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Morphological and molecular taxonomic analysis of *Pseudopoda* Jäger, 2000 (Araneae: Sparassidae: Heteropodinae) in Sichuan Province, China

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Abstract

The genus *Pseudopoda* Jäger, 2000 is revised from material collected in Sichuan province. A molecular analysis shows the utility of DNA markers to support taxonomic hypotheses in Sparassidae.

Two new species are described: *Pseudopoda coenobium* **spec. nov.** from Emeishan (male, female) and *Pseudopoda wu* **spec. nov.** from Lugu Lake at the border to Yunnan (male, female). The latter species exhibits a unique reduction of the conductor and a strongly developed embolus. The female of *Pseudopoda virgata* (Fox, 1936) is described for the first time, the male is redescribed, the known range of the geographical distribution is considerably extended to the East (Baoxing and Tienqiang County), the vertical distribution range is extended from 300 m to slightly more than 2000 m. The male of *Pseudopoda signata* Jäger, 2001 is described for the first time, the female is redescribed, the known distribution range of this species is extended from Muge Cuo Lake over Kangding town to the valleys of Paomashan, Gonggashan and Yanzi. It shows a strong morphological variation, which may be interpreted as developing subspecies status in different valleys. However, according to results from a molecular analysis it is clearly considered intraspecific variability. Three further species are recorded from Sichuan: *Pseudopoda emei* Zhang *et al*., 2013, *Pseudopoda* sp. cf. *yunnanensis* (Yang & Hu, 2001) and *Pseudopoda rivicola* Jäger and Vedel, 2007.

Key words: Huntsman spiders, intraspecific variability, phylogeny, biogeography, taxonomy, systematics

Introduction

The genus *Pseudopoda* Jäger, 2000 was described 15 years ago for one Indian species, *Heteropoda prompta* (O. Pickard-Cambridge, 1885). Today, 109 species are known from Pakistan in the West to Japan in the East and from Korea in the North to Sumatra in the South (World Spider Catalog 2015). For an account of relevant publications see list under *Pseudopoda* in the taxonomy section. All species seem to need a certain degree of humidity, live mostly in the leaf litter or in similar habitats close to the ground. In higher elevations (> 3800 m) without leaf litter producing shrubs or trees no *Pseudopoda* species have been found. According to Jäger (2001) *Pseudopoda* species show a strong altitudinal differentiation, which explains partly the sometimes local high diversity on a specific level. Another reason for this diversity may be an inability to balloon, which would explain the existence of so many small range endemics within the genus. Similarly to the overwhelming diversity of Coelotinae in their mountainous habitats in South, East and north-western parts of Southeast Asia (World Spider Catalog 2015), the real number of *Pseudopoda* species is considered much higher than the number of formally described species. Currently 48 species are known from China, among them 30 from Yunnan, six from Sichuan, two each from Hainan, Hunan, Taiwan, and Tibet as well as one each from Guizhou, Jiangxi, Chongqing, Shaanxi, and Zhejiang. In the present paper, we report mainly on material collected during two expeditions to Sichuan in 1999 and 2004. Two new species are described, the previously unknown sex is described for further two species, and distribution maps are given for all. Nine species are now recorded from Sichuan, 31 from Yunnan. Among the new species the first *Pseudopoda* species with almost entirely reduced male conductor is recognised. A molecular analysis is conducted to test species hypotheses and boundaries.

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Material and methods

The examined spiders were preserved in 70% denatured ethanol. Examination and drawings were carried out with a Leica MZ 16 stereomicroscope with camera lucida attachment. Female copulatory organs were dissected and the sclerotised internal duct system was cleared in 96% DL-lactic acid ($C_3H_6O_3$). All measurements are in millimetres [mm]. Prosoma length/width means length/width of the dorsal shield of prosoma, opisthosoma length/width the length without petiolus and spinnerets. Leg formula, leg spination pattern, size classes and terminology follow Jäger (2001). Palp and leg lengths are listed as: total (femur, patella, tibia, metatarsus, tarsus). Arising points of tegular appendages in males are described as clock-positions of the left pedipalp in ventral view. The angle between the anterior margins of the lateral lobes is measured between the roughly straight parts pointing to the median line, bent anterior parts are not considered (Fig. 73). In schematic illustration of the internal duct system the blind ending (glandular) appendage is marked with "T", the copulatory orifice with a circle, and the end of the fertilisation duct in direction of the *uterus externus* with an arrow. As in Jäger (2005: 88), slit sensilla close to the epigyne are generally considered as descriptive character. However, in most species these are either absent or might be too small to be detected in light microscopy, hence they are in the latter case not illustrated. A ventral tibial apophysis of the male palp (cf. Rheims 2013) is recognised as such for the first time within Asian Heteropodinae. It builds a functional unit of the tibia-tarsus-joint with a proximal cymbial pit as counterpart (Fig. 1). However, this apophysis is not included in the description of species, since it has no diagnostic and rather less descriptive significance. Colouration is described from specimens in ethanol, in some species photographs of live specimens are added.

Species are listed in order of their geographic appearance from West to East and North to South. Elevation is given in metres [m]. Geographic coordinates (and rough estimate of elevation) are given in square brackets when detected via Google Earth. Maps were produced with Arcview version 3.2 (Sichuan) and DIVA GIS version 7.5.0 (Asia).

For the molecular study we chose 33 ingroup specimens from the genus *Pseudopoda* including specimens from locations south of Sichuan (Laos, Myanmar). In addition, we included four outgroup taxa, including *Olios scalptor* Jäger & Ono, 2001, *Heteropoda languida* Simon, 1887 and two unidentified specimens of the genus *Sinopoda* Jäger, 1999. DNA was extracted from leg tissue of each specimen using the Qiagen DNeasy kit according to the manufacturer's protocol (Qiagen, Germany). Using the primers C1-J-1718-spider & C1-N-2776-spider (Vink *et al.* 2005) and 28SRD4.8a & 28SRD7b.1 (Schwendinger & Giribet 2005), we amplified a ~900 bp fragment of the mitochondrial Cytochrome Oxidase subunit 1 (COI) and a 850 bp fragment of the nuclear 28SrDNA (28S). COI and 28S are both well established as taxonomic markers (Hebert *et al.* 2003; Sonnenberg *et al*. 2007). PCRs were run with 1 µl of DNA template and 35 cycles at an annealing temperature of 56°C and using the Qiagen Multiplex PCR kit according to the manufacturer's protocol. PCR purification and sequencing were carried out as described in Krehenwinkel & Tautz (2013). Sequences were manually edited in CodonCode Aligner (CodonCode Cooperation, USA), then aligned using ClustalW in MEGA (Tamura *et al.* 2007) under default alignment settings, and the final alignment was manually inspected for proper alignment of gaps. The COI alignment was translated to amino acid sequence in MEGA, to check for potential pseudogenes. Suitable nucleotide substitution models were chosen for both gene fragments using JModeltest (Posada 2008) and using the AIC model selection. Phylogenetic analyses were then carried out using MrBayes (Huelsenbeck *et al.* 2001) with a GTR+i+g substitution model which was identified as the most appropriate model for both markers. The analyses were run with a chain length of 1,100,000, 4 heated chains, a subsampling frequency of 200 and a burn-in length of 100,000. We generated trees for each separate dataset, as well as a combined tree. In addition, we calculated uncorrected pairwise genetic distances between all included species in the analysis, and between specimens from different populations for which we wanted to test their species status. These were the specimens which morphological similarity to *P. signata* and *P. virgata*. The sequences were uploaded to Genbank under the accession numbers KP343877–KP343950.

Abbreviations used in the text:

ALE—anterior lateral eye
AME—anterior median eye

AW—anterior width of dorsal shield of prosoma
C—conductor
dRTA—dorsal part/branch of RTA
DS—dorsal shield of prosoma
E—embolus
LL—lateral lobes
OS—opisthosoma
PJ—numbers represent subsequent numbers of Sparassidae examined by the first author
PL—length of dorsal shield of prosoma
PLE—posterior lateral eye
PME—posterior median eye
PW—width of dorsal shield of prosoma
RTA—retrolateral tibial apophysis
SD—serial number of tissue samples for molecular analyses
vRTA—ventral part/branch of RTA
I–IV—referring to leg numbers

Terminology used in the text is mainly explained in Figs 1–4 and Figs 8–9. In other figures only exceptional or new features are indicated

Museum collections (with curators)

IZCAS	Institute of Zoology, Academy of Sciences, Beijing, China (Shuqiang Li)
MHBU	Museum of Hebei University, Baoding, China (Guodong Ren)
SMF	Senckenberg Research Institute, Frankfurt, Germany (Julia Altmann, Peter Jäger)
USNM	United States National Museum, Washington D.C., USA (Jonathan Coddington)

Taxonomy

Sparassidae Bertkau, 1872

Heteropodinae Thorell, 1873

Pseudopoda Jäger, 2000

Pseudopoda Jäger, 2000: 62 (description of genus). Jäger 2001: 24 (redescription of genus, description of 49 new species, redescription of 11 species, identification key for species-groups and species); Tang and Yin 2000: 274 (description of 1 new species from China: Hunan); Jäger and Ono 2001: 23 (first record from Taiwan, description of 2 new species); Jäger and Yin 2001: 126 (transfer of 2 species to *Pseudopoda*, listing of 14 nominal species for China); Jäger *et al*. 2002: 26 (description of 2 species); Jäger 2002: 57 (transfer of 2 species to *Pseudopoda*); Jäger and Ono 2002: 109 (first record for Japan, description of 2 new species); Jäger and Vedel 2005: 2 (first record for Vietnam, description of 1 new species); Jäger *et al*. 2006: 220 (first record for Laos, description of 3 new species); Jäger 2007: 55 (description of 2 new species from Laos); Jäger and Vedel 2007: 3 (description of 15 new species from China: Yunnan; redescription of 1 species, transfer of 1 species to *Pseudopoda*); Jäger 2008a: 46 (description of 1 new species from China: Yunnan); Jäger 2008b: 516 (description of 3 new species from India); Fu and Zhu 2008: 657 (description of 1 new species from Tibet); Jäger and Praxaysombath 2009: 44 (description of 1 new species from Laos); Yang *et al*. 2009: 18 (description of 2 new species from China: Yunnan); Sun and Zhang 2012: 25 (description of 1 new species from China: Yunnan); Zhang *et al*. 2013a: 274 (description of 4 new species from China: Yunnan); Zhang *et al*. 2013b: 39 (description of 4 new species from China: Yunnan, Guizhou, Sichuan, Chongqing); Quan *et al*. 2014: 556 (description of 3 new species from China: Hainan, Hubei); Jäger 2014: 184, 186 (transfer of 3 species to *Pseudopoda*).

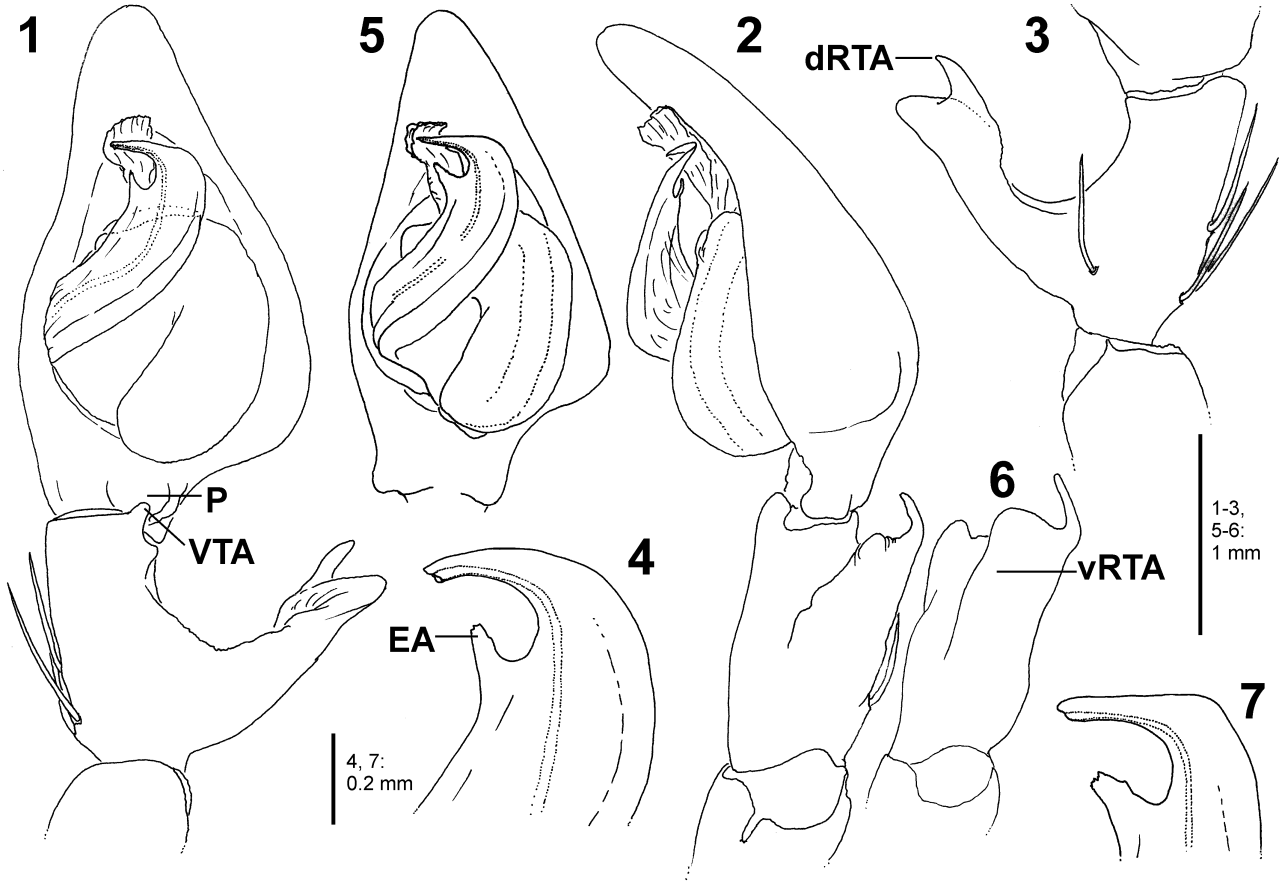
Modified diagnosis (after Jäger 2000). Male palp with membranous conductor (not sheath-like as in *Heteropoda* spp.), may be strongly reduced to an inconspicuous rest on tegulum (the latter state currently known

only in one species: *Pseudopoda wu* **spec. nov.**, Figs 115–117), embolus broadened (at least in its proximal part; not filiform as in *Heteropoda* spp.) and flattened, RTA arising in mesial or basal position (not in distal position as in *Heteropoda* spp.) (Figs 1–2).

Distribution. South, East and parts of Southeast Asia: Pakistan to Japan, Korea to Sumatra.

***Pseudopoda virgata* (Fox, 1936)**
Figs 1–23, 130

Heteropoda virgata Fox, 1936: 127, fig. 6 (Description of male; holotype male from between Suifu [=Yibin] and Yachou [=Ya'an], Sichuan, China; deposited in USNM, examined).
Pseudopoda virgata (Fox). Jäger 2001: 62, figs 37a–e (Transfer, redescription and illustration of male).

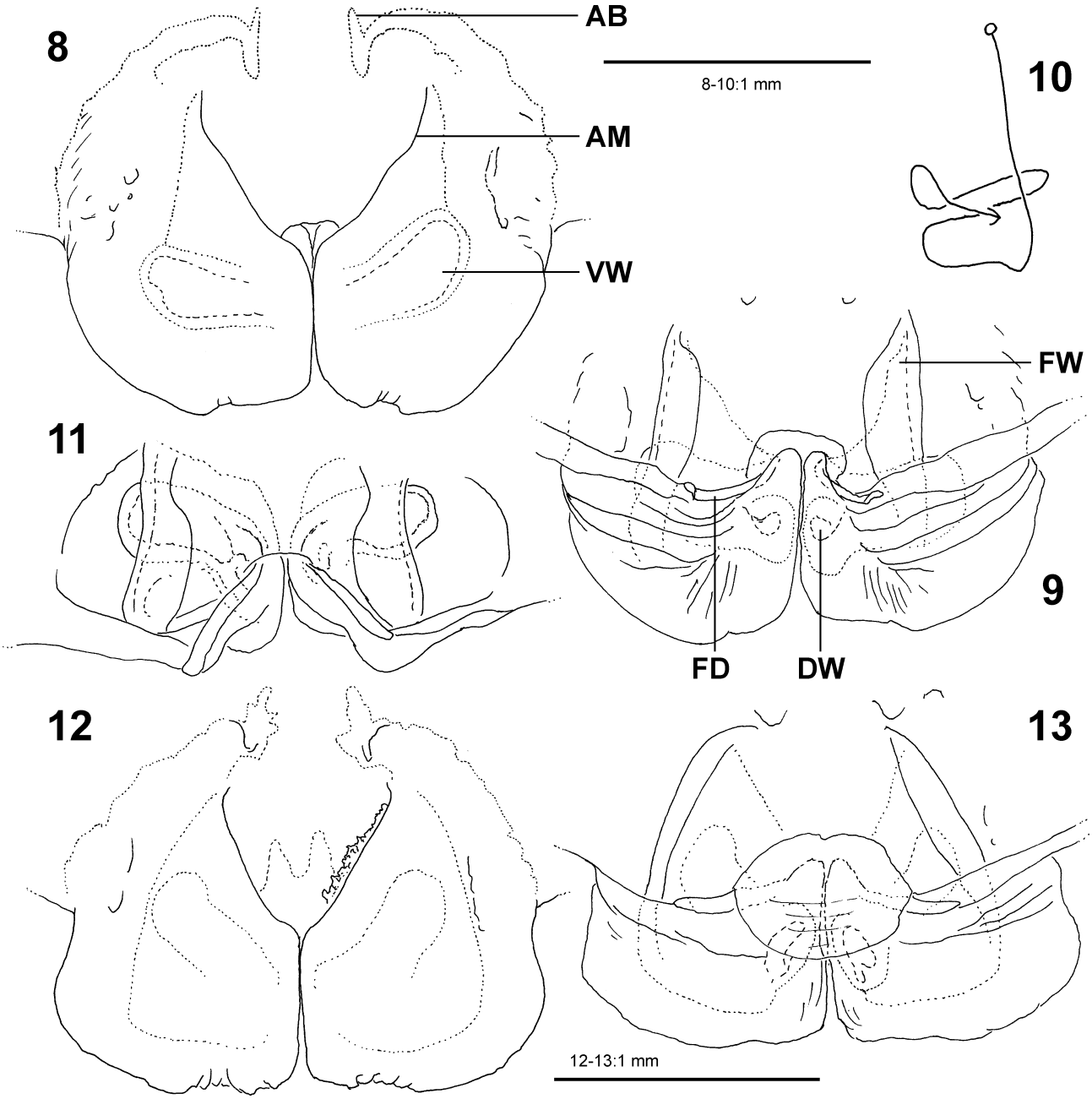


FIGURES 1–7. *Pseudopoda virgata* from Baoxing County, copulatory organs of males (1–4 PJ 3519, 5–7 PJ 3488). 1–2, 5 Left male palp (1, 5 ventral, 2 retrolateral); 3, 6 tibia of left male palp (3 dorsal, 6 retrolateral); 4, 7 Embolus tip, ventral. dRTA—dorsal retrolateral tibial apophysis, EA—embolic apophysis, P—cymbial pit, vRTA—ventral retrolateral tibial apophysis, VTA—ventral tibial apophysis.

Additional material examined (2 males, 5 females). China: *Sichuan*: 1 male (PJ 3488, SD 59), Baoxing County, gorge south of Fengtong village, 30°34'22.50"N, 102°52'57.00"E, 1623 m, found dead, S. Li leg., by hand, 2 June 2004 (IZCAS); 1 male (PJ 3519, SD 62), Baoxing County, Fengtong Zhai, Yaoji (2), 30°40.239'N, 102°45.019'E, 2015 m, sparse secondary forest, stones and leaf litter, P. Jäger leg., by hand, 5 July 2004 (SMF); 2 females (PJ 3520, 3522; SD 48, 25), Baoxing County, Fengtong Zhai, between Yaoji (2) and (3), 30°40.239'–30°38.718'N, 102°45.019'–102°46.733'E, 2002-2015 m, sparse secondary forest, stones and leaf litter, P. Jäger leg., by hand, 5 June 2004 as immature, adult: November 2004 (SMF); 1 female (PJ 3521, SD 27), Baoxing County, Fengtong Zhai, S of Yaoji (3), 30°38.718'N, 102°46.733'E, 2002 m, F. Lin leg., by hand, by day, 5 June 2004 as immature, adult: 19. October 2004 (IZCAS); 1 female (PJ 3534), Tienqiang County, Erlangshan, Labahe Nature Reserve, 30°05.720'N, 102°24,869'E, 1900 m, at rock in web of *Achaearanea* sp., P. Jäger leg. 10 July 2004, SD 79 (SMF).

1 female, Erlangshan, Labahe Nature Reserve, 30°03.500'N, 102°25.571'E, 1350 m, X. Xu leg. as juvenile, adult in lab, 10.07.2004 (SMF).

Note. The village Yaoji (=Qiaogi) is now covered by water in front of a dam. The collection sites Yaoji 2 and Yaoji 3 are situated along the river downstream and are still reachable. One male specimen (PJ 3488) seemed to be damaged by a predator (a spider) and only few measurements could be taken. Left tarsus and right (mirrored) tibia of the male palp are illustrated, since left RTA was broken off.



FIGURES 8–13. *Pseudopoda virgata* from Baoxing (8–11) and Tienqiang County (12–13), copulatory organs of females (8–11 PJ 3520, 12–13 PJ 3534). 8, 12 Epigyne, ventral; 9, 11, 13 Vulva (9, 13 dorsal, 11 frontal); 10 Schematic course of internal duct system, dorsal. AB—anterior bands of epigynal field, AM—anterior margins of lateral lobes, DW—dorsal windings of internal duct system, FD—fertilisation duct, FW—first winding windings of internal duct system, VW—ventral windings of internal duct system.

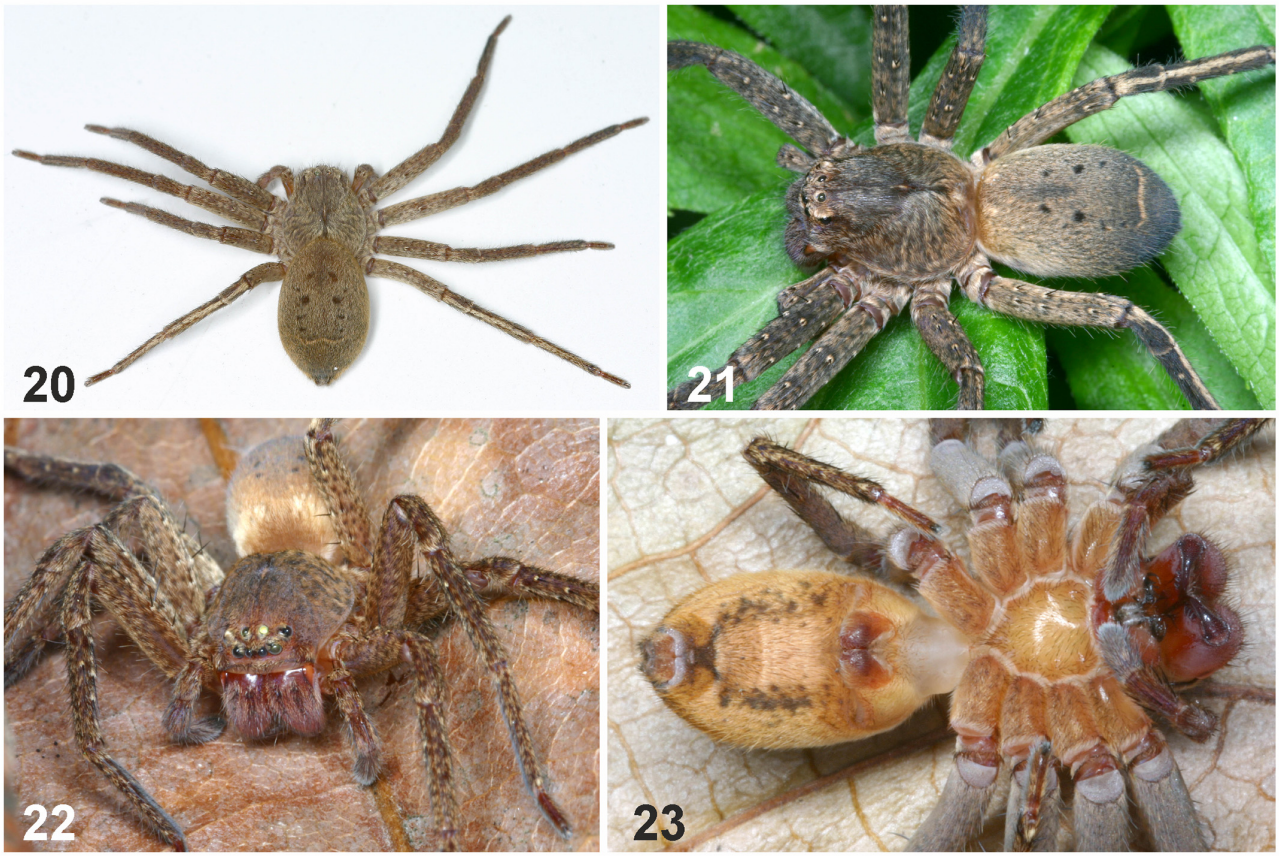
Diagnosis. Small to medium sized *Pseudopoda* species with body length of males 9.8–10.7, of females 11.1–14.0. Males [modified from Jäger 2001: 62] with embolus as in other members of the *martensi*-group with flat and sickle-shaped embolus and sub-distal embolic apophysis. This latter apophysis short, i.e. as long as wide at its base,

with slightly serrated margin and pointing in direction of the embolus tip. The latter with opening situated slightly sub-apically. RTA running at a 40° angle to tibia when seen in ventral view, dRTA finger-like, vRTA sub-quadrangular to sub-trapezoid in retrolateral to orthogonal view (Figs 4, 6), its tip laterad in ventral view (Fig. 1). Females similar to those of *P. coenobium* **spec. nov.** and *P. emei* in having similar shapes of lateral lobes and distinct ventral windings of internal duct system, but distinguished by ventral windings laterad to antero-laterad, wide and simple (double windings in *P. coenobium* **spec. nov.**, meandering in *P. emei*). Anterior margins of lateral lobes forming medially 70°–85° angle (100°–110° in *P. coenobium* **spec. nov.** and *P. emei*).

Redescription. Male (PJ 3519): DS length 5.5, width 4.6, AW 2.6, OS length 5.2, width 2.8. Eyes: AME 0.24, ALE 0.37, PME 0.25, PLE 0.32, AME–AME 0.16, AME–ALE 0.07, PME–PME 0.27, PME–PLE 0.44, AME–PME 0.24, ALE–PLE 0.32, clypeus height at AME 0.47, at ALE 0.38. Spination: palp: 131, 101, 2101; legs: femur I–II 323, III 322, IV 331; patella I–IV 101; tibia I–I 2226, III–IV 2126; metatarsus I–II 2024, III 3035, IV 3037. Metatarsus IV ventrally with double row of bristles along entire length and sparse scopula distally, metatarsus III with some bristles in proximal half and dense scopula in distal half. Leg formula: 2143. Measurements of palp and legs: palp 8.0 (2.9, 1.1, 1.4, -, 2.6), leg I 24.6 (6.3, 2.6, 7.1, 6.9, 2.1), leg II 26.7 (7.1, 2.6, 7.6, 7.0, 2.4), leg III 21.0 (5.7, 2.1, 5.7, 5.6, 1.9), leg IV 24.0 (6.4, 2.1, 6.2, 7.0, 2.3). Cheliceral furrow with ca. 35 denticles in small patch at distal anterior tooth. Promargin of chelicerae with 3 teeth, retromargin with 4 teeth.

Palp as in diagnosis (Figs 1–6). RTA arising proximally to medially from tibia. Cymbium with strong retrolateral bulge and proximal pit, the latter acting as counterpart for the ventral tibial apophysis, both parts representing a functional unit of the tibia-tarsus-joint. Tegulum with proximal prolatero-proximad bulge. E arising in 9-o'clock-position from tegulum, E tip prolaterad. C arising in 11- to 11.30-o'clock-position from tegulum.

FIGURES 14–19. *Pseudopoda virgata* from Baoxing County. Habitus of preserved males (14–16 PJ 3519) and females (17–19 PJ 3520) (14, 17 dorsal, 15, 18 frontal, 16, 19 ventral).



FIGURES 20–23. *Pseudopoda virgata* from Baoxing County. Habitus of live females (20 PJ 3520, 21 PJ 3522, 22–23 PJ 3521) (20–21 dorsal, 22 obliquely frontal, 23 ventral.

Colouration (Figs 14–16): Yellowish brown. DS with fovea and radial striae marked and with irregular patches of dark hairs. Sternum, coxae and chelicerae pale yellowish, without pattern. Legs yellowish brown with femora dotted indistinctly on their ventral side. OS dorsally dark brown with heart patch reddish-brown, followed by pairs of dark patches. OS ventrally irregularly spotted. Spinnerets ventrally light.

Description. Female (PJ 3520): DS length 5.8, width 5.2, AW 3.4, OS length 8.2, width 5.7. Eyes: AME 0.30, ALE 0.41, PME 0.27, PLE 0.38, AME–AME 0.27, AME–ALE 0.14, PME–PME 0.45, PME–PLE 0.59, AME–PME 0.43, ALE–PLE 0.46, clypeus height at AME 0.47, at ALE 0.37. Spination: palp: 131, 101, 2121, 1014; legs: femur I 323, II 324, III 323, IV 331; patella 001; tibia I 2026, II–III 2126, IV 2125; metatarsus I–II 2024, III 3035, IV 3037. Metatarsus IV and III as in male. Leg formula: 2143. Measurements of palp and legs: palp 8.0 (2.4, 1.3, 1.8, -, 2.5), leg I 18.8 (5.1, 2.6, 5.0, 4.4, 1.7), leg II 20.1 (5.5, 2.7, 5.4, 4.7, 1.8), leg III 16.0 (4.9, 2.2, 4.0, 3.6, 1.3), leg IV 18.1 (5.3, 2.0, 4.2, 4.8, 1.8). Cheliceral furrow with 30–35 denticles in small patch at median anterior tooth. Promargin of chelicerae with 3 teeth, retromargin with 4 teeth. Palpal claw with 8 teeth.

Copulatory organ as in diagnosis (Figs 8–13). Epigynal field wider than long, with short anterior bands. LL with muscle sigilla in their lateral parts and distinct wrinkles dorsally. First winding of internal duct system wide, converging anteriorly. Fertilisation ducts laterad in ventral view.

Colouration (Figs 17–19): As in male, but reddish-brown. Sternum reddish-brown marginally and yellowish brown in the centre. Coxae ventrally with light stripes and indistinct dots. Chelicerae reddish-brown with indistinct longitudinal bands. Leg femora more distinctly dotted. OS dorsally with dark transversal line in posterior half, ventrally very light with four longitudinal lines. Colouration of live spiders differs in the following features (Figs 20–23): legs with small light spine patches and vivid spots all over, leg IV with distinct narrow light lines dorsally from patella to metatarsus. OS dorsally with light transversal line, ventrally with broadly V-shaped pattern consisting of spots. Parts of this colouration disappearing in ethanol most likely due to its different refraction index.

Variation. Male (n=1) DS length 5.5. Finger-like part of dorsal RTA shorter in one male (PJ 3519) and as long as in the holotype in the other male (PJ 3488) (cf. Jäger 2001: figs 37a–c). **Females (n=3)** DS length 5.3–6.1, OS length 5.8–8.2. Spination. Femur II 3(2)23, III 32(3)3(2); patella II 101, III 101, IV 2126; metatarsus II

3036[median ventral spines double]/2014, III 303(2)5. Left chelicerae with posterior second proximal tooth with double apex. Palpal claw with 7 teeth. Anterior bands of epigynal field may be indistinct or absent (Figs 12–13). Colouration in ethanol may be yellowish brown and generally lighter than the female described.

Distribution. China: *Sichuan*: Between Yibin and Ya'an (type locality); Baoxing County, Fengtong village, former Yaoji village; Tienqiang County, Erlangshan, Labahe Nature Reserve (the known range of the geographical distribution is considerably extended to the East, the vertical distribution ranges now from 300 m to slightly more than 2000 m) (Fig. 130).

Pseudopoda emei Zhang *et al.*, 2013

Figs 24–36, 130

Pseudopoda emei Zhang *et al*. 2013b: 44, figs 18–33 (Description of male and female; holotype male, 1 male, 3 female paratypes from China, Sichuan, Emeishan; deposited in MHBU, not examined).

Note. Zhang *et al*. (2013b) listed wrong geographic coordinates as well as a wrong elevation of the type locality. The corrected data are: Emeishan, Fuhu Temple, 29°34'47.33"N, 103°23'03.12"E, 891 m (Feng Zhang, personal communication).

Material examined (2 males, 1 female). China: *Sichuan*: 1 male (PJ 3515), Tienqiang County, c. 5 km from Tienqiang town, 30°02,089'N, 102°46,079'E, 720 m, slopes along road, dense vegetation with ferns (*Selaginella* sp.), weeds, grasses, P. Jäger leg., by hand, at day, 7 July 2004, SD 70 (SMF); 1 male (PJ 3514), as previous specimen, caught as subadult, adult: 11 July 2004, SD 84 (IZCAS); 1 female (PJ 1900), Emeishan, Wannian Temple [29°34'53.06"N, 103°22'55.35"E, ca. 1000 m], in front of temple wall, P. Jäger leg., by hand, at night, 25 March 1999 (SMF).

Diagnosis (modified from Zhang *et al*. 2013)**.** Small to medium sized *Pseudopoda* species with body length of males 12.7–15.4, of females 13.2–14.1. Males similar to those of *P. virgata* in having a serrated embolic apophysis and a narrow embolic tip as well as a similarly shaped RTA (Figs 32–34), but distinguished by 1) Embolus tip narrow and long, abruptly narrowing (constantly narrowing and shorter in *P. virgata*), 2) Embolus tip bent at a right angle, tip ventrad (not distinctly bent in *P. virgata*). Females very similar to those of *P. signata* in having similar trilobate epigynal field and arrangement of ventral and dorsal windings of internal duct system (Figs 24–29), but distinguished by 1) Ventral windings wide, double S-shaped (ventral windings narrower, with various shapes in *P. signata*), 2) Dorsal windings kidney-shaped (dorsal windings subparallel in *P. signata*). Moreover, *P. emei* is known so far to live in distinctly lower elevations of 720–1000 m (*P. signata*: 2600–3800 m).

Note. Windings of female internal duct system are only fully visible when immersed in lactic acid or a similar clearing agent.

For colouration of living male see Figs 35–36.

Variation. Males (n=2): total length 12.7–12.8, 35–45 denticles in cheliceral furrow in restricted patch close to 2 distal anterior teeth. Spination: Palpal tibia 2111 (2101); femur III 32(3)3; tibia III21(2)26; metatarsus I 2024 (1012, malformation). In one male (PJ 3514) embolus not distinctly narrowing as shown in Zhang *et al*. (2013: fig. 21) and Fig. 32. Female (n=1): total length 14.1. Spination: palpal tarsus 1014; femur III 322, IV 331; tibia I 2226, II 22(1)26; metatarsus I–II 2014, III 3025, IV 3037. Most important difference between illustrations of the female paratype(s) (Zhang *et al*. 2013b) and the present female is the shape and course of the internal duct system: ventral windings double-S-shaped, their axis sub-parallel to anterior margins of LL; dorsal windings kidney-shaped, distinctly visible even in uncleared vulva; fertilization duct arising from sub-apical part of ventral windings leaving a blind-ending part without recognizable pores.

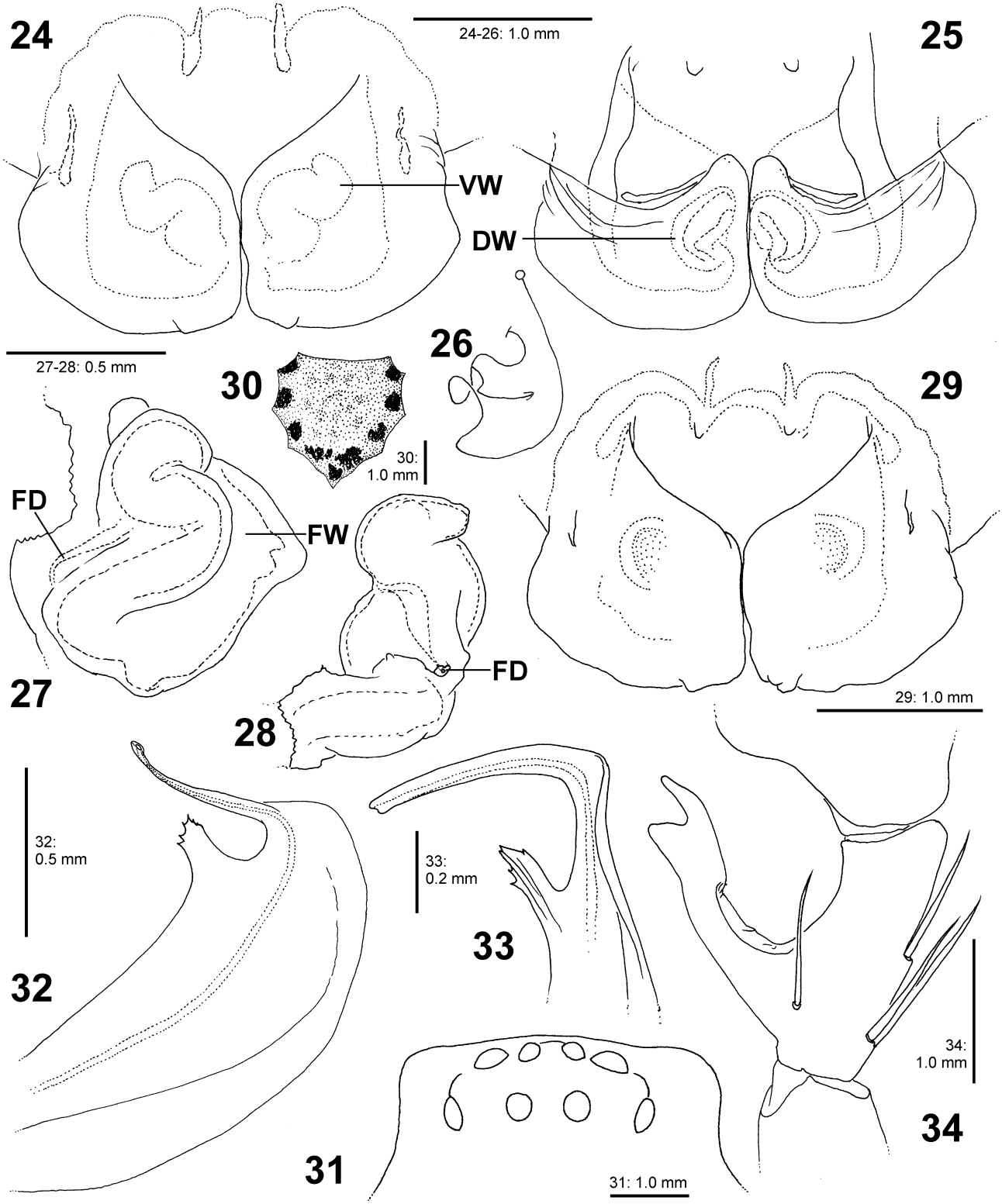
Distribution. China: *Sichuan*: Emei Shan (type locality; 890–1000 m), Tienqiang (720 m) (Fig. 130).

Pseudopoda coenobium spec. nov.

Figs 37–40, 130

Type material. CHINA: *Sichuan*: Holotype: male (PJ 1901), Emeishan, Wannian Temple [29°34'53.06"N, 103°22'55.35"E, ca. 1000 m], at wall, P. Jäger leg., by hand, at night, 29 March 1999 (SMF).

Paratypes: 1 female (PJ 1896), with same data as for holotype, 26 March 1999 (SMF). 2 females (PJ 1902–1903), with same data as preceding specimen (SMF, IZCAS).



FIGURES 24–34. *Pseudopoda emei*, males from Tienqiang County (32–34 PJ 3515) and females from Emei Shan (24–31, PJ 1900). 24, 29 Epigyne, ventral; 25, 27–28 Vulva (25 dorsal, 27–28 left half of vulva, various views); 26 Schematic course of internal duct system, dorsal; 30 sternum, ventral; 31 eye arrangement, dorsal; 32–33 Embolus tip (32 ventral, 33 retrolateral); 34 Palpal tibia, dorsal. DW—dorsal windings of internal duct system, FD—fertilisation duct, FW—first winding of internal duct system, VW—ventral windings of internal duct system.

FIGURES 35–36. *Pseudopoda emei* from Tienqiang County. Habitus of live male (PJ 3514) (35 dorsal, 36 ventral.

Additional material examined. 1 subadult male, 5 subadult females, with same data as for holotype (SMF). 1 subadult female (PJ 3487), with same data as for holotype, but: W. Schawaller leg. 19–30 March 1999 (SMF).

Etymology. The species name is taken from the middle age to late Latin word "coenobium" meaning "monastery"; noun in apposition.

Diagnosis. Medium sized *Pseudopoda* species with body length of males 10.8, of females 11.9–13.1. E of the new species differs from that of the most similar species, *P. virgata* (Fox, 1936), in 1) E broader, 2) Tip of embolic apophysis bent, 3) Narrow E tip shorter, 4) dRTA short, not finger-like (Figs 37–39). Females resemble those of *P. virgata*, *P. grahami* (Fox, 1936), *P. obtusa* Jäger & Vedel, 2007, *P. digitata* Jäger & Vedel, 2007 or *P. daliensis* Jäger & Vedel, 2007 with ventral windings of internal duct system laterad, but distinguished from them by the double ventral windings, both laterad, anterior pair extending more laterally (Figs 41–47).

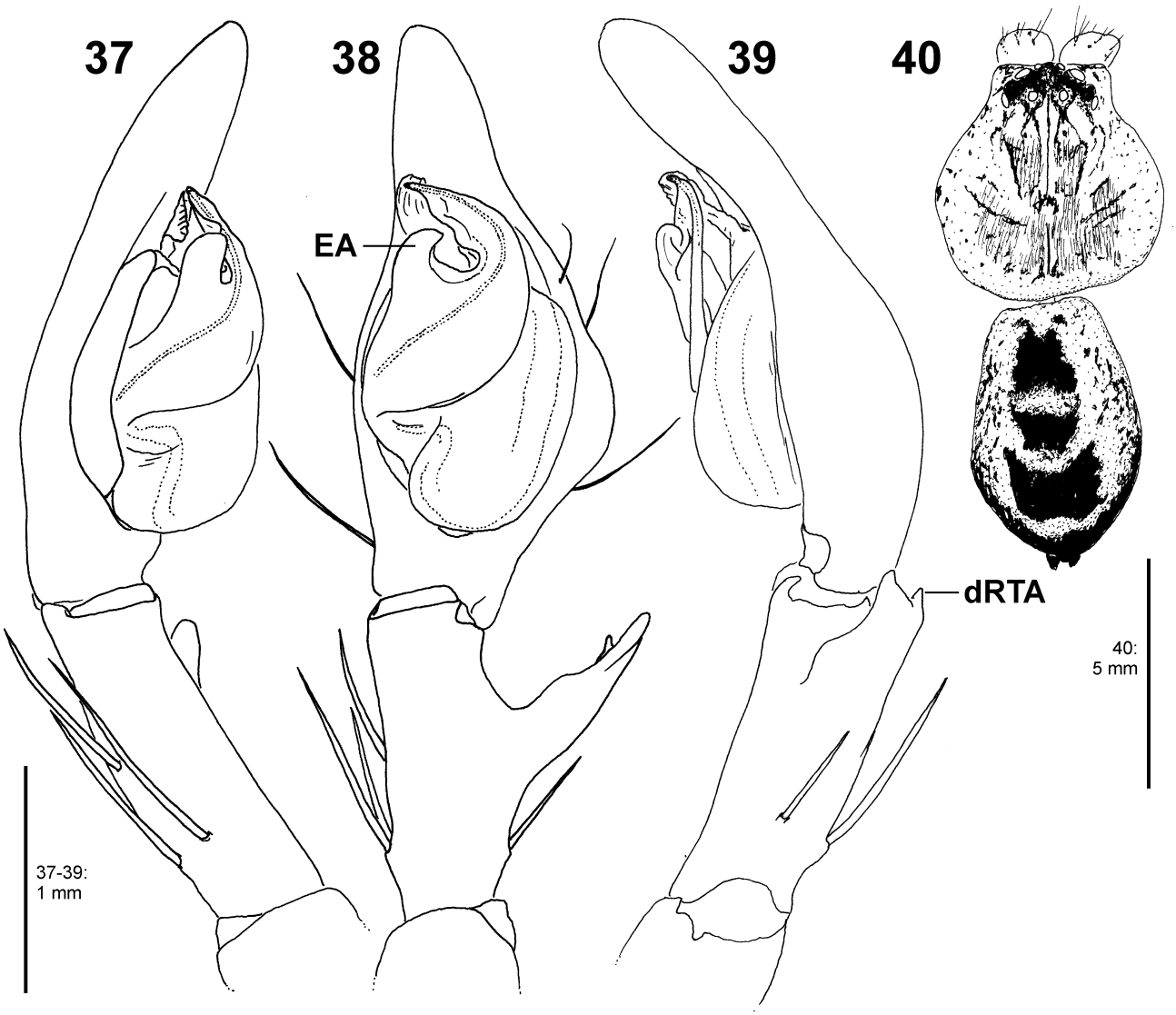
Description. Male (holotype, legs I regenerated, not considered): DS length 5.2, width 4.5, AW 2.4, OS length 5.6, width 3.5. Eyes: AME 0.29, ALE 0.38, PME 0.32, PLE 0.34, AME–AME 0.21, AME–ALE 0.04, PME–PME 0.33, PME–PLE 0.43, AME–PME 0.34, ALE–PLE 0.32, clypeus height at AME 0.31, at ALE 0.40. Spination: palp: 131, 101(0), 2111; legs: femur II 323, III 333, IV 331; patella II–III 101, IV 100; tibia II 2228, III–IV 2126; metatarsus II 2024, III 3025, IV 3037. Metatarsus IV ventrally with numerous bristles along entire length. Leg formula: 243. Measurements of palp and legs: palp 8.4 (2.8, 1.2, 1.5, -, 2.9), leg II 32.9 (8.5, 2.8, 9.6, 9.0, 3.0), leg III 25.1 (7.0, 2.3, 7.1, 6.6, 2.1), leg IV 27.9 (7.7, 2.4, 7.5, 7.9, 2.4). Cheliceral furrow with ca. 40 denticles in elongated patch. Promargin of chelicerae with 3 teeth, retromargin with 4 teeth.

Palp as in diagnosis (Figs 37–39). RTA arising medially from tibia, with two short apices. Cymbium roughly twice as long as tibia, with strong retrolateral bulge and 5 bristles. Tegulum with proximal bulge. Spermophor wide retrolaterally, narrow within E and intermediate proximo-prolaterally. E arising in 9- to 10-o'clock-position from tegulum, with subdistal two-lobed seam, E tip prolaterad. C arising in 11.30-o'clock-position from tegulum.

Colouration (holotype not fully hardened; Figs 40, 51–52): Pale yellowish with distinct dark reddish-brown markings. DS with fovea marked at its anterior and posterior end, with broken radial striae, marble like pattern behind eye region and at posterio-lateral margin, with eye region dark. Sternum dotted mostly in posterior half and with marginal larger spots at coxae. Coxae ventrally dotted, labium and gnathocoxae without pattern. Chelicerae frontally dotted. Legs spotted and with spine patches, patella and parts of tibia and metatarsus ventrally dark. OS dorsally with heart patch and broader dark patch followed by a light transversal W-marking, behind that again dark, anal tubercle light, spinnerets dorsally dark, ventrally light. OS ventrally dotted, median band with more and larger dots, fused to triangle in front of spinnerets.

Female (paratype, PJ 1896): DS length 5.9, width 5.3, AW 3.1, OS length 7.2, width 5.0. Eyes: AME 0.33, ALE 0.43, PME 0.30, PLE 0.38, AME–AME 0.18, AME–ALE 0.06, PME–PME 0.34, PME–PLE 0.42, AME–PME 0.33, ALE–PLE 0.35, clypeus height at AME 0.51, at ALE 0.47. Spination: palp: 131, 101, 2121, 1014; legs: femur I–II 323, III 322, IV 322; patella I–III 101, IV 100; tibia I–II 2228, III–IV 2126; metatarsus I–II 2024, III 3025, IV 3037. Metatarsus IV ventrally with numerous bristles along entire length. Leg formula: 2143. Measurements of palp and legs: palp 9.3 (2.7, 1.5, 2.2, -, 2.9), leg I 28.5 (7.9, 3.2, 8.1, 7.0, 2.3), leg II 30.0 (8.5, 3.3,

8.4, 7.3, 2.5), leg III 22.7 (7.0, 2.5, 6.0, 5.3, 1.9), leg IV 25.3 (7.7, 2.6, 6.5, 6.3, 2.2). Cheliceral furrow with 55–60 denticles in elongated patch. Promargin of chelicerae with 3 teeth, retromargin with 4 teeth. Palpal claw with 6 teeth.



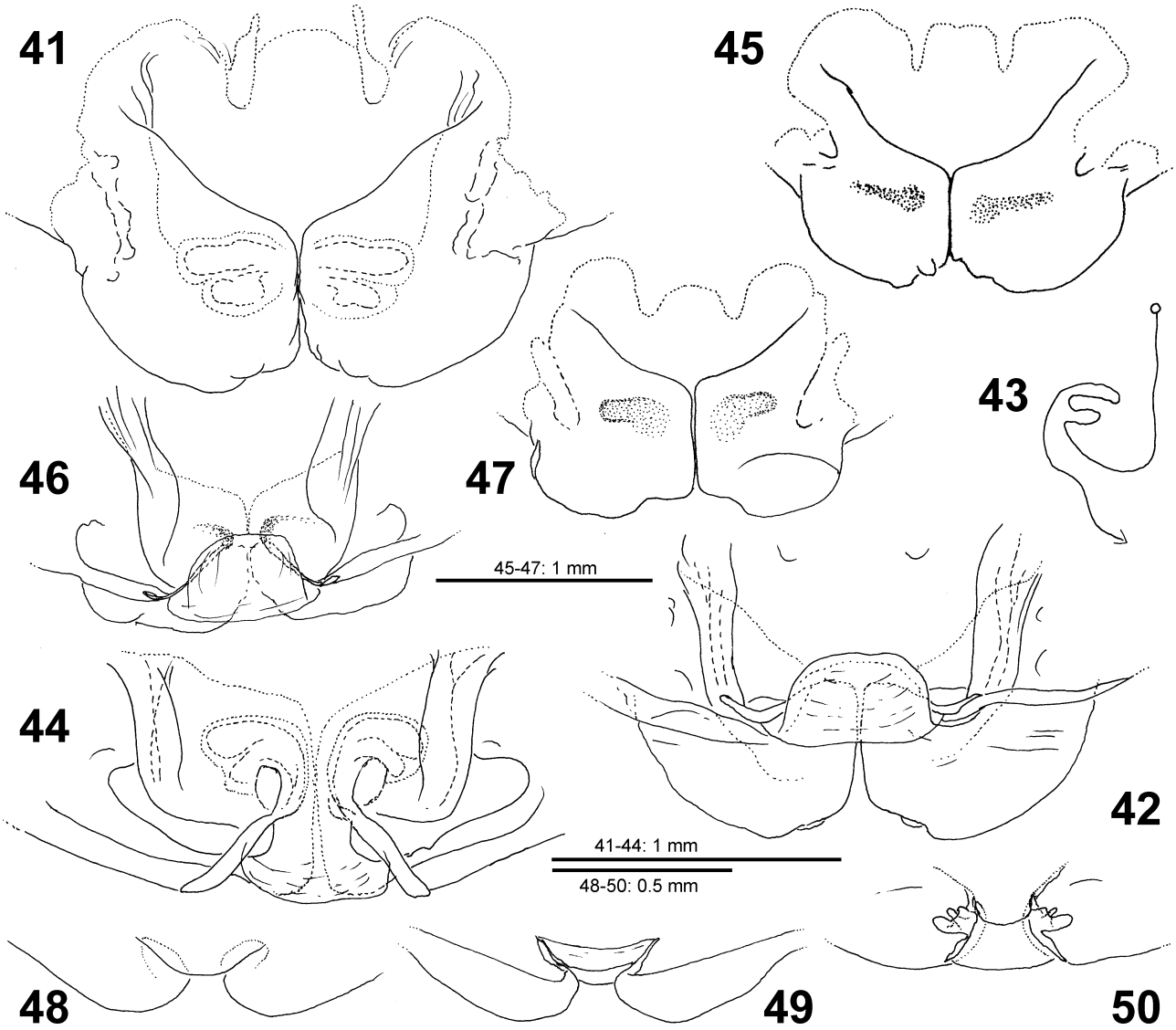
FIGURES 37–40. *Pseudopoda coenobium* **spec. nov.** from Emeishan, holotype male. 37–39 Left male palp (37 prolateral, 38 ventral, 39 retrolateral); 40 Habitus with colouration pattern, dorsal. dRTA—dorsal retrolateral tibial apophysis, EA—embolic apophysis.

Copulatory organ as in diagnosis (Figs 41–47). Epigynal field slightly wider than long, with trilobate anterior margin and short anterior bands. LL with bands of muscle sigilla in their lateral parts. First winding wide, converging posteriorly. Fertilisation duct long, laterad in ventral view. Pre-epigyne with LL not touching each other, pre-vulva with one small and one large pair of lateral protrusions (Figs 48–50).

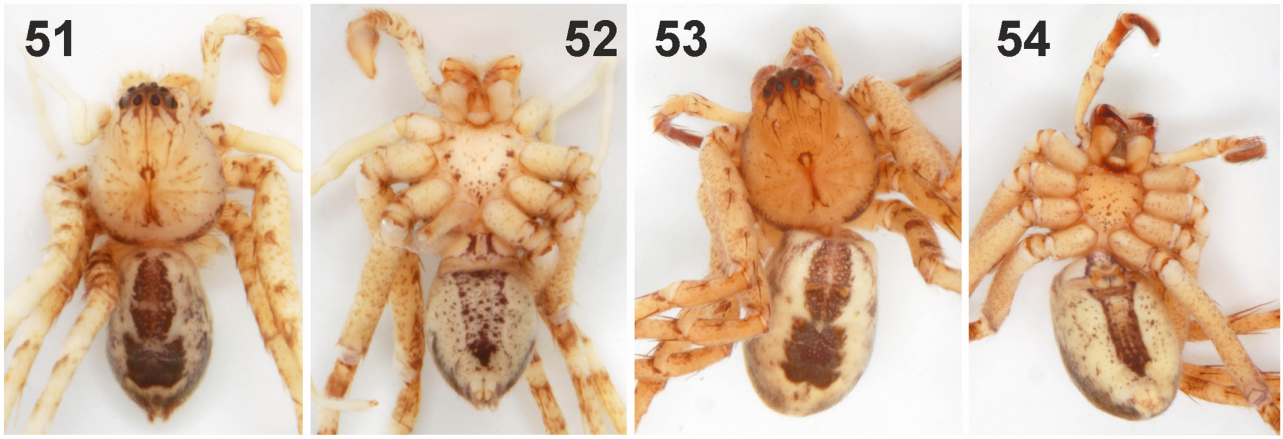
Colouration (Figs 53–54): As in male but generally slightly darker. Pale reddish- to yellowish brown. Labium proximally dark. Chelicerae distinctly darker than DS. Patella, tibia, metatarsus ventrally not as dark as in male. OS dorsally with white W-mark in posterior half longer. OS ventrally with lateral margins of median band fused.

Variation. Females (n=2) DS length 5.5–6.1, OS length 6.4–7.1. Spination: femur III 323/323(2), IV 331/33(2)1. Colouration: both females (PJ 1902–1903) not fully hardened, therefore paler than the paratype described above. OS dorsally with 2 light thin chevrons in broad dark posterior part, lateral ends of "W"-marking marked with light spots.

Distribution. China: *Sichuan*: Emei Shan (1000 m) (known only from the type locality) (Fig. 130).



FIGURES 41–50. *Pseudopoda coenobium* **spec. nov.** from Emeishan, female paratypes (41–44 PJ 1896, 45–46 PJ 1902, 47 PJ 1903) and subadult female (48–50 PJ 3487). 41, 45, 47 Epigyne, ventral (41 cleared, 45, 47 not cleared); 22, 44, 46 Vulva (42, 46 dorsal, 44 frontal); 43 Schematic course of internal duct system, dorsal; 48 Pre-epigyne, ventral; 49–50 Pre-vulva (49 dorsal; 50 frontal)

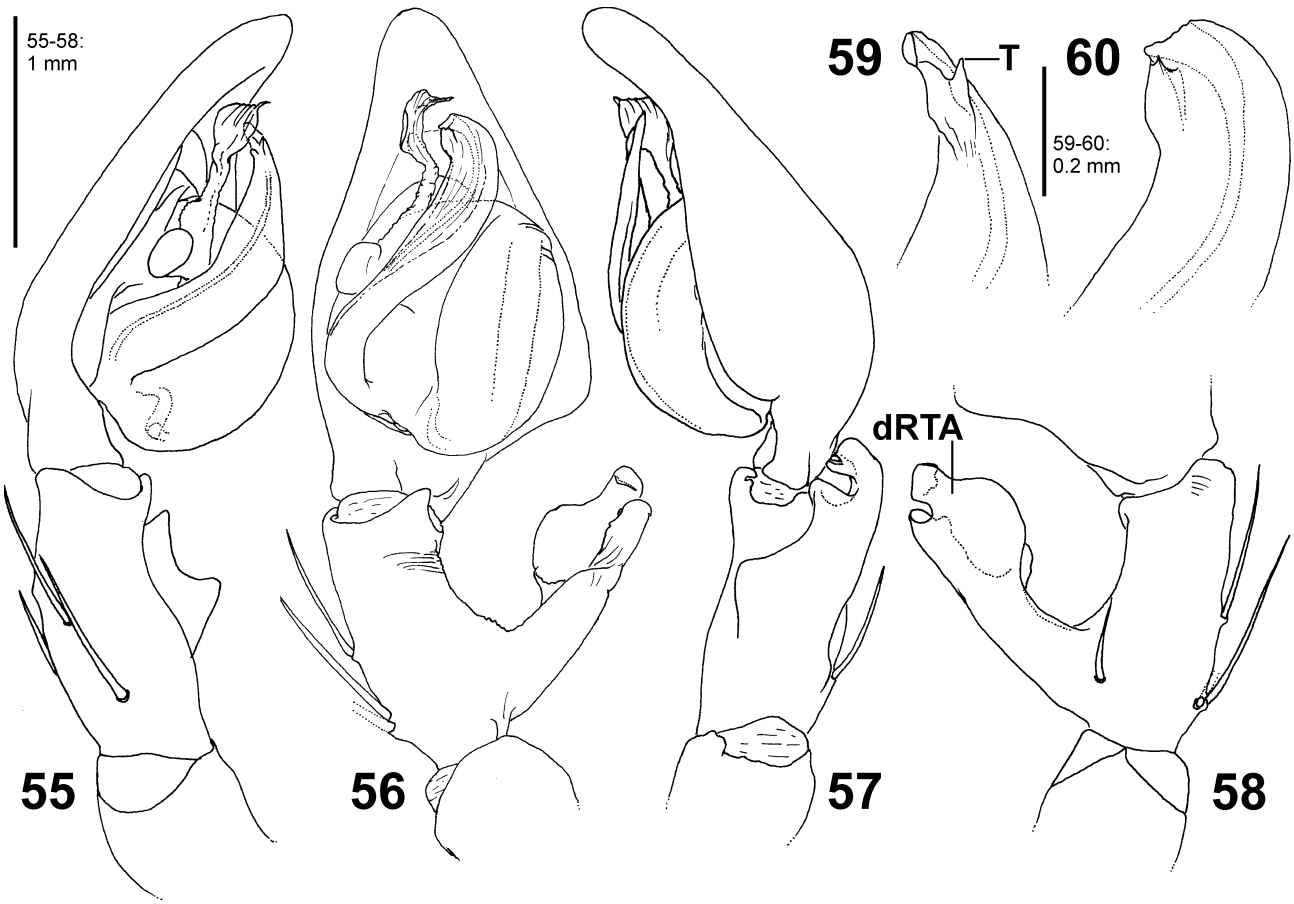


FIGURES 51–54. *Pseudopoda coenobium* **spec. nov.** from Emeishan, holotype male (51–52), female paratype (53–54 PJ 1896). Habitus (51, 53, dorsal, 52, 54 ventral)

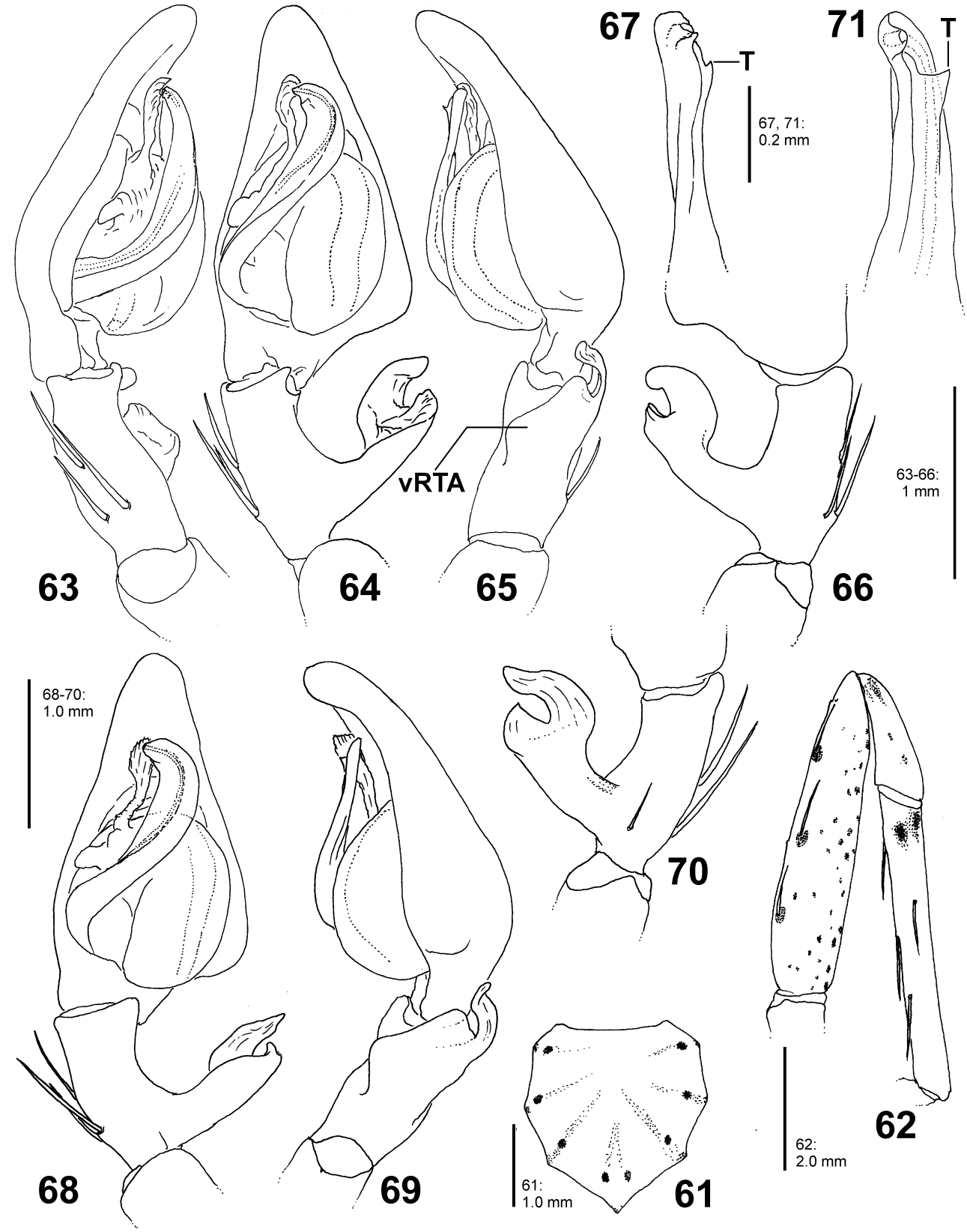
***Pseudopoda signata* Jäger, 2001**
Figs 55–90, 93–106, 130

Pseudopoda signata Jäger, 2001: 50, figs 29h–j (Description of female; holotype female and 1 female paratype from China, Sichuan, Kangding environments, 3000–3100 m, Heinz leg. 21–23 July 1994, SMF; examined).

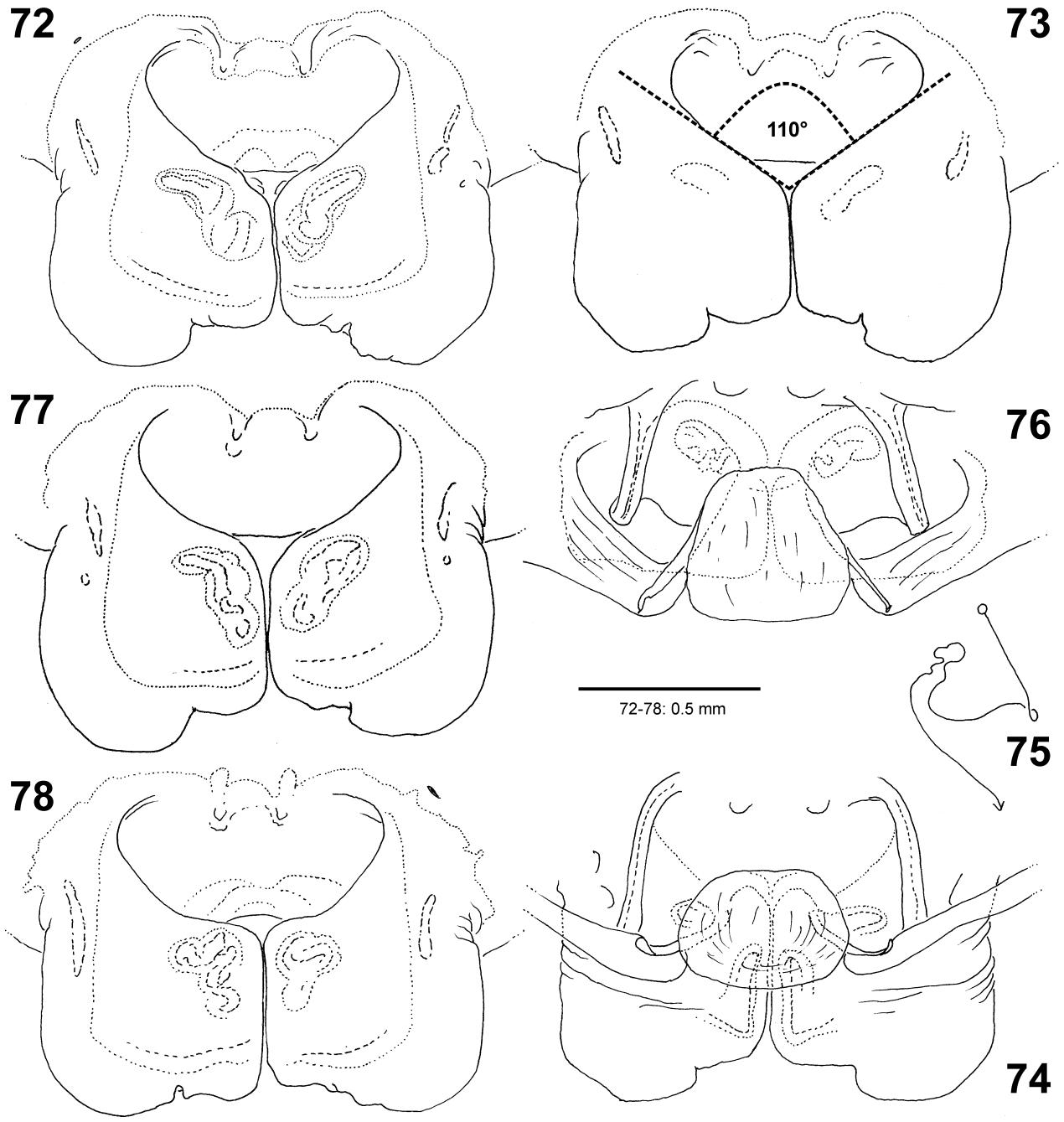
Additional material examined (18 males, 17 females). China: *Sichuan*: 1 female (PJ 3513, SD 93), north of Muge Cuo Lake, 30°11'1.89"N, 101°52'14.93"E, 3432 m, forest and pasture along road, Xiang Xu leg., by hand, 14 July 2004 (SMF); 9 males (PJ 2148–2150, 2166 [SD 94], 2168–2172), Kangding town, walls along road, 30°2'56"N, 101°57'28"E, 2580 m, P. Jäger leg., by hand, 15–16 July 2004 (SMF); 1 male (PJ 2167, SD 85), 3 females (PJ 2152 [SD 87], 3493 [SD 86], 3495 [SD 24]), valley of Paomashan S of Kangding (1), 29°59'49"N, 101°57'0.1"E, 2770 m, P. Jäger leg., 13 July 2004; 3 males (PJ 2162 [SD 89], 2164–2165 [SD 88]), 5 females (PJ 3496–3499, 3501 [SD 90]), valley of Paomashan S of Kangding (2), 29°56'48"N, 101°57'40"E, 3055 m, X. Xu & S. Li leg., 13 July 2004 (SMF); 1 male (PJ 2163), 4 females (PJ 3492, 3494 [SD 91], 3502–3503), valley of Paomashan S of Kangding (3), ascent to pass, 29°55'39"N, 101°58'45.89"E, 3533 m, transition between pasture and shrubs, P. Jäger, Z. Li & X. Xu leg., by hand, partly as subadult, 13 July 2004 (SMF); 2 males (PJ 3506–3507), 2 females (PJ 3504 [SD 104], 3505 [SD 103]), Luding District, Moxi town, Gonggashan valley (2), 29°49'34.36"N, 102° 3'8.26"E, 2963 m, under dead wood, P. Jäger & Xiang Xu leg., by hand, 20 July 2004 (1 male, 1 female: IZCAS, 1 male, 1 female: SMF); 1 male (PJ 3509), 2 females (PJ 3510–3511), Luding District, Xinxing town, Gongga Shan, Yan Zi Gou Resort, 3800 m, Yangong Xu leg., 15 June 1983 (IZCAS #118; PJ 3511: SMF); 1 male (PJ 3516), Luding, Gongga Shan, east slopes, 2350m, Yangong Xu leg., 5 June 1983 (IZCAS #141).



FIGURES 55–60. *Pseudopoda signata* from Kangding town, male copulatory organ (PJ 2148, 2580 m elevation). 55–58 Left male palp (55 prolateral, 56 ventral, 57 retrolateral, 58 dorsal); 59–60 Embolus tip (59 prolateral, 60 ventral). dRTA—dorsal retrolateral tibial apophysis; T—subdistal embolic tooth.

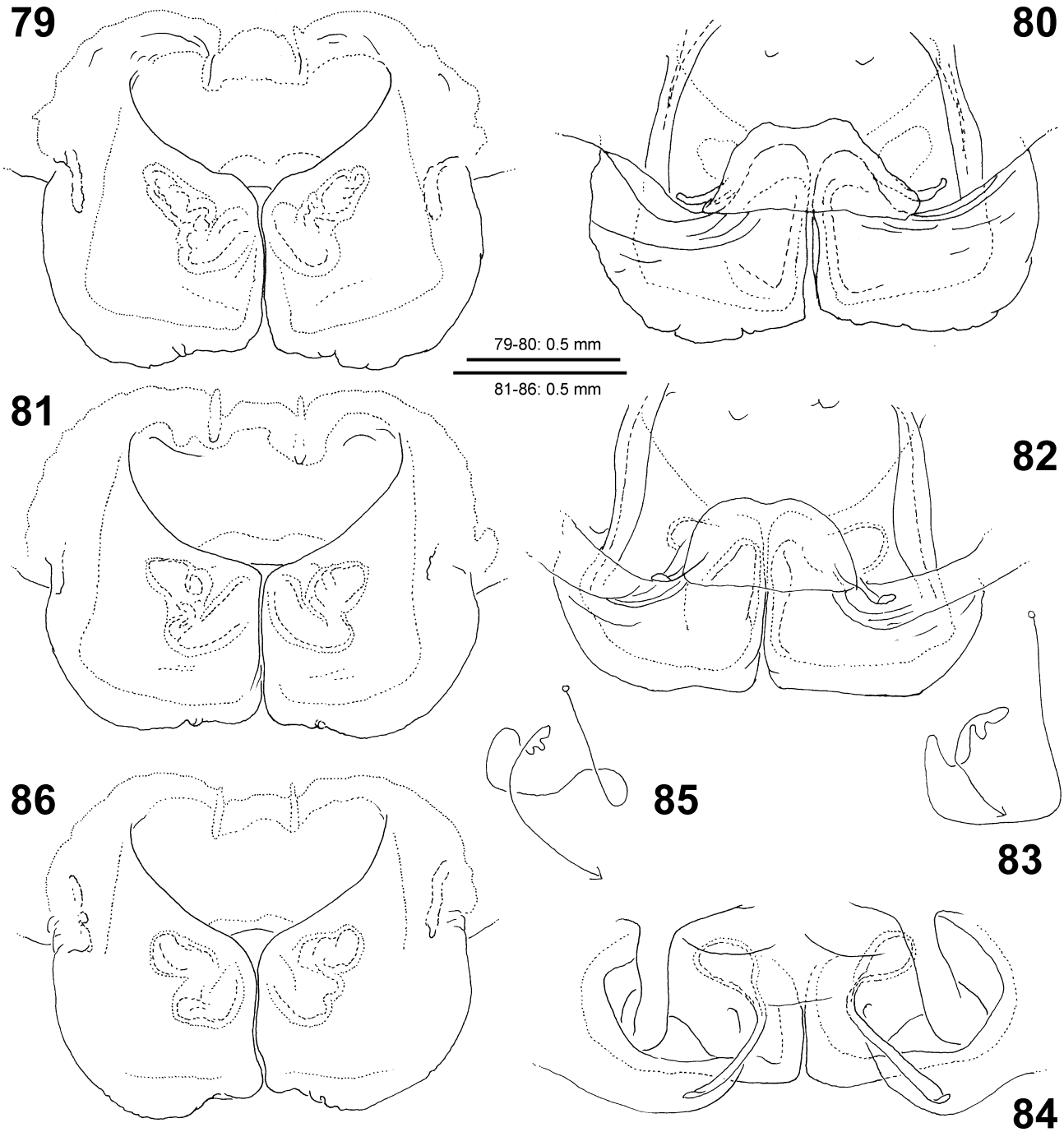


FIGURES 61–71. *Pseudopoda signata* from Kangding town (61–62: PJ 2148, 2580 m elevation) and Gonggashan valley (63–67: PJ 3506, 2963 m elevation; 68–71: PJ 3509: 3800 m elevation). 61 Sternum, ventral; 62 Leg II, prolateral; 63–65, 68–69 Left male palp (63 prolateral, 64, 68 ventral, 65, 69 retrolateral); 66, 70 Palpal tibia, dorsal; 67, 71 Embolus tip, prolateral. vRTA—ventral retrolateral tibial apophysis.



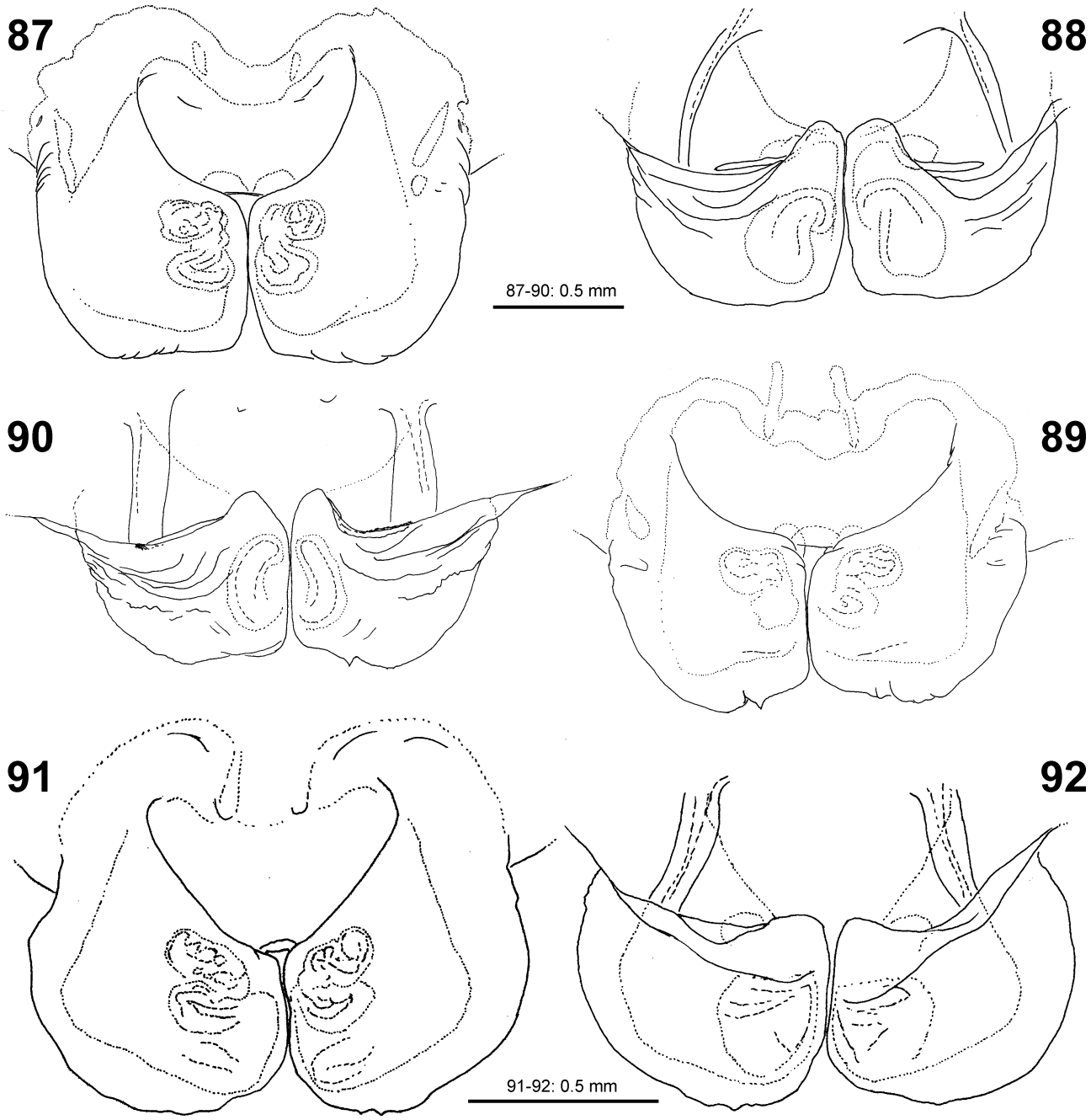
FIGURES 72–78. *Pseudopoda signata* from Paomashan valley (72–76: PJ 3492, 3533 m elevation; 77: PJ 3494, 3533 m elevation; 78 PJ 3493: 2770 m elevation). 72–73, 77–78 Epigyne, ventral (73 uncleared); 74, 76 Vulva (74 dorsal, 76 frontal); 75 Schematic course of internal duct system, dorsal. For angle indicated in Fig. 73 see Material & Methods.

Diagnosis (modified from Jäger 2001)**.** Small to medium-sized Heteropodinae with body length of males 6.8–9.9, of females 8.0–11.4. Males and females most similar to *P. yunnanensis* (Yang & Hu, 2001), males also to *P. yinae* Jäger & Vedel, 2007 in having a very similar shape of the embolus as well as of the RTA. Males can be distinguished by 1) Presence of subdistal tooth at distal embolus (Figs 59, 67, 71; absent in *P. yinae* and *P. yunnanensis*), 2) Convex prolateral margin of the dorsal RTA (concave in *P. yunnanensis* and *P. yinae*), 3) (only from *P. yinae*) More or less blunt embolus tip (more distinctly pointed in *P. yinae*) and 4) (only from *P. yinae*) Rounded ventral RTA in retrolateral view (right-angled in *P. yinae*) (Figs 55–60, 63–71). Females may be distinguished from those of *P. yunnanensis* by 1) Anterior margins of LL forming an angle larger than 90° resulting in a broader "U" or "V" (angle smaller than 90° in *P. yunnanensis*), 2) Ventral windings extending not or only rarely in anterior epigyne, i.e. in the area lateral of the "U" or "V" (Figs 72–89).



FIGURES 79–86. *Pseudopoda signata* from Muge Cuo (79–80: PJ 3513, 3432 m elevation) and Gonggashan valley (81–85: PJ 3504; 86: PJ 3505, all 2963 m elevation). 79, 81, 86 Epigyne, ventral; 80, 82, 84 Vulva (80, 82 dorsal, 84 frontal); 83, 85 Schematic course of internal duct system (83 dorsal, 85, frontal).

Description. Male (PJ 2148): DS length 4.8, width 4.1, AW 2.5, OS length 5.1, width 3.0. Eyes: AME 0.22, ALE 0.32, PME 0.25, PLE 0.30, AME–AME 0.19, AME–ALE 0.08, PME–PME 0.31, PME–PLE 0.35, AME–PME 0.33, ALE–PLE 0.30, clypeus height at AME 0.30, at ALE 0.30. Spination: palp: 131, 101, 2101; legs: femur I–II 323, III 322, IV 331; patella I–II 001, III–IV 000; tibia I–III 2026, IV 2023; metatarsus I–II 2024, III 3025, IV 3037. Metatarsus IV ventrally with numerous bristles along entire length, metatarsus III with some bristles, most of them in proximal half. Leg formula: 2143. Measurements of palp and legs: palp 6.7 (2.1, 1.0, 1.4, -, 2.2), leg I 19.5 (4.6, 2.2, 4.8, 4.3, 1.6), leg II 20.9 (5.3, 2.3, 5.1, 4.6, 1.6), leg III 15.0 (4.6, 2.0, 4.2, 3.8, 1.4), leg IV 17.4 (5.0, 1.8, 4.3, 4.6, 1.7). Cheliceral furrow with ca. 25 denticles in small patch at median anterior tooth. Promargin of chelicerae with 3 teeth, retromargin with 4 teeth.



FIGURES 87–92. 87–90 *Pseudopoda signata* from Yanzi Gou (87–90: PJ 3510–3511, 3800 m elevation). 91–92 *Pseudopoda* sp. from Leng Long Cun (PJ 3512, ca. 3200 m elevation). 87, 89, 91 Epigyne, ventral; 88, 90, 92 Vulva, dorsal.

Palp as in diagnosis (Figs 55–60, 63–71). RTA arising proximally to medially from tibia, with distinct ventral hump in retrolateral view and two short apices. Cymbium roughly twice as long as tibia, with strong retrolateral bulge. Tegulum with proximal bulge which varies in shape. Spermophor wide retrolaterally, narrow within E and intermediate proximo-prolaterally. E arising in 9- to 10-o'clock-position from tegulum, E tip prolaterad. C arising in 11.30- to 12-o'clock-position from tegulum.

Colouration (Figs 61–62, 94–96, 100–101): Yellowish brown with reddish-brown markings. DS with 2 lateral bands consisting of radial striae and submarginally with irregular dots, fovea marked with two small dots and 4 bristles in front. Sternum with 8 dots and striae close to coxae. Coxae pale yellowish, without pattern. Chelicerae reddish brown, frontally dotted. Legs pale yellowish brown with tibia to tarsus distinctly darker; femora dotted and with spine patches, patella and parts of tibia with patches proximally and lines dorsally. OS dorsally with heart patch and broader converging dark patch behind, followed by light area with distinct boundary. OS laterally

irregularly spotted, ventrally with 2 parallel patches in front of epigastric furrow, otherwise pale yellowish brown with dots and V-shaped pattern in front of spinnerets. Anterior spinnerets dark, posterior spinnerets light. For colouration of living spider see Fig. 93.

Redescription. Female (PJ 3492): DS length 3.5, width 3.2, AW 1.9, OS length 4.5, width 2.8. Eyes: AME 0.16, ALE 0.24, PME 0.19, PLE 0.23, AME–AME 0.16, AME–ALE 0.07, PME–PME 0.29, PME–PLE 0.30, AME–PME 0.28, ALE–PLE 0.29, clypeus height at AME 0.25, at ALE 0.20. Spination: palp: 131, 101, 2121, 1014; legs: femur I–II 323, III 322, IV 331; patella 000; tibia I 1026, II–III 2026, IV 2125; metatarsus I–II 1024 [prolateral proximal spine absent], III 2025, IV 3037. Metatarsus IV ventrally with numerous bristles along entire length, metatarsus III with 12–15 bristles in proximal half. Leg formula: 2413. Measurements of palp and legs: palp 4.6 (1.2, 0.8, 1.1, -, 1.5), leg I 10.7 (3.0, 1.5, 2.8, 2.4, 1.0), leg II 11.5 (3.3, 1.6, 3.0, 2.6, 1.0), leg III 10.3 (2.9, 1.3, 2.5, 2.7, 0.9), leg IV 10.9 (3.3, 1.2, 2.6, 2.7, 1.1). Cheliceral furrow with ca. 18 denticles in slightly elongated patch at distal anterior tooth. Promargin of chelicerae with 3 teeth, retromargin with 4 teeth. Palpal claw with 7 teeth.

Copulatory organ as in diagnosis (Figs 72–89). Epigynal field wider than long, with bilobate to trilobate anterior margin and short, sometimes indistinct or reduced anterior bands. LL with bands of muscle sigilla in their lateral parts. First winding wide, converging slightly posteriorly. Fertilisation duct moderately long, narrow, laterad in ventral view.

Colouration (Figs 97–99, 102–104): As in male. DS with dark lateral margin in thoracic part. Sternum with additional dots sub-centrally in anterior half. Leg pattern more distinct than in males, and increasingly in posterior pair of legs, especially banded pattern in metatarsi. OS dorsally dark with 2 light patches lateral to heart patch, in posterior half with light transversal line with lateral ends widened. OS ventrally with dark median part bordered by light longitudinal lines. For colouration of living spiders see Figs 105–106.

Variation. Males (n=16): DS length 3.3–4.5. OS length: 3.2–5.0. Fovea in some males with only two patches in front or with two only indistinct anterior dots or without bristles. Some specimens with weaker contrast between light proximal and darker distal leg segments, some almost without leg pattern. Spination: Palpal patella 1(0)01(0); Femur III 323; Patella II 001(0), Tibia III 2126, IV 2026. Leg formula 2413. Cheliceral furrow with ca. 15–20 denticles in restricted patch at largest anterior tooth. Promargin of chelicerae with 2 teeth. Females (n=12): DS length 3.5–4.4. OS length 4.5–6.3. Spination: Palpal tibia 2021; femur I 3(2)23, III 323(2), IV 321; tibia I 2026, IV 2016; metatarsus I 2014, II 2024, III 3025, IV 3(4)037. Leg formula 2143. Palpal claw with 8 teeth. Male palps vary especially in the shape of the RTA, and here in the dRTA (Figs 58, 66, 70). Moreover, the subdistal embolic tooth may have different shapes and positions (Figs 59, 67, 71). The embolus tip varies also (Figs 56, 64, 68), as does the spermophor (straight: Figs 56, 68; slightly undulating: Fig. 64). Females have different shapes of their lateral lobes, especially striking at the posterior margins (with distinct incision: Figs 72, 76; without: Figs 79, 87), and of their ventral windings of the internal duct system (with longer anterior parts (Figs 72, 76, 79; with shorter anterior parts: Figs 77, 87).

Distribution. China: *Sichuan*. The known range of the distribution spans from Muge Cuo Lake over Kangding town to the valleys of Paomashan, Gonggashan and Yanzi (Fig. 130).

Natural history. In Kangding town at 2500 m elevation spiders of *P. signata* have been recorded between stones in walls along roads. Here, three males were found caught in webs of *Achaearanea* spiders. In the Paomashan valley south of Kangding in higher altitudes up to 3500 m elevation specimens were recorded in natural habitats under stones, under deadwood and in the leaf litter of shrub-like stocks of *Quercus semecarpifolia* Smith, 1814.

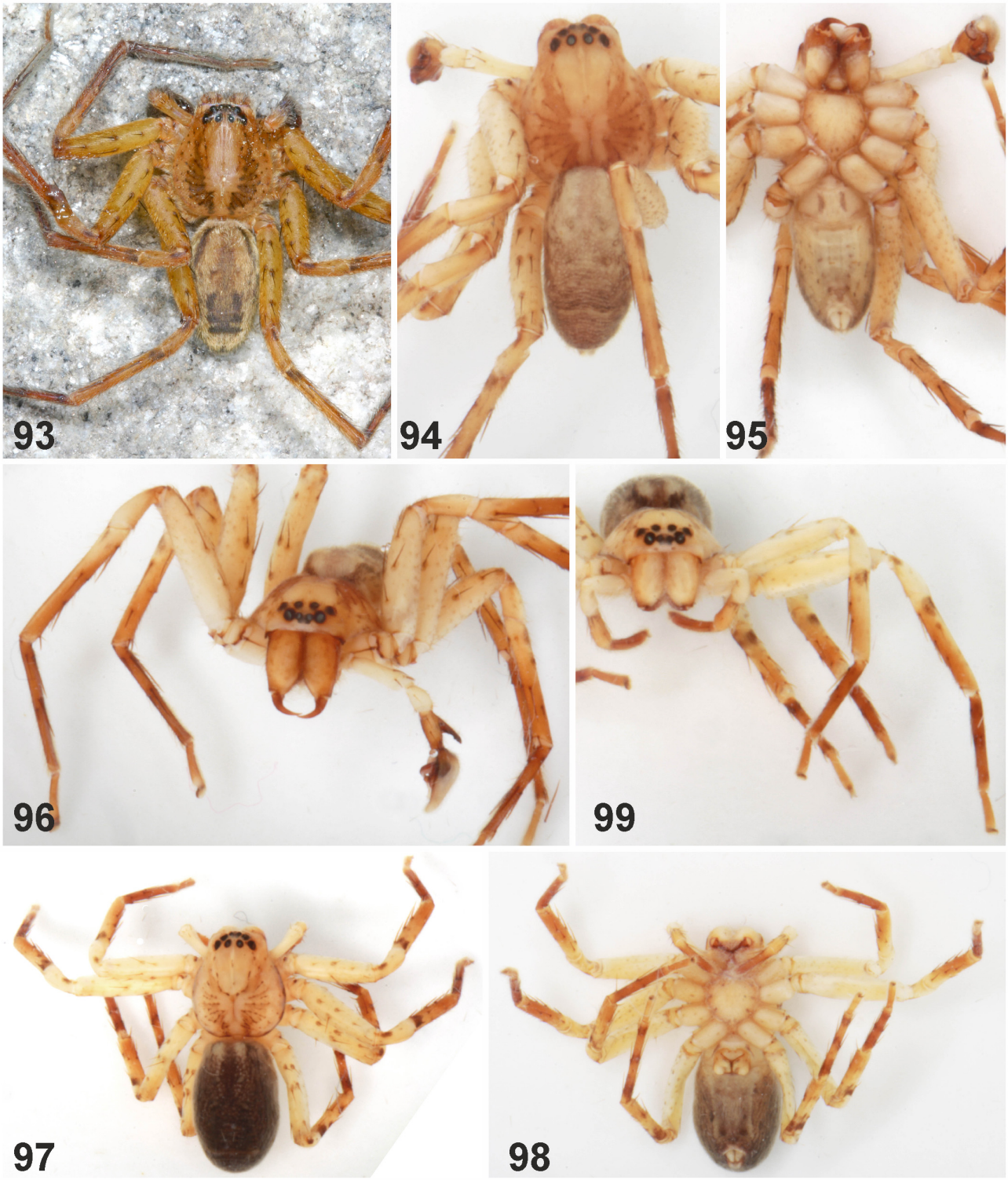
***Pseudopoda* sp.**
Figs 91–92, 130

Material examined. China: *Sichuan*: 1 female (PJ 3512), Xiangcheng, Leng Long Cun [ca. 28°58'13.90"N, 99°46'6.27"E, 3200 m], 26 June 1982, SD 1255 (IZCAS #142).

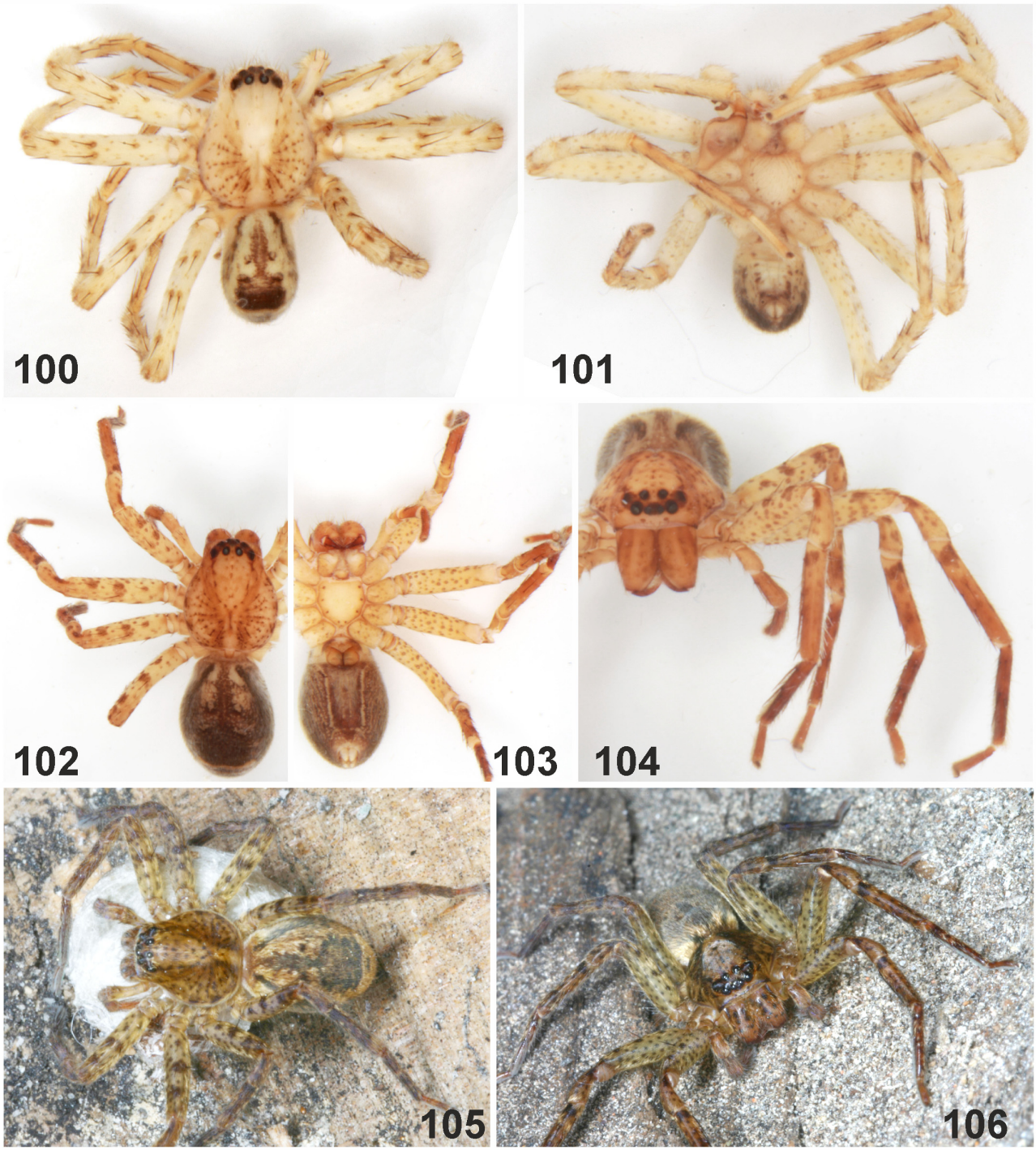
Notes. From the ventral windings (Fig. 91) and other characters as size, colouration, spination etc. it could well be considered as intraspecific variation within either *P. signata* or *P. yunnanensis*. Since it was recorded c. 250 km WSW of Kangding (type locality of *P. signata*) and c. 360 km N of Dali, Cangshan (type locality of *P.*

yunnanensis) and no fresh molecular sample or a conspecific male was available, it cannot be identified to species level.

Distribution. China: *Sichuan*. Known only from one locality in SW Sichuan (Fig. 130: cf. *yunnanensis*/*signata*).



FIGURES 93–99. *Pseudopoda signata* from Kangding town (93: PJ 2166; 94–96 PJ 2150, 2580 m elevation, males) and Paomashan valley (97–99: PJ 3492, 3533 m elevation, female). Habitus of live (93) and preserved (94–99) spiders (93, 94, 97 dorsal, 95, 98 ventral, 96, 99 frontal).

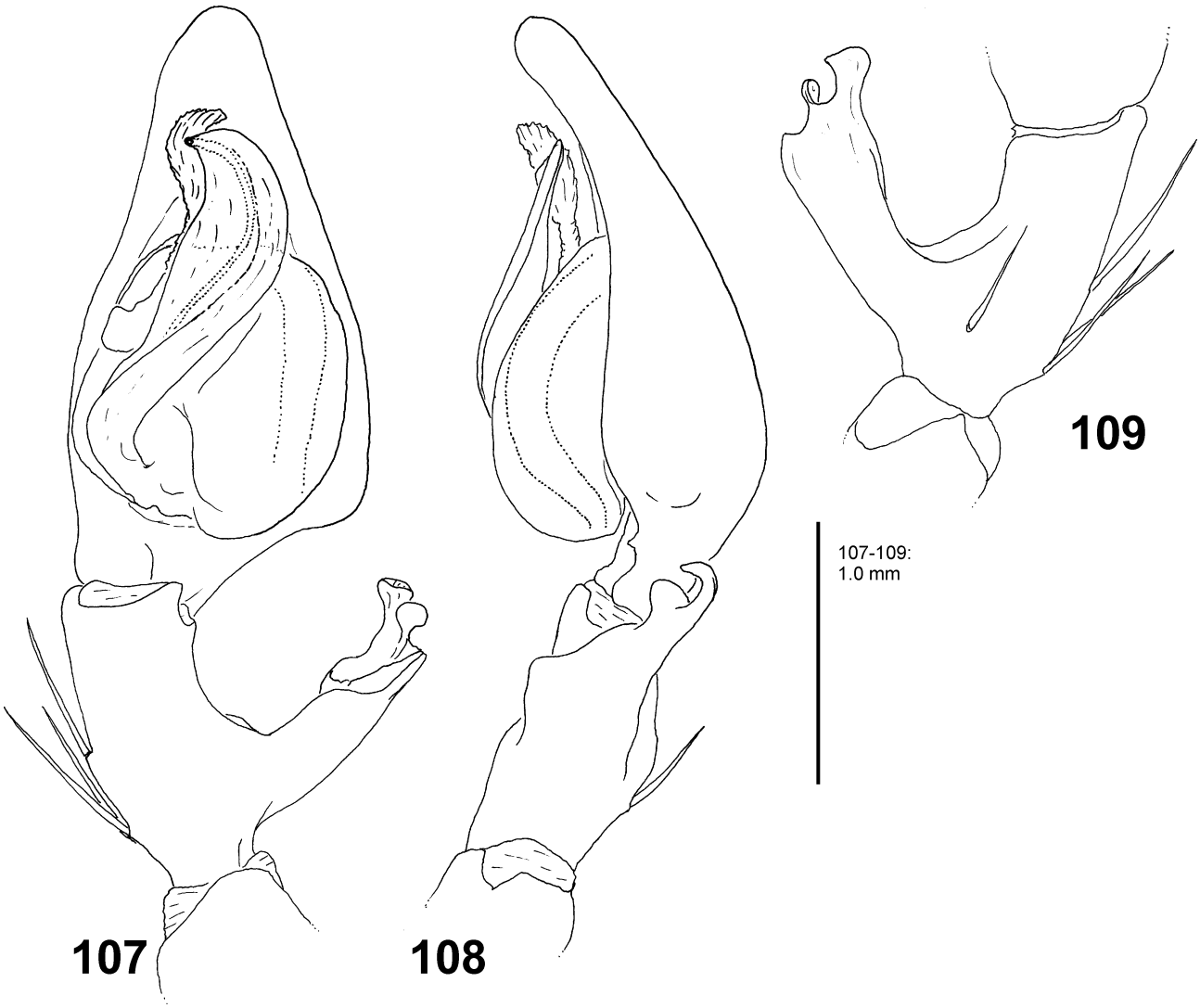


FIGURES 100–106. *Pseudopoda signata*, from Gonggashan valley (2963 m elevation), male (100–101: PJ 3506) and females (102–105: PJ 3505; 106: PJ 3504). Habitus of preserved (100–104) and live (105–106) spiders (100, 102, 105 dorsal, 101, 103 ventral, 104, 106 frontal).

***Pseudopoda* sp. cf. *yunnanensis* (Yang & Hu, 2001)**
Figs 108–109, 130

Material examined. China: *Sichuan*: 1 male (PJ 3508), Gongga Shan, west slopes, Chanzhu Tang leg., July[?] 1983, SD 1255 (IZCAS).

Notes. *Pseudopoda yunnanensis* was described in the genus *Sinopoda* by Yang and Hu (2001) and transferred to *Pseudopoda* by Jäger and Vedel (2007; type material not available). Yang and Chen (2008) described the female for the first time and illustrated both sexes with their copulatory organs as well as with photos of their dorsal habitus. *Pseudopoda yunnanensis* certainly belongs into one lineage with *P. signata* according to the very similar palpal structures (shape of embolus, shape of RTA; Figs 107–109), *P. yinae* might also belong into this group. Considering the complex diversity, i.e. closely related species with only tiny morphological differences (see diagnosis under *P. signata*) and the fact that there are differences in the palp of the present specimen and the original illustrations of the type material, we refrain from identifying the present specimen to species level. Specimen not mapped due to lacking coordinates.



FIGURES 107–109. *Pseudopoda* sp. cf. *yunnanensis* from west slopes of Gonggashan, male left palp (107 ventral, 108 retrolateral, 109 dorsal).

Pseudopoda rivicola Jäger and Vedel, 2007

Figs 110–114, 130

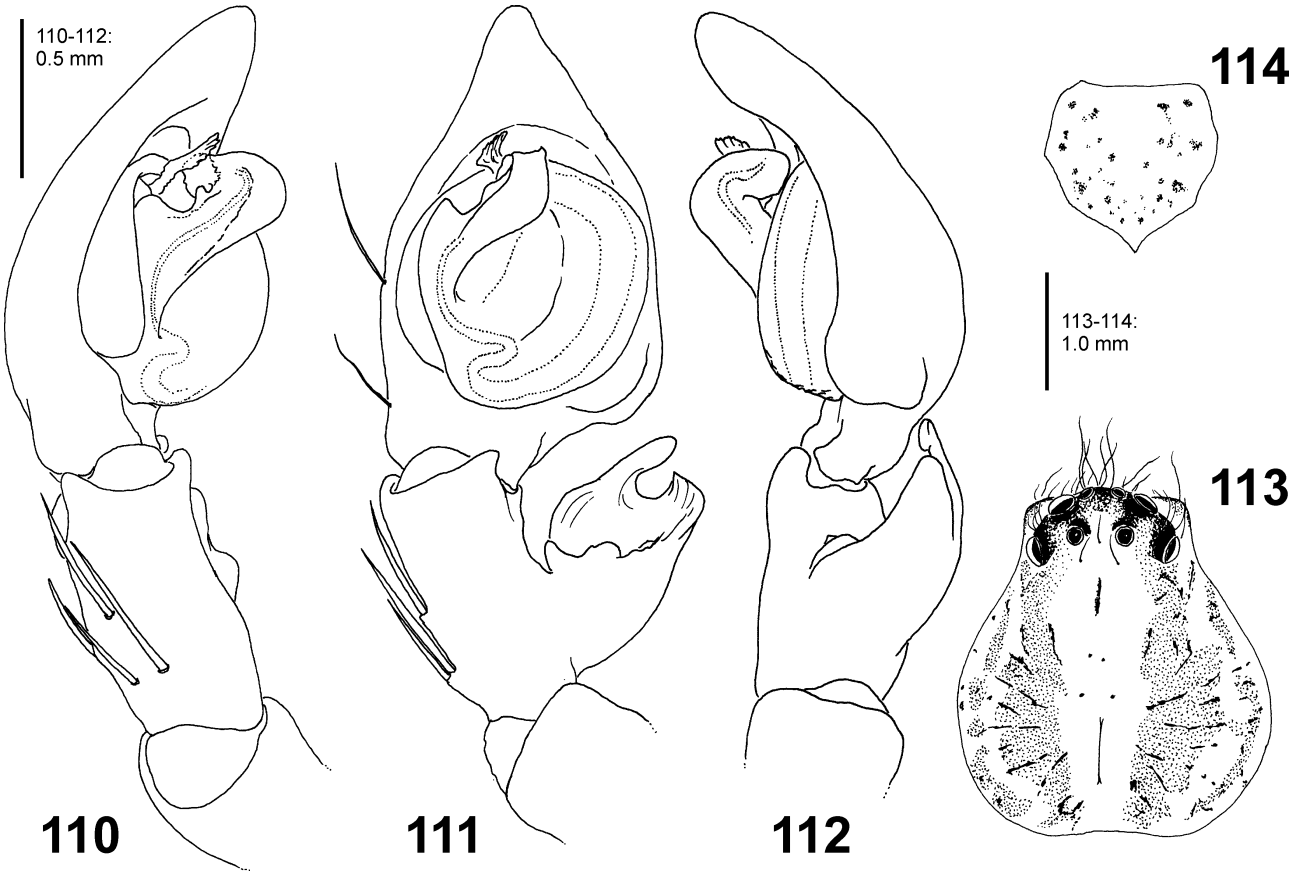
Pseudopoda rivicola Jäger and Vedel, 2007: 27, figs 97–104, 137 (Description of male and female; holotype male, male and female paratypes from China, Yunnan, Cangshan; deposited in SMF and IZCAS, examined).

Note. Jäger and Vedel (2007) illustrated only specimens from Yunnan. Here, the only known male from Sichuan is shown (Figs 110–114). There is almost no variation in the palp between the male from Yunnan and the present male.

Material examined. China: *Sichuan*: 1 male (PJ 1811), Emeishan, river below Wannian cableway valley station [29°35'52.42"N, 103°22'39.10"E, 750 m], under stones, P. Jäger leg., by hand, at day, 22 March 1999 (SMF).

Diagnosis. See Jäger and Vedel (2007).

Distribution. China: *Yunnan* (Cangshan), ***Sichuan*** (Emeishan) (Fig. 130).



FIGURES 110–114. *Pseudopoda rivicola*, male from Emeishan. 110–112 Male left palp (110 prolateral, 111 ventral, 112 retrolateral). 113 Prosoma, dorsal. 114 Sternum, ventral.

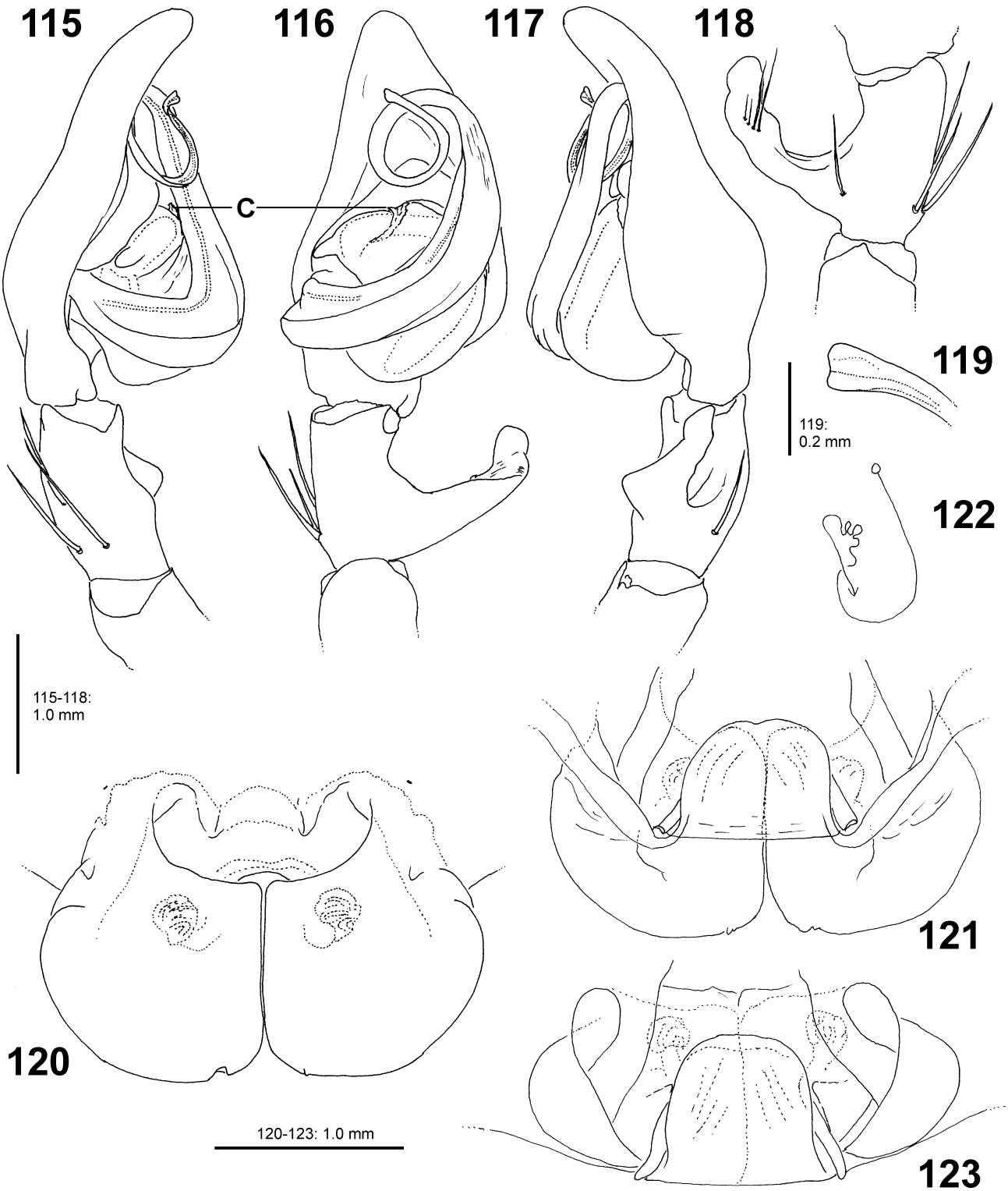
***Pseudopoda wu* spec. nov.**
Figs 115–130

Type material. CHINA: *Sichuan*: Holotype: male (PJ 3489) Lugu Lake, 27°46'10.04" N, 100°45'52.47"E, 3100 m, extremely dry (secondary) *Pinus* forest, J. Martens leg., by hand, 27 May 2011 (SMF).

Paratypes: 1 female (PJ 3490, SD 1134), with same data as for holotype (SMF). ***Yunnan*:** 1 male (PJ 3491, SD 1135), with same data as for holotype, but: 27°37'55.90" N, 100°49'04.06"E, 3300 m, 28 May 2011 (IZCAS).

Etymology. The species name is derived from the Chinese word " 无[無], wú" meaning "without" and referring to the fact that this new species is the first one of the genus *Pseudopoda* with an almost entirely reduced conductor; term in apposition.

Diagnosis. Medium sized representatives of *Pseudopoda*, body length of males 11.0–11.6, of females 12.6. Male palp of the new species differs from all other species of the genus by its C reduced to a small inconspicuous structure (Figs 115–116: C). Proximal part of E similar to that of *P. signata* or related species, but distinguished by 1) Distal end of E with one coil, 2) RTA with simple tip, i.e. not divided in two apices (Figs 115–119). Females resemble those of *P. signata* in anterior margins of LL broadly U-shaped and ventral windings situated close to anterior margin of LL, but are distinguished by 1) Ventral windings narrower and accumulated in a small spherical structure, 2) First windings diverging posteriorly more strongly, 3) LL more rounded posteriorly (Figs 120–122).



FIGURES 115–123. *Pseudopoda wu* **spec. nov.**, holotype male (115–119) and female paratype (120–123: PJ 3491) from Lugu Lake. 115–118 Male left palp (115 prolateral, 116 ventral, 117 retrolateral, 118 dorsal); 119 Embolus tip, ventral. 120 epigyne, ventral. 121, 123 Vulva (121 dorsal, 123 frontal). 122 Schematic course of internal duct system, dorsal. C—conductor.

Description. Male (holotype): DS length 5.5, width 5.1, AW 3.0, OS length 6.1, width 3.6. Eyes: AME 0.28, ALE 0.39, PME 0.30, PLE 0.40, AME–AME 0.19, AME–ALE 0.11, PME–PME 0.36, PME–PLE 0.42, AME–PME 0.40 ALE–PLE 0.42, clypeus height at AME 0.38, at ALE 0.33. Spination: palp: 131, 001(small), 2101; legs: femur I 313(324), II 323, III 3(2)33, IV 33(2)1; patella I–III 001, IV 001(0); tibia I–IV 2026; metatarsus I 2014, II 2024, III 3025, IV 3037(6). Metatarsus IV ventrally with several bristles along entire length, metatarsus III with

few bristles in proximal half. Leg formula: 2143. Measurements of palp and legs: palp 8.1 (2.6, 1.2, 1.3, -, 3.0), leg I 24.3 (6.5, 2.8, 6.6, 6.2, 2.2), leg II 26.5 (7.2, 2.9, 7.3, 6.9, 2.2), leg III 22.1 (6.2, 2.5, 5.8, 5.6, 2.0), leg IV 23.2 (6.5, 2.2, 6.0, 6.3, 2.2). Cheliceral furrow with ca. 25 denticles in restricted patch at largest anterior tooth. Promargin of chelicerae with 3 teeth, retromargin with 4 teeth.

Palp as in diagnosis (Figs 115–119). RTA arising proximally from tibia, with distinct ventral hump in retrolateral view. Cymbium more than twice as long as tibia, with prolateral and retrolateral bulge. Tegulum with proximal bulge, prolatero-distal elongate nipple. Spermophor wide in tegulum, very narrow within E. E arising in 9-o'clock-position from tegulum, strong, in distal coil narrower, E tip widened, disto-prolaterad. C arising in 12-o'clock-position from tegulum, small, not reaching embolus tip as in other *Pseudopoda* species.

Colouration (Figs 124–126): Yellowish to reddish-brown with dark brown markings. DS with fovea and striae marked, the latter with rows of dots, margins slightly darker than rest. Sternum with 6 dots at coxae I–III. Coxae and femora ventrally indistinctly dotted, labium and gnathocoxae distally lighter. Chelicerae reddish-brown, without pattern. Legs with coxae to tibiae yellowish, metatarsi and tarsi reddish-brown, femora with spine patches, tibiae proximally with few irregular patches. OS dorsally with heart patch and lateral markings in anterior half; in posterior half with dark chevrons and write transversal line. OS ventrally with several spots.

Female (paratype): DS length 5.4, width 4.8, AW 3.0, OS length 7.2, width 4.7. Eyes: AME 0.24, ALE 0.35, PME 0.29, PLE 0.35, AME–AME 0.23, AME–ALE 0.09, PME–PME 0.38, PME–PLE 0.45, AME–PME 0.36, ALE–PLE 0.37, clypeus height at AME 0.38, at ALE 0.30. Spination: palp: 131, 101, 2121, 1014; legs: femur I–II 323, III 323(2), IV 331; patella I–III 001, IV 000; tibia I–IV 2026; metatarsus I–II 2024, III 3025, IV 3037. Metatarsus IV ventrally with many bristles along entire length, metatarsus III with few bristles in proximal half. Leg formula: 2143. Measurements of palp and legs: palp 6.9 (2.0, 1.1, 1.5, -, 2.3), leg I 18.7 (4.9, 2.4, 4.8, 4.1, 1.5), leg II 19.1 (5.5, 2.6, 5.1, 4.4, 1.5), leg III 16.1 (4.8, 2.2, 4.0, 3.7, 1.4), leg IV 17.5 (5.3, 1.8, 4.3, 4.4, 1.7). Cheliceral furrow with ca. 45 denticles in restricted patch close to median anterior tooth. Promargin of chelicerae with 3 teeth, retromargin with 4 teeth. Palpal claw with 8 teeth.

FIGURES 124–129. *Pseudopoda wu* **spec. nov.**, male (124–126) and female paratype (127–129: PJ 3491) from Lugu Lake, habitus (124, 127 dorsal, 125, 128 ventral, 126, 129 frontal).

Copulatory organ as in diagnosis (Figs 120–122). Epigynal field wider than long, with trilobate anterior margin and anterior bands inconspicuous and included in epigynal field. Part of LL extending posteriorly beyond epigastric furrow longer than part anterior of epigastric furrow. Dorsal part of LL developed as prominent anterior hump with rills. Fertilisation ducts latero-posteriad.

Colouration (Figs 127–129): As in male but generally markings more distinct. Sternum and coxae ventrally with few indistinct dots. OS dorsally as in male paratype (see variation), transversal line with anterior margin distinct, posterior margin frayed; OS ventrally with narrow V-shaped marking and few additional dots.

Variation. Males (n=1): DS length 4.9, OS length 6.1. Spination: femur I 322(3), II 323, III 322, IV 331; patella I–II 101, III 001, IV 001(0); tibia 2026; metatarsus I–II 2024, III 3025, IV 3037. Colouration: Markings more distinct (Figs 124–126) than in holotype. DS with dots and markings forming 2 indistinct longitudinal bands. Sternum with several dots also centrally. OS dorsally with darker heart region accompanied by light areas and light patches, transversal line in posterior half very distinct. OS ventrally with dots fused to V- to U-shaped marking, in front of epigastric furrow with 2 parallel markings.

Distribution. China: ***Yunnan***, ***Sichuan***. Known from the type locality in South Sichuan and a nearby locality in North Yunnan (Fig. 130).

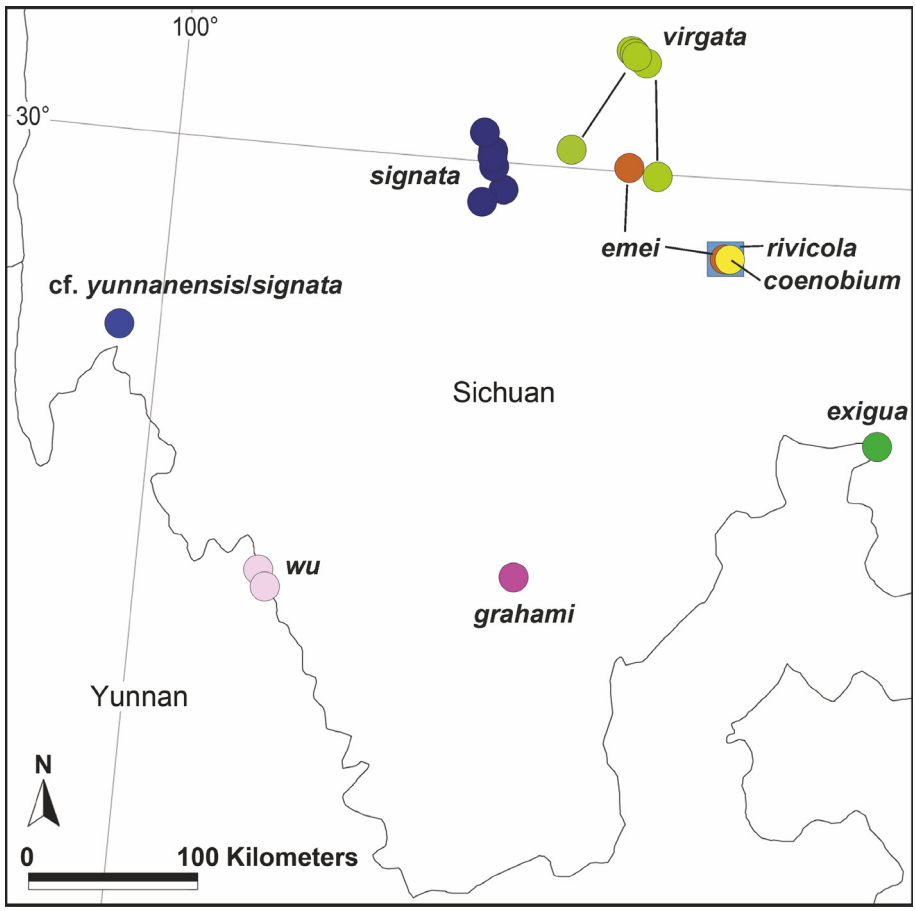


FIGURE 130. Map of Sichuan with records of *Pseudopoda* spp. (*Pseudopoda* sp. cf. *yunnanensis* not mapped). *Pseudopoda grahami* (Fox, 1936) and *P. exigua (*Fox, 1938) are included as described from Sichuan although no new records are known and therefore not mentioned in the text.

Notes. A reduction and arrangement of a conductor as exhibited in *P. wu* **spec. nov.** is an extraordinary character only known from few species within the Sparassidae (presently with 1148 species known; World Spider Catalog 2015). In several Sparassidae the conductor is developed as sheath-like structure, most likely functioning as guiding support during the copulation process. This type is known for instance from the genera *Heteropoda* Latreille, 1804, *Yiinthi* Davies, 1994, *Gnathopalystes* Rainbow, 1899 and *Damastes* Simon, 1880. In many species the conductor is membranous and more or less spoon-shaped with the embolus tip close to the conductor's distal part, e.g. in *Pseudopoda*, *Sinopoda* Jäger, 1999, *Spariolenus* Simon, 1880, *Leucorchestris* Lawrence, 1962 or

Palystella Lawrence, 1928. In the Deleninae, the conductor is spiral shaped or screw-like and supports the wound embolus at least in its resting position (e.g., in *Neosparassus* Hogg, 1903). In other species it is reduced and sits attached with a broad base directly at the tegulum, but still with the embolus tip close to it (many species of *Olios* Walckenaer, 1837). In species of, for instance, the genera *Bhutaniella* Jäger, 2000, *Cebrennus* Simon, 1880, *Rhitymna* Simon, 1897, *Vindullus* Simon, 1880, and in *Origes pollens* Simon, 1897, the conductor is almost entirely or entirely reduced. *Pseudopoda wu* **spec. nov.** represents a morphological and most likely functional novelty within the genus. It might be explained by the rigid embolus that does not need any supportive structure. Behavioural observations and analyses are necessary to support this hypothesis.

Molecular analysis

We sequenced PCR fragments of ~900 bp from 37 Sparassidae specimens belonging to 17 species. However, due to sequencing quality problems, we had to trim the alignments to 515 (COI) and 790 bp (28S) respectively. All phylogenetic analyses generally revealed very similar trees. The COI tree lacks support at deeper divergence and the 28S tree lacks resolution at shallow divergence. A phylogeny from the combined dataset resulted in considerable improvement of the overall clade support values (Fig. 131).

However, we still find several clades with low support values. Interestingly, specimens from Sichuan group in two different clades in our phylogeny. This might indicate two independent colonization events of the area, but more markers will be necessary to fully resolve relationships in the genus *Pseudopoda*. We thus refrain from deriving more biogeographic inferences from our dataset and focus on its taxonomic interpretation. All specimens, which were identified as *P. signata*, form a well-supported monophyletic clade (*P. signata* clade; Fig. 131: Sichuan II). The same holds true for formerly unidentified *Pseudopoda* sp. SD28 and SD79, which cluster with specimens identified clearly as *P. virgata* and which could be identified by the supportive results of the molecular analysis. *P. emei* is identified as one potential sister group of *P. virgata*, supported by very similar morphological characters and a high posterior probability in the phylogeny (Fig. 131).

The average genetic distances between *Pseudopoda* species are much higher than those observed within the *P. signata* and in parts of the *P. virgata* clades (Table 1, Figure 133). Moreover, there is little overlap between intra-clade and interspecific distances, indicating the presence of a barcode gap (Figure 133). Even the closely related species *P. virgata* and *P. emei* are clearly separated by a high COI distance (ca. 8% COI distance). Nevertheless, the genetic distances within the *P. signata* and *P. virgata* clades in the COI gene are considerable (up to 4 %). This finding is particularly interesting in *P. signata*, were specimens are differentiated according to their geographic origin. However, our 28S analysis shows almost no differentiation within the *P. signata* and *P. virgata* clades. In the absence of nuclear divergence, mitochondrial differentiation thus not necessarily indicates completed speciation. The inclusion of nuclear DNA markers is thus strongly advised in integrative taxonomic analyses of spiders and provides additional support for taxonomic hypotheses. Based on these results, we suggest that the analysed specimens of the *P. signata* and the *P. virgata* clades, respectively, are likely conspecific. Still, the geographic structure of mitochondrial divergence and morphological variation might suggest ongoing speciation in the *P. signata* clade. It should, however, be noted that our distance analysis is not exhaustive, as we include only a subset of the species in the genus *Pseudopoda*. A denser taxonomic and geographic sampling will be necessary to test for the presence of geographic structure in *P. signata* and to conclude about the taxonomic status of specimens in the *P. virgata* clade as well as about the biogeographical history of the genus and possible migration routes (cf. Fig. 132).

TABLE 1. Average pairwise genetic distances (p-distance) and its standard deviation between all analysed *Pseudopoda* taxa and within the *P. signata* and *P. virgata* groups for mitochondrial COI and nuclear 28S.

	Average COI	Average 28S
P. signata clade	0.023 ± 0.011	0.000 ± 0.000
P. virgata clade	0.027 ± 0.020	0.001 ± 0.001
Interspecific	0.12 ± 0.01	0.009 ± 0.004

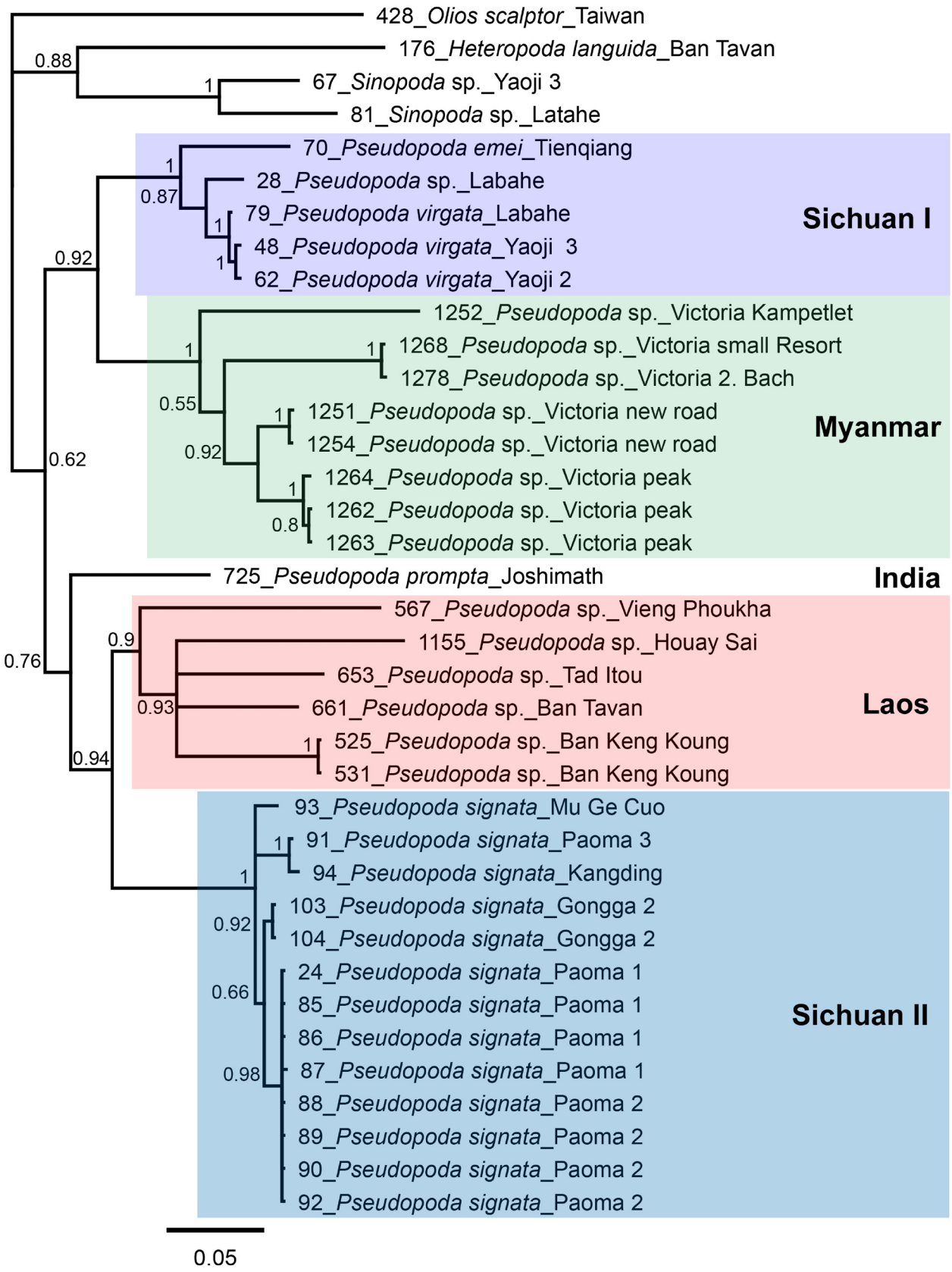


FIGURE 131. Bayesian consensus phylogeny for selected taxa of the genus *Pseudopoda*. Numbers on nodes indicate posterior probability. Branches with a support of less than 0.5 are not resolved. Tree based on the combined dataset of 28SrDNA and mitochondrial COI genes. Numbers in front of taxon names are SD numbers and referred to in the text. The main geographic clades are indicated.

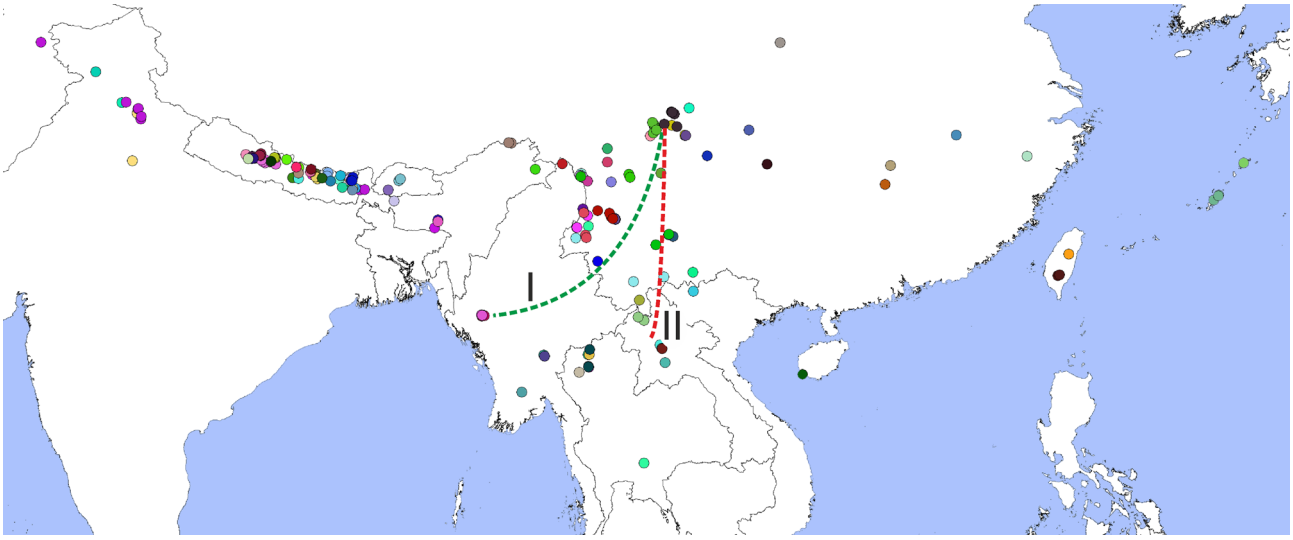


FIGURE 132. Map with distribution records of *Pseudopoda* species. Different colours represent different species or forms (n=136 including all described species with coordinates as well as undescribed taxa). Broken lines indicate proposed relationships of Sichuan clade I and II with Burmese and Laotian species. Roman numbers refer to clades distinguished in Fig. 131.

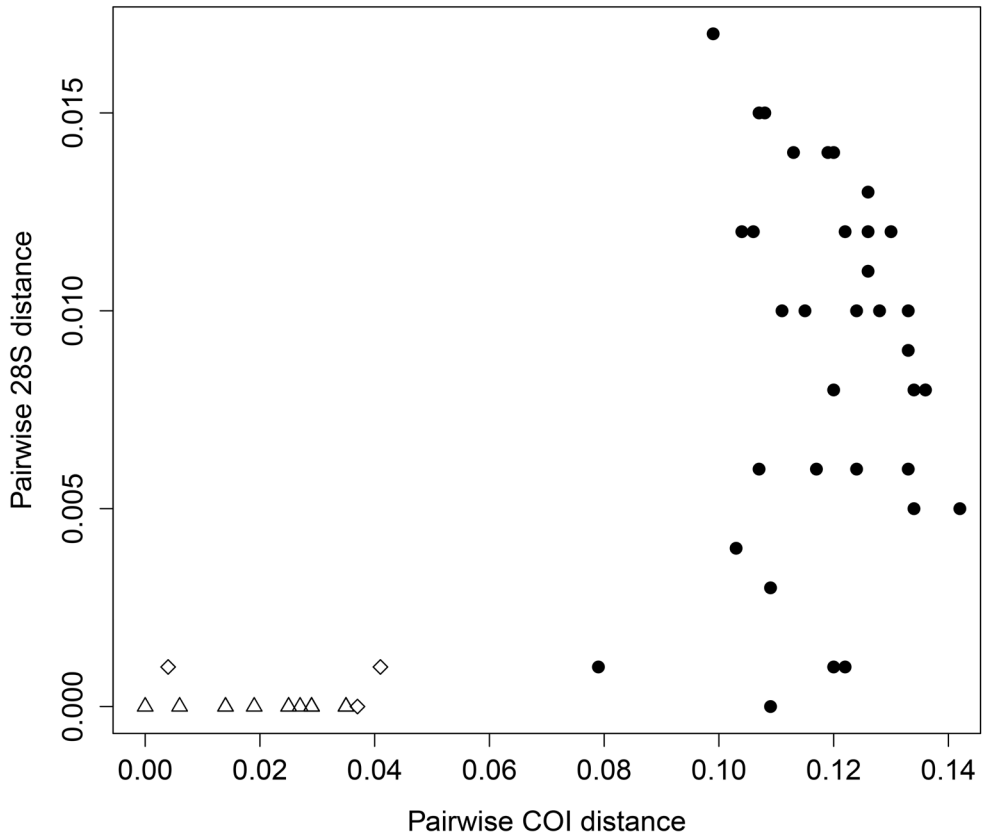


FIGURE 133. Pairwise genetic distances between *Pseudopoda* species (filled circles) and within the *P. signata* (open triangles) and *P. virgata* clades (open squares). The distances for COI and 28s are plotted against each other for each pairwise comparison.

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