimen (Figures 4 and 7), bears an original field number (347), a date ("20 Nov. 1901"), reports the specimen's collection from "conglomerate hills" ("Nature of Place where caught") at "Mt Anderson (W Kimberley)" (locality), and indicates that it was "Rare" (a classification only occasionally reported on his mammal tags). Tunney originally marked the sex of the animal as female ("♀"), which was later corrected in pen on the tag to "young ♂" (reflecting a mammal difficult to sex, as echidnas can be). Tunney left the "Name" field blank on his tag, which is somewhat unusual—he usually reported a scientific or common name on his mammal tags. This may indicate that Tunney was uncertain exactly what species he had before him. Tunney also usually reported standard length measurements on tags for his mammal and bird specimens (i.e., head-body, tail, and hind foot lengths), but in this case he gave the measurements of the specimen only as "21 inches over back from tip to tip" and "under measurement 20 inches", indicating a mammal for which the head-body and tail lengths were unusually difficult to measure. The total study skin, as now prepared, still measures about 21 inches measured over the dorsum and 20 inches measured along the underside. The specimen also bears a smaller field tag, worn and dirty, that is made of cloth-like paper, attached to the right hindleg with wire, and bearing only the field number, "N 347" (Figure 7).

The specimen is a well-made study skin, with the hindlegs directed posteriorly and the forelegs folded back against the underside (Figure 4). It was originally prepared with the skull and parts of the limbs retained intact inside the skin (the skull and right forelimb were apparently later removed from the skin and prepared in England—see below). The pelage is quite pale brown, and the specimen is rather sparsely furred, with mostly white spines, and has spines invading the sides of the belly, claws only on the middle three digits of both forefeet and both hindfeet, and hindleg spurs.

This specimen was misidentified as a Short-beaked echidna before its skull was extracted and studied. Identified by field number (347), it was listed as "*Echidna aculeata*" (i.e., *Tachyglossus aculeatus*) when it was sent from Australia to Rothschild at Tring, and identified as such in a letter dated 25 April 1904 sent by Bernard Woodward to Oldfield Thomas in London, discussing details of the mammal specimens collected by Tunney (Figure 8). Soon after its arrival at Tring, ectoparasite specimens taken from this skin formed the basis for the description of a new species of tick, *Amblyomma australiense*, by Neumann (1905), and a new species of flea, *Echidnophaga liopus*, by Jordan and Rothschild (1906). Both of these publications still listed the identity of the host as "*Echidna aculeata*" (these parasitological discoveries are discussed further below).

Though the identification of this specimen as *Zaglossus* has gone unreported in the literature until now, we are not the first researchers to notice that this specimen provides a modern record for *Zaglossus* from Western Australia. Oldfield Thomas, arguably the greatest mammalogical taxonomist of all time, examined Tunney's specimens when they arrived in England, and made notes that indicate he understood Tunney's

Figure 4. Study skin of the Kimberley *Zaglossus* (BMNH 1939.3315), bearing the original field tags of John T. Tunney. From top: dorsal, ventral, right lateral, and left lateral views. Scale bar = 5 cm.

specimen was a Kimberley *Zaglossus*. Thomas would have known that the Tunney skin in question was a *Zaglossus* rather than a *Tachyglossus* the moment he saw it, even if Rothschild was unaware of this. Thomas apparently removed the skull (the skull, by its lack of sutural ossifications, shows the animal to be a nearly mature subadult) and the bones of the right forelimb (articulated radius, ulna, and forefoot) from the study skin. The skull is intact apart from some missing basicranial fragments and is labelled "Kimberley" in Thomas' handwriting on the palate (Figure 5); it also bears two labels in Thomas' handwriting, one identifying the specimen as an "imm[ature]. Zaglossus, coll[ected by]. Tunney" and the other noting that the skull compares favorably to an immature specimen of *Z. bruijnii* from Fakfak (western New Guinea) preserved in the Zoological Museum in Amsterdam. The dentary is also marked in ink with the word "Kimberley" in Thomas' handwriting (Figure 5). Thomas labeled the forelimb "Zaglossus Kimberley N.W.A. (Tunney)" (i.e., N.W.A. = north-western Australia) (Figure 6). These labels indicate to us that Thomas recognized that the specimen was indeed a *Zaglossus*, and that he was satisfied that it had been collected by Tunney in the Kimberley region of Australia. We suspect that Thomas extracted the right forelimb elements from the skin of the specimen to see if its humerus was preserved. He would have wanted to compare it to the humeri of the large fossil echidnas that had previously been described from Australia; the holotypes of two large echidna taxa described from the Australian Pleistocene (*Echidna owenii* Krefft, 1868, *Echidna ramsayi* Owen, 1884, now classified in the genus *Megalibgwilia*) are right humeri (Mahoney and Ride 1975). Only the radius, ulna, and distal elements of the manus were present in the skin, however. An x-ray of the skin confirms that the right forelimb and skull of this specimen were indeed extracted from the skin, with their impressions, still evident inside the skin, closely matching the osteological elements.

It is not clear on what date Thomas extracted the skull and forelimb of the Tunney specimen, but he may have written the accompanying labels after 1907 (or replaced them with newer labels if he had written them earlier), because until at least 1907 Thomas was apparently under the impression that *Acanthoglossus* (rather than *Zaglossus*) was the correct generic name for the long-beaked echidnas (Thomas 1907a, 1907b), though usage of this name wavered at the time. Universally accepted usage of *Zaglossus* Gill 1877, which predates the generic synonyms *Acanthoglossus* Gervais 1877a and *Proechidna* Gervais 1877b (names which had previously enjoyed wide usage), followed from Allen's (1912) influential monograph on the genus, though earlier authors, including Rothschild, had regularly pointed out that *Zaglossus* was the earliest generic name (e.g., Gill 1885, Palmer 1895, Coues 1895, Rothschild 1905a). In any case, Thomas died in 1929 (Thomas and Tunney both passed away in June 1929) without discussing Tunney's *Zaglossus* specimen in any publication, which is surprising considering that Thomas was such a prolific author of papers on mammals (he produced approximately 1100 publications on mammal taxonomy, naming 2900 mammal taxa [Hill 1990]). We can identify several reasons why Thomas may not have prioritized publishing a note about this specimen. The most important might be Rothschild's eccentric penchant for echidnas (along with kangaroos—similar to his personal interest in ratites amongst his ornithological collections [M. Rothschild 1983]), which may have excluded Thomas from freely publishing on these holdings at Tring. Rothschild permitted Thomas to publish many papers based on Tring mammals, but Rothschild was very fond of kangaroos and echidnas, keeping various kinds alive at his family's estate (M. Rothschild 1983), and it seems he preferred to publish reviews

Figure 5. Cranium and dentaries of the Kimberley *Zaglossus* (BMNH 1939.3315). From top: dorsal view of the cranium, dorsal view of the dentaries, ventral view of the cranium, ventral view of the dentaries, and, at bottom, close-up views of Thomas' labeling of "Kimberley" on the specimen's palate (left) and dentary (right). Scale bar = 20 cm.

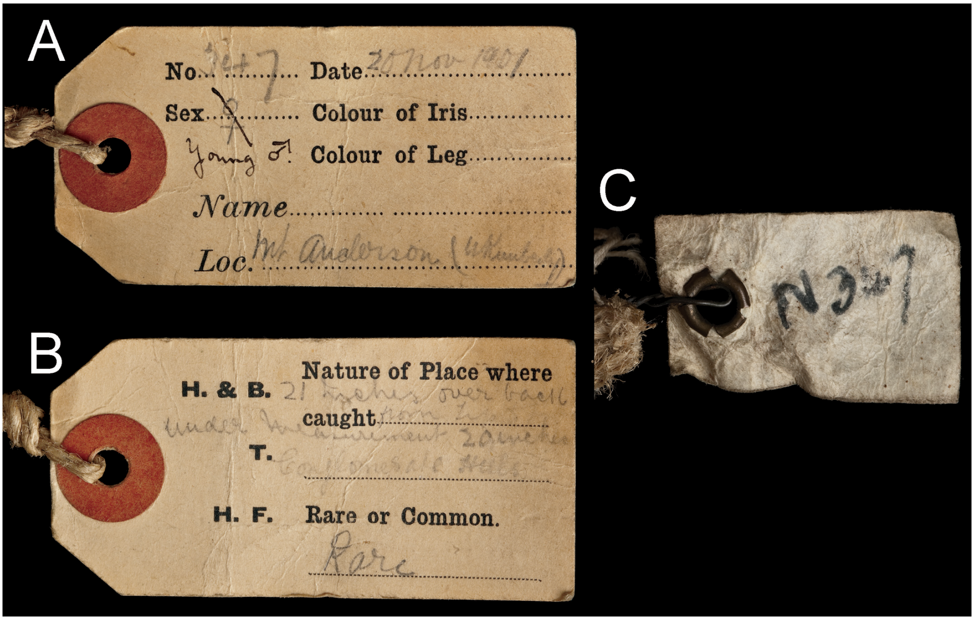
of Tring's kangaroos and echidnas on his own, except perhaps where Thomas chose to name them in Rothschild's honor (as in the case of *Petrogale rothschildi* Thomas, 1904b). This may have suited Thomas fine, as Rothschild's publications on kangaroos and echidnas were often premature and incompletely prepared and reasoned (e.g., Rothschild 1903, 1904, 1905b, 1905c, 1907) (with some important exceptions, such as the tree kangaroo monograph published by Rothschild and Dollman 1936), in general falling far short of Thomas' authoritative command of these groups, which was established early in Thomas' career (Thomas 1888). Another reason that Thomas did not publish on the specimen could be that it was not clearly describable as a new taxon (the Thomasian special focus), the single specimen available being indistinguishable from specimens of *Zaglossus bruijnii* from western New Guinea. With the wealth of clearly new mammal taxa Thomas had available to describe, he may have set this echidna specimen to the side, hoping that additional Australian specimens, especially a mature specimen or a series, might become available so that he could better understand the characteristics of the Kimberley *Zaglossus*.

While Thomas' impressions as to the identity of the Tunney *Zaglossus* specimen seem clear, it is not clear whether Rothschild was aware that the specimen was a *Zaglossus*, or if so, whether he accepted its authenticity. Rothschild published several observations on echidna taxonomy (Rothschild 1892, 1905a, 1913), including one co-authored with Thomas (Thomas and Rothschild 1922), and one in which Thomas abstained or was excluded from authorship (Rothschild, in Thomas and Rothschild 1922). Like Thomas, Rothschild never mentioned Tunney's *Zaglossus* specimen in a publication before he died in 1937. In 1939, the Tring mammal collection was transferred to the BMNH, and most of it is now housed at South Kensington. This is when the echidna specimen was given the BMNH accession number 1939.3315. The BMNH Mammalogy accession register only mentions a skin for this specimen, raising the possibility that the skull (which confirmed the identity of the specimen beyond doubt to Thomas) had been retained on loan by Thomas at South Kensington, perhaps to be described one day, and was only reunited with the skin on its permanent arrival to the BMNH in 1939. Importantly, the Tunney *Zaglossus* specimen bears a third tag, added to the right hind leg either at the Tring Museum or when the specimen arrived with the Rothschild Bequest (Figure 9). This tag disputes the Tunney association of the specimen, noting, "other label apparently does not belong to this specimen" on one side, and "*Zaglossus bruijni goodfellowi* see Nov. Zoologicae vol 20, 1913" on the other side. The author of this label has been identified as Fred Young, who was a taxidermist at the Tring Zoological Museum, by Effie Ward, Tring librarian. The 1913 paper mentioned on this tag (Rothschild 1913) discusses *Zaglossus* specimens at BMNH and Tring that Rothschild was aware of in 1913, and lists them by taxon, age, sex, and preparation. The Tunney *Zaglossus* specimen, being an immature male skin (and, possibly, extracted skull) is not clearly associable with any specimens identified in this paper. The paper in question provides a taxonomic key for *Zaglossus* identification, and we take the tag's reference to this *Novitates Zoologicae* paper to refer to this key. In effect, our understanding is that the person who wrote the message on this

Figure 6. Articulated right forelimb elements of the Kimberley *Zaglossus* (BMNH 1939.3315). Associated label notes "Zaglossus Kimberley N.W.A. (Tunney)" in Thomas' handwriting. Ventral view above, dorsal view below. Scale bar = 5 cm.

third tag resorted to using Rothschild's key, and discovered that the Tunney specimen keys out to Rothschild's concept of "*Zaglossus bruijnii goodfellowi*", a taxon then considered endemic to the island of Salawati (= Salwaty, a continental island off the coast of western New Guinea) in Rothschild's taxonomic scheme. We suggest that, on account of this specimen's keyed identification, the writer of this last skin tag seems to have discounted the possibility that Tunney's original tag details could be correct, and that this was done without any critical examination of the background and data associated with this specimen or consideration of Thomas' extraction and examination of the skull and forelimb.

From the beginning of our investigations regarding this specimen, we have of course considered whether its original Tunney field tags truly belong to it, or whether they might have been transferred to it by mistake, as the latest tag associated with the specimen implies. However, several lines of evidence point to the fact that Tunney's



No. 347 Date 20 Nov 1901
Sex ~~♀~~ Colour of Iris
Young ♂! Colour of Leg
Name
Loc. Mt Anderson (Kimberley)

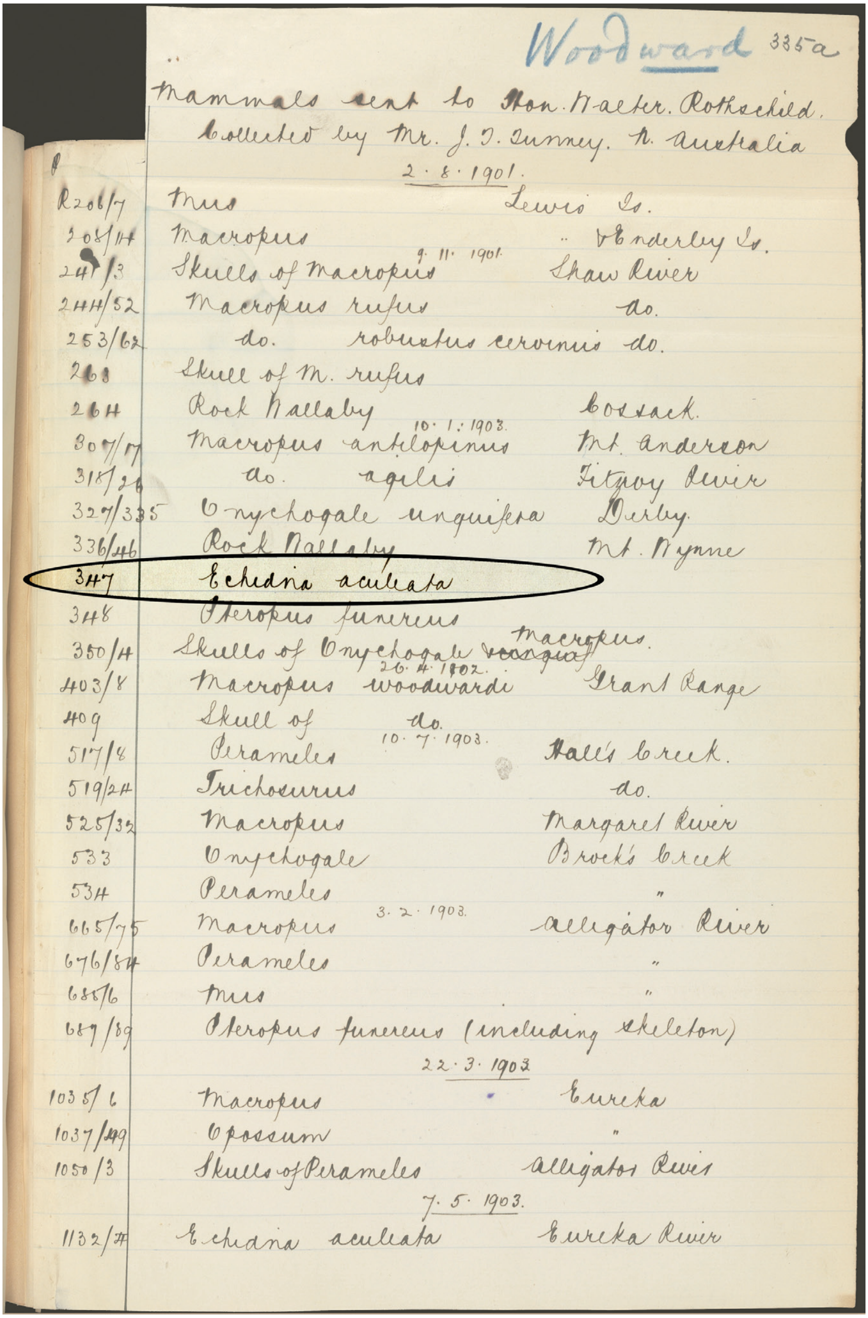
H. & B. 21 inches over back
Nature of Place where caught [illegible]
under measurement 20 inches
T. Conglomerate Hills
H. F. Rare or Common.
Rare

N 347

Figure 7. John Tunney's original field labels attached to the skin of BMNH 1939.3315. **A** front of card skin tag (attached with sturdy twine to right ankle of study skin) bearing original data, providing the specimen's field number, date of collection, age and sex, and locality **B** back of same card skin tag bearing original data, detailing the specimen's measurements, context of collection, and abundance **C** cloth tag bearing original field number ("N 347"), wired tightly to right ankle of study skin. See text for details.

tags were always associated with an echidna, and that this tag was not likely to have been transferred by mistake from a *Tachyglossus* specimen to a *Zaglossus* specimen.

In addition to Tunney's original tag, two sources—correspondence between Perth and London/Tring, and several parasitological publications—establish that Tunney's specimen (his field number 347) was definitely an echidna, such that we are certain that its original tags were not transferred by mistake from a specimen of some other kind of animal. The specimen was mentioned in the original export paperwork, and discussed in parasitological literature, as *Tachyglossus aculeatus* (originally as *Echidna aculeata*), and its tag data, including the difficulty of sexing and the style of measurement, suggest an echidna. Thus the only conceivable mix-up could involve a *Tachyglossus* specimen collected by Tunney, with tags that became disassociated from the original specimen, and later erroneously attached to a specimen of *Zaglossus bruijnii* that came from New Guinea. However, we believe that Tunney's original tags from Mt. Anderson are authentically associated with this *Zaglossus* specimen for several reasons. First, the nature and timing of any putative specimen switch is difficult to understand. Tunney collected only a few *Tachyglossus* during his expeditions in northern Australia, and these seem to be accounted for in the WAM and BMNH collections, and we note with interest that these tags were written somewhat differently. For example, on the tag of the only Tunney-collected *Tachyglossus* at BMNH, Tunney provided the name



Woodward 335a

Mammals sent to Hon. Walter. Rothschild.
Collected by Mr. J. T. Tunney. W. Australia

	2 · 8 · 1901.	
R206/7	Mus	Lewis Is.
208/14	Macropus	.. & Enderby Is.
	9 · 11 · 1901.	
241/3	Skulls of Macropus	Shaw River
244/52	Macropus rufus	do.
253/62	do. robustus cervinus	do.
263	Skull of M. rufus	
264	Rock Wallaby	Cossack.
	10 · 1 · 1903.	
307/17	Macropus antilopinus	Mt. Anderson
318/26	do. agilis	Fitzroy River
327/335	Onychogale unguifera	Derby.
336/46	Rock Wallaby	Mt. Wynne
347	Echidna aculeata	
348	Pteropus funereus	
350/4	Skulls of Onychogale ~~unguifera~~ macropus.	
	26 · 4 · 1902.	
403/8	Macropus woodwardi	Grant Range
409	Skull of do.	
	10 · 7 · 1903.	
517/8	Perameles	Hall's Creek.
519/24	Trichosurus	do.
525/32	Macropus	Margaret River
533	Onychogale	Brock's Creek
534	Perameles	"
	3 · 2 · 1903.	
665/75	Macropus	Alligator River
676/84	Perameles	"
685/6	Mus	"
687/89	Pteropus funereus (including skeleton)	
	22 · 3 · 1903	
1035/6	Macropus	Eureka
1037/49	Opossum	"
1050/3	Skulls of Perameles	Alligator River
	7 · 5 · 1903.	
1132/7	Echidna aculeata	Eureka River

Figure 8. Specimen export list. A list of specimens shipped from Perth to Tring included in a letter, dated 25 April 1904, from Bernard Woodward at the Western Australian Museum to Oldfield Thomas, detailing the transfer of Tunney specimens to Rothschild at Tring. The list includes his number 347 (now BMNH 1939.3315), an echidna identified as "*Echidna aculeata*" (i.e. *Tachyglossus aculeatus*) prior to Thomas' examination of the specimen in London, where he realized it is a *Zaglossus*; we have circled and highlighted this entry in the list.

of the species as "Echidna" (left blank on the *Zaglossus* tag), and stated its abundance as "numerous" ("Rare" in the case of the *Zaglossus* specimen). Second, such a switch would have to have taken place after the echidna specimen arrived at Tring (in 1903-1904), not earlier in Perth, because no *Zaglossus* specimen was available in Perth—Tunney never collected in New Guinea, and the WAM has apparently never had a modern *Zaglossus* specimen in their mammal collection (as judged by details from the WAM accession register). But any switch must have already happened by the time that Thomas first inspected the Tunney specimens sent to Tring, as it seems clear that Thomas accepted that Tunney's specimen number 347 was a *Zaglossus* collected in the Kimberley region once he was able to make confirming examinations of its skull and forelimb. Thomas had already published one report on Tunney's 1903-1904 shipment to Tring by 1904 (Thomas 1904a), indicating that any switch that was unbeknownst to Thomas must have occurred at the very point of arrival at Tring. This is not impossible, but it is very difficult to imagine, especially in light of Rothschild's clearly very active interest in all incoming echidnas. The Tunney skin came with two original tags, a small tag with field number wired to the leg, and a heavier card tag tied to a leg with strong twine. Both tags would need to have been removed from a *Tachyglossus* specimen, and reattached by mistake to one of Rothschild's few and precious *Zaglossus* skins at Tring, which is unlikely. A decade later, there were still only 13 *Zaglossus* specimens identified in the Tring collection, and it is clear from Rothschild's publications that these were highly valued and carefully curated by Rothschild (Rothschild 1913). In summary, it is highly implausible to envision a switch-up in Perth or in Tring that could explain how tags from an Australian *Tachyglossus* specimen would have become mistakenly associated with a specimen of *Zaglossus* that originated from New Guinea.

Another important consideration is the size of the animal measured by Tunney. Tunney's tag gives the specimen's total length measurement as 21 inches (= 533 mm), and this value matches very well the size of the study skin to which it is currently attached, as measured with a flexible measuring tape. This body size measurement is consistent with either a subadult *Zaglossus* (i.e., like the specimen to which it is attached) or an unusually large adult *Tachyglossus*. Total length measurements of 539-1000 mm have been reported for adult *Z. bruijnii* (Allen 1912, Rothschild 1913). Extremely large *Tachyglossus* specimens only rarely reach the lower limit of this size range. Typical lengths for adult *Tachyglossus* are in the range of 300-450 mm (Wood Jones 1923, Menkhorst and Knight 2001, Augee 2005). An unusually large and aged male *T. aculeatus* (USNM 283961) from Groote Eylandt, Northern Territory, measuring 555 mm in total length (original field measurements), approximates a maximum body size for the genus. This specimen is by far the largest *Tachyglossus* in the USNM collection (of about 40 specimens), and is among the very largest and most robust of *Tachyglossus* specimens in world museums by skin and skull size (K. Helgen and G. Perri, in litt, 2012). In summary, only the largest *Tachyglossus* outliers on record could match the size of the echidna reported on Tunney's tag, Tunney's measurements are consistent with the dimensions of a *Zaglossus* nearing cranial maturity, and Tunney's measurements are a match for the actual dimensions of the specimen to which his tags are attached.

Rothschild
Museum

BRIT MUS. 1939.3315.

Other label apparently does not
belong to this specimen

Rothschild Bequest

Zaglossus bruijni
goodfellowi
See Nov. Zoologicae Vol 20
1913

Figure 9. Non-original tag (views of front and back) added at Tring or BMNH, and apparently bearing the handwriting of Tring taxidermist Fred Young. The tag bears a note suggesting that the original labels must be incorrect because the specimen corresponds to Rothschild's concept of *Zaglossus bruijni goodfellowi,* then considered endemic to the Indonesian island of Salawati, following his 1913 key (Rothschild 1913). The note seems to indicate that knowledge of the importance of this specimen has been obscured since or before the specimen's transfer from Tring to BMNH, as it was assumed by Young to be a mistake.

The specimen's locality

The tag locality provided by Tunney for the *Zaglossus* specimen is "Mt. Anderson, W Kimberley." First named in 1879 by Alexander Forrest in his "North-West Expedition" from DeGrey to Darwin (Forrest 1880), Mount Anderson is situated near the Grant Ranges, along the Fitzroy River about 90 km southeast of Derby at approximately 18°02'S, 123°56'E (Storr 1966). In early October, Tunney sailed from Port Hedland to Derby, where he arrived about October 11, and he collected at and in the vicinity of Mount Anderson from the end of October to late November (Storr 1966), during which time (20 November 1901) the echidna was collected.

Inland areas of the West Kimberley were settled by white Australians for sheep and cattle pastoralism in the aftermath of Forrest's surveys (since 1881) but the region has historically been very sparsely inhabited by both European and Aboriginal communities (Bolton 1952, Speck 1964) and remains so today. Tunney's visit to the area took place in the early decades of the region's utilization for livestock. It was the first reconnaissance for mammals in this region, and the immediate area remains zoologically little known today. On its tag, Tunney characterized the habitat of the *Zaglossus* specimen as "conglomerate hills", suggesting that the animal was found in a rocky area, where echidnas would surely make their burrows. The only other mammals obtained by Tunney at Mount Anderson were specimens of the large macropodids *M. antilopinus* and *M. robustus* (specimens at BMNH). Birds collected by Tunney at Mount Anderson included the Varied Lorikeet (*Psitteuteles versicolor*), Red-backed Fairywren (*Malurus melanocephalus cruentatus*), and Brown Goshawk (*Accipiter fasciatus cruentus*) (specimens in the AMNH ornithological collections).

The distribution of *Zaglossus* in New Guinea is today centered on montane tropical rainforests (but open areas of subalpine grassland are also prime habitat, and some areas of lowland forest and limestone country are also utilized). It might thus be expected that the last areas of survival for *Zaglossus* populations in the Kimberley would be in the region's many tiny and scattered evergreen rainforest fragments, which are largely distributed to the north of the Fitzroy River (McKenzie et al. 1991). However, the Mount Anderson area is reasonably well watered (Registrar et al. 1902), and its inaccessibility, sparse human population, and the availability of rugged, steep, rocky areas may explain its importance in hosting a late-surviving remnant population of *Zaglossus* in Australia. Six decades after Tunney's visit, in their review of "Lands of the West Kimberley Area", Speck et al. (1964: 191) discussed the Grant Ranges-Mt. Anderson area under their classification of "inaccessible country" and "inaccessible pasture land", describing it thus:

"*Environment. The rugged mountain ranges, elevated plateaux, steep hills, and associated valleys have a complex geological pattern with quartzites, sandstones, shales, slates, schists, basalt, dolerite, and limestone. It is mostly rough, inaccessible, unproductive, and undeveloped. Soils are varied but characteristically skeletal with extensive outcrop.*

Composition. Most of the lands are within the higher-rainfall area and the vegetation of these parts is an open woodland with moderate shrub layer and grassy ground storey of curly spinifex pasture type.... In the lower-rainfall parts the vegetation is more stunted and open and the grass layer is hard spinifex... Grasses other than spinifex are poorly represented. Edible top feed is also scanty.

Pastoral Value. Only where these lands are adjacent to better country is utilization possible. They are more likely to have a nuisance value. They are generally well watered and therefore provide a hideout for scrub bulls, increasing the difficulty of herd management and mustering. At best it will remain extremely poor pastoral country.

Reaction to Grazing, and Management. Much of the area is unstocked and there is little or no evidence of pasture degradation or denudation except in isolated, restricted areas adjacent to watering points."

A visual representation of the vegetation currently present around Mount Anderson today can be seen with mapping resources available in the online resource *Atlas of Living Australia* (http://spatial.ala.org.au/), which indicates that present vegetation is dominated by "Acacia open woodlands" but also includes some small areas of "Rainforest and vine thickets." We suggest that these latter habitats (rainforest, vine thickets) would be relevant remnant habitat for *Zaglossus*, and that these habitats were likely more expansive at the time of Tunney's visit to the region well over a century ago in 1901.

Relatively inaccessible and sparsely inhabited rocky areas provide some of the most important remaining areas of occurrence for *Zaglossus* in New Guinea, on the southern and northern slopes of the Central Cordillera, and in limestone country throughout the "Bird's Neck" region in the west of the island. That similarly remote and sparsely inhabited areas of northern Australia apparently sheltered at least one remnant population of *Zaglossus* into the twentieth century is an astonishing realization, and serves as strong encouragement for wildlife researchers to undertake surveys of remote candidate areas of northern Australia with the goal of establishing whether *Zaglossus* may still exist in any rainforest fragments or rugged gorges across the Kimberley.

Taxonomy, biogeography, and the Kimberley *Zaglossus*

We confidently identify the Kimberley specimen of *Zaglossus* as the Western Long-Beaked Echidna, *Z. bruijnii*, otherwise known only from the western portion of the island of New Guinea, which it matches in size, cranial features, claw number, and pelage features. *Zaglossus bruijnii* is the only echidna taxon that typically lacks claws on the first and fifth digits of all feet (the claw conformation seen in the Kimberley specimen), and always lacks a claw on the first digit of the hindfeet (a claw is always present on the first digit of the hindfoot in *Z. bartoni*) (Flannery and Groves 1998). As Oldfield Thomas noted, the subadult skull of the Kimberley specimen is a good match in overall size and shape for specimens of *Z. bruijnii* that are of equivalent age (as judged by cranial development, in terms of robustness and sutural ossification). The relatively short and modest (rather than long and heavy) growth of fur in between the spines on the dorsum, relatively pale brown (rather than blackish brown) pelage, presence of some black-tipped spines on the dorsum, and presence of visible spines on the underside, are external features that in combination are typical only of lowland populations of *Z. bruijnii*, such as those recorded from the land-bridge island of Salawati, the adjacent Vogelkop coast at Sorong, and the Fakfak and Charles Louis Ranges in the Bird's Neck region (skins especially at the BMNH, MCZ, and MZB).

The Western Long-beaked echidna, *Zaglossus bruijnii*, occurs in western New Guinea in habitats from as low as sea level up to the top of the highest peaks in the Vogelkop Peninsula—in the Tamrau and Arfak Ranges (to 2900 m)—and from the land-bridge island of Salawati in the west, to the "Bird's Neck region" of New Guinea in the east, extending as far east as the Fakfak Range and possibly the Charles Louis Ranges on the western edge of the Central Cordillera (in the south) and possibly to the eastern shores of Geelvink (= Cenderawasih) Bay (in the north) (Rothschild in Thomas and Rothschild 1922, Van Deusen and George 1969, Flannery 1995a, 1995b, Flannery and Groves 1998, Aplin et al. 1999, Helgen 2007). The Eastern long-beaked echidna, *Zaglossus bartoni*, does not usually occur in habitats below about 1000 m, with low-elevation records known only in far south-eastern New Guinea at Collingwood Bay (down to 0–200 m) and in the vicinity of Haia on the south side of the Central Cordillera in east-central New Guinea (down to about 500–600 m).

Though previously recorded only from western New Guinea, *Zaglossus bruijnii* is the *Zaglossus* taxon occurring in closest geographical proximity to the Kimberley region, and is the only *Zaglossus* regularly documented in lowland contexts. Given that similar relevant habitats, including sparsely inhabitated limestone country and remnant rainforests, are to be found across the Kimberley region, it does not surprise us that the modern Kimberley representative of the genus should be *Z. bruijnii*. We envision a late Pleistocene distribution of *Z. bruijnii* that extended across rugged, rocky country and rainforests along the western parts of the Sahul Shelf, comprising much of the area between Australia and New Guinea that has been inundated by the Arafura Sea since the terminal Pleistocene, thus connecting the restricted Recent range from the Vogelkop Peninsula in the north to the Kimberley region and Arnhem Land in the south.

Ectoparasites from the Kimberley *Zaglossus*

The Kimberley *Zaglossus* specimen, while overlooked in mammalogical literature, has been referenced with surprising regularity in parasitological papers. It is the "symbiotype" (i.e., host to the type series; Frey et al. [1992]) for two ectoparasite taxa, the flea *Echidnophaga liopus* Jordan and Rothschild, 1906; and the ixodid tick *Amblyomma australiense* Neumann, 1905. In all of the parasitological literature in which Tunney's specimen is referenced, the specimen is mistakenly referred to as a *Tachyglossus* (e.g., Neumann 1905, Jordan and Rothschild 1906, Robinson 1926, Roberts 1953, Dunnet and Mardon 1974, Keirans 1982), obscuring until now the correct host association of these parasites.

The flea *Echidnophaga liopus* is so far documented firmly only from Tunney's *Zaglossus* specimen and is unknown to date in *Tachyglossus*. Other *Echidnophaga* specimens attributed to *E. liopus* in literature, which come from Indian rodents (Rothschild and Jordan 1906), seem more likely to represent a distinct Asian species (Dunnet and Mardon 1974). Out of interest, we note that two of the most commonly recorded and host-specific fleas of *Tachyglossus aculeatus*—*Echidnophaga ambulans* and *Bradiopsyllae echidnae* (Dunnet and Mardon 1974)—have not been recovered from Tunney's specimen.

Neumann (1905) originally described the Australian tick *Amblyomma australiense* based on examplars in the N.C. Rothschild collection taken from Tunney's *Zaglossus* specimen (Robinson 1926, Roberts 1964, Keirans 1982). Apart from this original record from Tunney's *Zaglossus*, a few other records of occurrence are available for this apparently northern Australian tick; Taylor (1913) and Roberts (1964) recorded it from *Tachyglossus* at Townsville in Queensland, Robinson (1926) recorded it from a unidentified large lizard at Darwin in Northern Territory, and Roberts (1964) recorded it from an "unspecified snake", also at Darwin. The closely related tick *Amblyomma echidnae* Roberts, 1953, considered by some to be conspecific with *A. australiense* (but held as distinct, pending critical study, by Guglielmone et al. [2009]) is apparently known to date only from Australian *Tachyglossus* (Roberts 1953, 1964, 1970).

So far, none of the ectoparasites recorded from Tunney's *Zaglossus* have been reported from New Guinea *Zaglossus*, but very little is known about the parasites of

Long-beaked echidnas. We are aware of only two ectoparasites definitively recorded from New Guinea *Zaglossus*. The tick *Bothriocroton oudemansi* (Neumann, 1910) has been reported from *Z. bruijnii* at Fakfak, and from *Z. bartoni* in the Central Cordillera (Beati et al. 2008). The tick *Ixodes zaglossi* Kohls, 1960, was described from a specimen of *Z. bartoni* from the Wissel Lakes at the western end of New Guinea's Central Cordillera. Whether either of these ticks is the same taxon as *Ixodes acanthoglossi* Lucas, 1878 (regarded as an indeterminable *nomen dubium* by Beati et al. [2008]), originally described as a parasite of *Z. bruijnii* in the Arfak Mountains, has not been determined.

Possible Aboriginal familiarity with *Zaglossus* in the Kimberley

The Late Quaternary occurrence of Long-beaked echidnas in northern Australia is widely accepted on the basis of a compelling Aboriginal rock art illustration (Figure 2), from an undisclosed Arnhem Land locality, that accurately depicts *Zaglossus* (Murray and Chaloupka 1984). This illustration, usually considered Late Pleistocene in age, has been often reproduced in reference books on Australian mammals (e.g. Johnson 2006, Tyndale-Biscoe 2005), and demonstrates Australian Aboriginal familiarity and interaction with Long-beaked echidnas.

It is possible that Aboriginal Australians also interacted with *Zaglossus* much more recently. In 2001, years before we became aware of the Australian provenance of the *Zaglossus* specimen reported here, one of us (Kohen) recorded a potential example of living memory of *Zaglossus* while engaged in field work in the East Kimberley. His account of the experience is as follows:

While conducting faunal surveys at Faraway Bay, I was accompanied by an Aboriginal woman in her fifties who belonged to the Miriwoong Gadjerong tribe. Their territory extends from the coast inland in the region close to the Western Australia-Northern Territory border. In this part of Australia, tribal affiliation is passed down through the female line. However, Faraway Bay is on her father's country, and he belonged to the Kwini tribe.

While walking close to the coast, we found a scat. On asking my informant what she thought it was, she correctly identified it as an echidna scat, which she referred to as "porcupine". As only one echidna is traditionally known from Australia, I assumed that it belonged to Tachyglossus. *A few hours later we had returned to the camp and were sharing tea when she commented about the echidna scat we had found. She said that her grandmothers "used to hunt the other one". I asked her what other one, and she said that she meant a much larger echidna. She indicated its height which I estimated to be around 40 cm.*

I was intrigued, as both of her grandmothers were still alive and in their nineties. However, one had recently suffered a stroke and the other lived some distance away. When we returned to Kununurra, I had an opportunity to speak to my informant's mother. As it happened, I had a copy of Tim Flannery's 1990 paper [Flannery 1990] *on the extinct megafauna of Australia, which included a series of shadow illustrations of large Australian mammals. When I showed this to her, and asked her if she knew any of these animals, she identified the* Zaglossus. *My impression was that the animal had not been seen for a long time.*

We readily acknowledge that these kinds of informant accounts are fraught with difficulty of interpretation. However, we mention these interactions, because, like the Tunney specimen, this information from Kohen's informants could be relevant to the survival of *Zaglossus* in the Kimberley region into the twentieth century. We suggest that future efforts to investigate the recent survival of *Zaglossus* in remote northern Australia take into account evidence that may be derived from cultural sources such as rock art, living memories from Aboriginal cultures, and examination of vocabularies relevant to animal names in Aboriginal languages.

Discussion

Specimen-based evidence of recent survival of *Zaglossus* in Australia

We are sufficiently convinced by the tags and information associated with the Tunney *Zaglossus* specimen to regard it as evidence for the survival of the long-beaked echidna in the Kimberley region into the early twentieth century. We accordingly recommend that the Western Long-beaked echidna, *Zaglossus bruijnii*, be included in future faunal compilations of the modern mammal fauna of Australia (e.g., Walton 1988, Walton and Richardson 1989, Menkhorst and Knight 2001, Van Dyck and Strahan 2005), and on the long list of mammal species that have declined to extirpation, extinction, or near extinction in Australia over the past two centuries (Johnson 2006).

We realize that, despite our conclusions, summarized here, others may remain skeptical of this *Zaglossus* specimen's association with Tunney's tags. Additional studies of this remarkable specimen might include analyses of ancient DNA, stable isotopes, and trace elements to test its origins and the context of its collection. Further targeted studies of relevant Kimberley Pleistocene and Holocene subfossil assemblages (e.g. O'Connor et al. [2008], Start et al. [2012]) may also shed useful light on the late survival of *Zaglossus* in northern Australia.

Quaternary and recent extinctions

Most of Australia's remarkable Pleistocene megafauna (gigantic marsupials, reptiles, and birds) became extinct after about 50,000 years before the present (Flannery 1994, Roberts et al. 2001, Miller et al. 2005, Rule et al. 2012) following the arrival of humans to the continent. Many other mammal species declined broadly, many to the point of extinction, across their mainland Australian distributions during the Holocene (e.g., thylacine, *Thylacinus*; Tasmanian devil, *Sarcophilus*) or since the onset of European impacts in the mid-1800s (Flannery 1994, Johnson 2006). The Tunney specimen adds *Zaglossus bruijnii* to the list of mammal species that underwent dramatic declines in Australia during recent times.

Another rather unexpected recent addition to the list of Quaternary extinctions in the Kimberley region is a fruit-bat of the genus *Styloctenium*, identified by Pettigrew et al. (2008) from definitive illustrations in (Late Pleistocene?) rock art from near Kalumburu. Species of *Styloctenium* are today known only from the large Indonesian island of Sulawesi (and some of its satellites) and the Philippine island of Mindoro (Bergmans and Rozendaal 1988, Esselstyn 2007). We also note with interest that compelling rock art images of the large, extinct carnivorous marsupial *Thylacaleo* have also recently come to light in the Kimberley (Akerman 2009, Akerman and Willing 2009). These discoveries point to the importance of rock art as a source of information about the past distributions in time and space of animals in northern Australian contexts.

Both *Styloctenium* and *Zaglossus* are largely rainforest-associated lineages that today are known only from tropical islands north of Australia. Their presence in the late Quaternary fauna of the Kimberley region doubtless reflects the former presence of extensive mesic forested habitats across much of northern Australia, with fragmentation and extinction of forest-reliant species driven by a combination of climate-change and prehistoric human impacts in recent millennia (McKenzie et al. 1991)—a topic that so far has received much greater attention in the Wet Tropics of Queensland than in the tropical rainforests of the Kimberley region (Joseph et al. 1995, Williams 1997, Schneider and Moritz 1999, Bowman et al. 2010). Today, none of the mammal species known to occur in Kimberley rainforests are entirely dependent on rainforest habitats (Friend et al. 1991). However, we suggest that further critical examination of rock art depictions, and of fossil and subfossil assemblages, will likely illuminate the former presence in the Kimberley rainforests of additional taxa typical of modern Indo-Malayan or Australo-Papuan rainforest habitats.

We hold out a small optimism that Long-beaked echidnas might yet dig burrows and hunt invertebrates in at least one hidden corner of Australia's north-west. Such hopes are founded on the remoteness of this little-studied expanse of the Australian continent, and on the relatively late discovery of other medium-sized Kimberley mammals including the Monjon, *Petrogale burbidgei* (Kitchener and Sanson 1978), a small rock wallaby endemic to the north-west Kimberley, and the recent rediscovery of the Scaly-tailed Possum (*Wyulda squamicaudata*) in the eastern Kimberley (Doody et al. 2012), where it had not been recorded since 1917.

All living *Zaglossus* taxa in New Guinea are considered to be critically endangered (Isaac et al. 2007, Leary et al. 2008a, 2008b, 2008c), with primary threats being subsistence hunting and habitat loss. While it is vitally and urgently important to explore whether *Zaglossus* still survives in remote areas of the Kimberley, it is also important to learn more about its recent distribution and history of decline. Such studies may identify hitherto unsuspected dimensions to the adaptive breadth of *Zaglossus* species, reveal the existing or former presence of populations with genetic diversity unrepresented in New Guinea, and possibly assist with long term conservation of *Zaglossus* in New Guinea by illuminating important patterns of habitat occurrence and historical decline in Australia. If *Z. bruijnii* is extinct in the Kimberley region, it might also warrant consideration as a candidate for reintroduction, once more is learned of its former distribution and ecological role.

Ecology of *Zaglossus bruijnii* in western New Guinea and Australia

Little is definitively recorded about diet in Long-beaked echidnas. Most information is based on anecdotes or extremely limited studies of *Z. bartoni*, which is thought to be a specialist earthworm feeder that also feeds on subterranean arthropods including centipedes and large insect larvae (Griffiths 1978, Griffiths et al. 1991, Flannery 1995a, Opiang 2009), with no evidence for feeding on social insects such as ants and termites, the principal diet of *Tachyglossus* (e.g. Abensperg-Traun and De Boer 1992). Because of the intimate cranial resemblance between *Z. bartoni* and other *Zaglossus* taxa, it can be expected that the diets of these congeners are similar. However, it is possible that *Z. bruijnii* eats more social insects than *Z. bartoni*, perhaps especially in lowland environments. One of only two comments about diet in an individual of *Z. bruijnii* is the firsthand account of naturalist Thomas Barbour, recounted by Allen (1912:302):

> *This specimen was kept alive for about a month and a few observations on its habits were made. It was absolutely nocturnal and spent the day partially buried in the deep layer of sand which was kept in its cage… At night it moved about sluggishly, often digging with motions that strongly recalled those of a turtle. It fed on ants only, which were procured by placing in a dish a considerable amount of shredded cocoanut. The ants soon swarmed in this and the whole was then placed in the Proechidna's cage. It ate the insects by thrusting its long tongue down into the cocoanut. It took a little water or water with condensed milk, but seemed to drink very little.*

It may of course be the case that this animal only ate ants because other, more favored foods were not offered to it. Ripley (1942: 256-259), provided the only other (conflicting) account that references the diet of *Z. bruijnii,* based on a captive animal at Sansapor (a settlement adjacent to the Tamrau Range), noting "The echidna is supposed to live on ants, although this one would never touch them, much preferring papaya and raw eggs." Studies of the anatomy of the salivary glands of *Z. bruijnii* (not available for *Z. bartoni*) show these glands to be greatly developed, as in various ant-eating animals, and very similar to those of *Tachyglossus* (Viallanes 1880, Allen 1912). Ants and termites would presumably constitute a reliable source of food for a large echidna in northern Australian contexts (Andersen and Majer 1991, Milewski et al. 1994, Barrow et al. 2006, 2007), though earthworms might remain key resources especially in remnant rainforest areas (McKenzie and Dyne 1991). If *Z. bruijnii* is more dependent on ants in lowland New Guinea (and Australian) habitats than other *Zaglossus* populations are in montane New Guinea habitats, its presence across northern Australia until recent times may shed new light on the riddle, posed by Milewski et al. (1994), of why, unlike other southern continents, Australia seems to have had no species larger than *Tachyglossus* exploiting social insects as a major food resource. Griffiths et al. (1991) similarly suggested that *Megalibgwilia*, the other (and more southerly distributed) large echidna genus present in the Australian Quaternary, may also have been an insect-eater rather than an earthworm-eating specialist.

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LETTER TO THE EDITOR

A peer-reviewed open-access journal
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Remarks on "*Two new species of Tornidae (Caenogastropoda, Rissooidea) from Espírito Santo, Brazil*", by Luiz Ricardo Simone (*ZooKeys* 238: 77–85, 2012) and a plea for improvement in *ZooKeys* editorial policy

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With comments provided by Terry Erwin, Eike Neubert and Lyubomir Penev

The purpose of this letter is to point out some shortcomings in the editing of a recent *ZooKeys* paper and to discuss broader issues relating to the editorial procedures used by this important journal. The paper of concern, titled "Two new species of Tornidae (Caenogastropodas, Rissooidea) from Espírito Santo, Brazil," was published by Luiz Ricardo L. Simone in *ZooKeys* 238: 77–85 on 6 November 2012. Grammatical errors begin to appear in the first sentence of the abstract. Not only are sentences sometimes incomplete and improperly constructed, but there are some instances where their meaning cannot be determined. For example, what sense can be made of "since specimens with periostracum to eroded shells" (p. 78)? The language problem is most troubling in the descriptions of the shells where there are constructions such as "On aperture, region between ridge of superior carina and insertion of outer lip in adjacent preceding whorl a small region with ridge of peripheral ridge reabsorbed, forming anal notch with ~ 1/5 of aperture size" (p. 79). Simone is no newcomer to English language publication (see here[1] for a list of his publications), but it appears that he used a machine translator for portions of this paper instead of relying on an English-speaking colleague.

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[1] https://uspdigital.usp.br/tycho/CurriculoLattesMostrar?codpub=67A2A1A0A5C6

Comment: *ZooKeys has well-defined policies for English language editing. During the submission process, authors are warned that manuscripts should be submitted only after being edited by a native English speaker. Authors have to confirm by checking a tick box that they have followed the above requirement. Unfortunately, it happens that some authors provide incorrect information on the language editing of their manuscripts.*

Involving outsourced language editing services by Pensoft would visibly increase the price of the open access fees charged by the journal, which shall become an additional obstacle for persons and institutions to publish in ZooKeys. Therefore we rely both on the conscience of our authors to provide stylistically proven texts and our editors to filter out badly written manuscripts.

The first two sentences of the *ZooKeys* Author Guidelines are: "All papers should be in grammatically correct English. Non-native English speaking authors are required to have their manuscripts checked by a native English speaker prior to submission." Surprisingly this is left to the author as the Guidelines state that "reviewers are not expected to provide a thorough linguistic editing or copyediting of a manuscript." Removing that burden from reviewers is understandable, but the same wording appears in the instructions for Subject Editors.

Comment: *ZooKeys provides basic copy-editing but not linguistic editing of the manuscript. We do not expect that our reviewers and editors should spend their precious time in thorough editing of the English language. Nevertheless, many of them do this on voluntary basis and we greatly appreciate their efforts!*

An unusual periostracum is an important feature of the *Cyclostremiscus* species described by Simone. However, it is not possible to determine exactly what is perisotracum in Figures 1–5 as there is no visible demarcation, or any indication of such, between shell and periostracum. The poor quality of this plate is compounded by the unintelligible description of the species which makes it difficult to understand why all of the shells in Figures 1–15 are treated as conspecific. In the Guidelines, *ZooKeys* lists six items under Focus & Scope. The second of these requires, for a new species, a thorough description with good quality images, neither of which is present in this paper, and the third requires a differential diagnosis. One may assume that Simone performed these tasks in an original Portuguese version of the manuscript, but it should have been properly translated. A fourth item required is an identification key. Keys are rarely used by malacologists and this requirement was obviously, and appropriately, waived for this paper.

Comment: *In his text, Simone describes the periostracum in a separate paragraph, and this structure can be clearly seen on the figures cited. On the intermediate carina, these structures are obviously somewhat darker, which might be due to sand grains that adhere to the periostracal rods. He could probably have added an arrow to explicitly pinpoint these structures, however, the description of this peculiar feature was*

> *clear to me on the first sight, so there was no direct need to add something. I agree, in the caption this could have been mentioned again. However, I do not agree that this is a plate of poor quality, particularly if you consider the small size of the objects! We all know that it is quite difficult to take pictures of shells with a size of 2.5 mm.*
>
> *Secondly, a differential diagnosis is present. Simone compares his new species to three other species, namely* C. beauii, C. pentagonus *and* C. trilix*, in the paragraph discussion.*

The fifth required item under Focus & Scope of the Authors' Guidelines is Etymology. Simone describes two new species in his paper. A complete etymology is given for one, but there is no etymology for the new species *Cyclostremiscus mohicanus*. Given the current state of knowledge of the Tornidae it is highly possible that this species may eventually be placed in a different genus. As *mohicanus* is not a Latin word, in the absence of its etymology it may present problems should it be placed in a feminine or neuter genus. The only Brazilian usage of this name located is for its use to describe the haircut style of a noted Brazilian football (= soccer) player. There can be no objection if that was the author's intent, but is it an adjective (he had a mohican haircut) or a noun (he had a mohican)? How it would be used in Portuguese is not known. I encourage Simone to publish a note providing the etymology of *mohicanus*.

> **Comment:** *As explained to me by Dr Simone, the species epithet "mohicanus" is derived from the Indian tribe name "Mohican" and used here as a simple adjective. As the gender of the species epitheton is determined by the gender of the genus, the grammatical form "mohicanus" is correct, because Cyclostremiscus is of male gender. In case this species is transferred to another genus with a female or neuter gender, it turns to "mohicana" or "mohicanum". In case this name would have been a noun in apposition, it would remain in its original form. This problem could have been avoided by publishing an etymology of the species epithet, and I am grateful to Mr. Petit for drawing our attention to this failure, for which I take responsibility.*

Every author has had a paper appear in print with typographical errors that should have been caught by him/her and were overlooked by reviewers and editors. Simone's paper did not escape such error as *Episcynia* is misspelled as *Episcinia* in the abstract and twice on page 81. Also, "(Bush, 1885)" appears in the text as "(Bursch, 1885)." Neither this Bush paper nor a number of other cited papers are listed in the References. An omission of a listing in References of all cited items for a *ZooKeys* paper is strange as the instructions to authors stress the importance of cross-checking all entries "because all references will be linked electronically as completely as possible to the papers cited." Failure to follow the guidelines, especially in this instance, reflects unfavorably on both the author and the editor and unnecessarily raises the question of whether or not the author ever actually saw a cited work.

The only two other papers in *ZooKeys* that are on non-opisthobranch shelled marine gastropods (Caballer et al. 2011; Dornellas 2012) also show editing lapses. In the paper by Caballer et al. (2011) the abstract is difficult to read because several sentences begin with abbreviations. Two sentences (p. 1), in part, are: "… *Rissoella venezolanicola* sp.n.*R. morrocoyensis* sp. n. …". The "*R.*" actually begins a sentence. This may be journal policy, but if so the propriety of changing that policy should be examined. The practice of beginning a sentence with a nonacronymic abbreviation is considered improper in the CBE Style Manual and in all English grammars.

The technically excellent paper by Dornellas (2012) is marred by the citation of Swanson instead of Swainson in the Introduction. The misspelled word radichian (instead of rachidian) would possibly escape notice were it not in bold face type. Quinn's *Calliostoma axelolssoni* is unfortunately corrupted to *C. axelsonni*. Again, in this paper there are many citations of papers that are not listed in the References.

> **Comment:** *As stated above, ZooKeys Editorial Office provides basic copy-editing for each manuscript, during which many errors and inconsistencies are being corrected. It may happen that some of the errors are overlooked, mostly due to the increase of the amount of work with the journal's exponential growth (see for detail Erwin et al. 2011, Erwin et al. 2012).*
>
> *Implementing of thorough copy-editing services would visibly increase the open access fees. The authors would suffer from price increase the most, hence we are convinced that the authors, with the help of the editors, reviewers and journal's Editorial Office should take proper care to bring their manuscripts into a shape corresponding to the journal's style requirements.*

Another unfortunate editorial feature is the elimination of periods after abbreviations, the reason for which is not known. This is further compounded in *ZooKeys* in the citation of references where authors' initials not only lack periods, but are written together and without a comma after the family name. Thus a 1974 paper by R. T. Abbott is listed as "Abbott RT (1974)." Perhaps it is this usage that is responsible for the disconnect in the authorship of *ZooKeys* papers by authors with Spanish surnames. As an example, the paper by Caballer has as authors "Manuel Caballer, Jesus Ortea, Samuel Narcisco." The abstract of this paper posted on the *ZooKeys* web site shows authors as "Manuel Caballer Gutierrez, Jesus Ortea, Samuel Narciso." If Caballer Gutierrez did not wish for his full name to be used, how did it get on the abstract? The abstracts of other papers by Spanish authors are similarly treated with the names on the abstract not in agreement with the names on the paper.

> **Comment:** *It is a practice in many modern electronic journals to avoid periods after abbreviations and generally to simplify citation and reference style (see for example, reference style in PLOS and BioMed Central journals). Such a simplification makes the process of markup and text mining easier, which in turn facilitates the dissemination and use of the published information, to the benefit of the authors and science community as a whole.*

The list of *ZooKeys* Subject Editors for most groups is impressive, with some groups and areas being quite restricted. For Mollusca there is one editor for "terrestrial slugs, Northern Hemisphere" (Andrzej Wiktor) and another for "terrestrial gastropods, Northern Hemisphere" (Eike Neubert). The latter is in addition to a listing of Anatoly A. Schileyko as editor for "terrestrial gastropods." The editor for Opisthobranchia is Nathalie Yonow. The only other Mollusca editor is Bruce A. Marshall for "shelled marine mollusks." Other categories (Bivalvia, Scaphopoda, other mollusks) are listed without editors.

These editors are detailed here because there is a serious question as to why, with such specific appointments, molluscan *ZooKeys* submissions have apparently not been assigned to the appropriate editor. Of the seven papers published on shelled marine mollusks, the only one on opisthobranchs was edited by "Guest Editor Herman Strack", presumably as it was written by the Opisthobranchia Editor Nathalie Yonow. Of the three papers on marine bivalves, one was edited by Marshall and two by Yonow. The only three papers on shelled marine gastropods were all edited by Neubert. An eighth marine mollusk paper, on cephalopods, was edited by Marshall. Dr. Marshall advises (personal communication 17 November 2012) that he has no knowledge of the papers on shelled marine mollusks that were edited by others.

> **Comment:** *For some reasons, it was difficult to assemble an editorial group responsible for mollusks in ZooKeys. Probably this is due largely to the fact that the community studying this large group of animals has established specialized society journals, thus many active specialists on Mollusca are engaged elsewhere as editors.*
>
> *Currently, ZooKeys is undertaking an initiative, called Global Editorial Networks (GENs)*[2] *to extend the focus and scope of the journal to areas close to or beyond taxonomy in its narrow sense. Specialists who wish to serve as subject editors in various subject and taxa, Mollusca included, may apply using the following link*[3].

Are authors in some way allowed to choose a *ZooKeys* editor? As shown above, neither the editors nor reviewers for this journal are expected to correct English usage. A cynical conclusion would be that *ZooKeys* is a venue for publishing a paper in which the English is less than minimal as an editor can be selected whose first language is not English — simply pay minimal page charges and bypass editing. I am not alleging that this has happened, but it is a possibility that is hard to ignore.

> **Comment:** *Authors have no influence on selecting the editors of their manuscripts. Editors are assigned by the journal's Editorial Office. We stress again that the lan-*

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[2] http://www.pensoft.net/journals/zookeys/about/Editorial%20Team#Global%20Editorial%20Networks%20%28GENs%29

[3] http://pensoft.net/gen_form.htm

> *guage editing in ZooKeys is a responsibility of the authors. It would be quite an exaggeration to generalize that "Zookeys is a venue for publishing a paper in which English is less than minimal" based on a single or few examples of papers published in not properly edited English language.*

The presence of a number of American systematists on the *ZooKeys* Bioinformatics Advisory Panel argues against any prejudice toward American authors. On the other hand, not only are there are no American Editors for Mollusca, the only two whose first language is English are Marshall and Yunow (inclusion of the latter is a guess based on her background—it is suspected that her English is superior to mine). Why were the only three papers on shelled marine non-opisthobranch gastropods edited by an editor (Neubert) whose first language is presumably German? As Dr. Neubert has published many papers in fluent English the core problem appears to be the failure of the Author Guidelines to require any supervision or correction of English. Indeed, the wording of the Guidelines is such that reviewers and editors are expected to expend their efforts on scientific quality and style. However, there is a provision that an editor can reject a manuscript for "poor English."

> **Comment:** *There is no, nor has there ever been, prejudice against either American authors or editors, nor against such from any other nationality! Invitations to American malacologists to join the board of ZooKeys have been sent several times in the past, but unfortunately these have been declined.*
>
> *The presence of many native English speakers in the Editorial team of ZooKeys is understandable and has a great value for the journal. On the other side, there are also many other excellent editors from non English-speaking countries, which reflects the truly international character of the journal and of taxonomy as a discipline in general.*
>
> *It would be unrealistic to rely exclusively on the services of native English speakers as editors and reviewers, just because they are expected to correct the language of the submitted manuscripts.*

The *ZooKeys* web site, as of 17 November 2012, lists by category the 1,014 papers it has published. Of that number 891 are on Arthropoda. These numbers may not be current as 22 papers on Mollusca are listed but 26 have been counted.

> **Comment:** *Numbers are derived from the articles' metadata. The above figures will be checked and corrected.*

Now that *ZooKeys* has become an important publication venue in systematic zoology, it would be advantageous for the journal to use editors who are familiar with the subject matter. There is also an obvious need to find some way to insure that English is used in a manner that can be understood. Minor grammatical errors can be accepted but wholesale misuse of the language should not be allowed. Unless the editing process is tightened up, it is unlikely that the malacological community will make much use of the journal.

ZooKeys performed no favor for Simone by publishing his poorly presented paper. Accepting and publishing a work that is basically unintelligible was a disservice to Simone and to *ZooKeys* and detracts from the credibility of both.

> **Comment:** *We fully agree with this general conclusion and thank you once again for raising the question. We are convinced that this case will be used to improve the control over the quality of English language editing of the manuscripts submitted to ZooKeys.*

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