

Two new species of the spider genus *Putaoa* (Araneae, Linyphiidae) from southern China

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Abstract

Two new species of the genus *Putaoa* Hormiga and Tu, 2008 from southern China are described, *Putaoa annulata* n. sp. (♂♀) and *Putaoa titanoverpa* n. sp. (♂♀), for a total number of five described species in this genus. Detailed descriptions and illustrations of the two new species are provided. A map of collecting localities is also provided for all five *Putaoa* species.

Key words: Distribution, linyphiid, morphology, classification, taxonomy

Introduction

The spider family Linyphiidae Blackwall, 1859 is a taxon with high species diversity, including more than 4800 species classified in 632 genera (WSC 2023). They inhabit a variety of environments, ranging from moist to dry habitats and from low to high elevations, occupying a great diversity of niches (Janetos 1983; Kolenda *et al.* 2021; Mammola *et al.* 2018; Schmidt and Tscharnke 2005). As the second largest spider family-group in terms of described species, linyphiids have been the study focus of arachnologists on alpha-taxonomy, phylogenetics, evolution, and phylogeography (e.g., Arnedo and Hormiga 2021; Frick and Scharff 2014; Hormiga 1994; Hormiga *et al.* 2003; Irfan 2019; Millidge 1977; Saaristo 1973; Schmidt and Tscharnke 2005; van Helsdingen 1969).

The genus *Putaoa* Hormiga & Tu, 2008 was erected by Hormiga and Tu in 2008 based on the type species, *Putaoa huaping* Hormiga & Tu, 2008, collected in Guangxi Zhuang Autonomous Region, China. Based on a morphological phylogenetic analysis Hormiga and Tu (2008) transferred a species, *Weintrauboa megacantha* Xu & Li, 2007 to *Putaoa* and placed *Putaoa* in the family Pimoidae Wunderlich, 1986. The same familial placement of *Putaoa* was found in the morphological analysis of Hormiga (2008). On the other hand, molecular analyses of the standard markers suggested placement of *Putaoa* and *Weintrauboa* Hormiga, 2003 in an early diverging clade at the base of Linyphiidae (Wang *et al.* 2015; Dimitrov *et al.* 2017), with Pimoidae Wunderlich, 1986 including only *Pimoa* Chamberlin & Ivie, 1943 and *Nanoa* Chamberlin & Ivie, 1943. Hormiga *et al.* (2021) reassessed and re-circumscribed Pimoidae and Linyphiidae using a standard target-gene approach, formally transferred the genera *Putaoa* and *Weintrauboa* into the linyphiid subfamily Stemonyphantinae (which in addition of *Stemonyphantes* Menge, 1866 also included the genus *Pecado* Hormiga & Scharff, 2005). In their study, *Putaoa* was represented by a single species, which was nested in the *Weintrauboa* clade (represented by two species), thus rendering the latter genus paraphyletic. Because the relationship between *Putaoa* and *Weintrauboa* require additional work and new species remain to be described, Hormiga *et al.* (2021) did not provide a formal recircumscription of these two genera.

At present time *Putaoa* includes three species: *P. megacantha*, *P. seediq* Hormiga & Dimitrov, 2017 and *P. huaping*, all from China (Sichuan, Taiwan, and Guangxi), and thus the genus is discontinuously distributed from the coniferous forests of the plateau area of western Sichuan to the tropical rainforests of the Taiwan Island. These areas of distribution span nearly 20 degrees of longitude with a total range spanning about two thousand kilometers, although only three collecting localities have the records of *Putaoa* species. In this paper, we describe two new species from southern China which fills up the partial interspace of discontinuous distribution of this group and increase its species diversity. These two new species, in addition, were collected from their webs hidden on the exposed roots of bushes growing on slopes.

Materials and methods

The specimens (preserved in 75% ethanol) were examined under an Olympus SZX16 stereomicroscope (Hunan Normal University, Changsha, China). Additional specimens, including paratypes, have been kept in 95% ethanol for future molecular analysis. All photographs were taken with a Canon 80D camera mounted on an Olympus BX53 compound microscope, and final multifocus images were produced using Helicon focus v. 6.0. Male palps were illustrated using a Leica M205A stereoscopic microscope equipped with a camera lucida. The male left palp and female genitalia were examined, photographed and illustrated after being dissected from the spider's body. Female genitalia were digested with pancreatin for three hours under indoor temperature before examination (Álvarez-Padilla and Hormiga 2007). Morphological measurements were taken using a stereomicroscope (LEICA M205C) and are given in millimeters. Eye diameters were taken at the widest point. Leg measurements are given as: total length (femur, patella, tibia, metatarsus, tarsus). Leg segments were measured on their dorsal sides. All specimens examined in this study were deposited in the College of Life Sciences, Hunan Normal University (HNU). Terms and abbreviations used in the text and figures follow those of Hormiga and Tu (2008) and Hormiga *et al.* (2021).

Taxonomy

Family Linyphiidae Blackwall, 1859

Subfamily Stemonyphantinae Wunderlich, 1986

Genus *Putaoa* Hormiga & Tu, 2008

Type species. *Putaoa huaping* Hormiga & Tu, 2008 from China (Guangxi).

Putaoa annulata new species

(环葡萄蛛)

Figures 1, 2, 5A–C, 6A, B, 7B

Holotype ♂ (HNU250): CHINA, Hunan Province, Hengyang City, Hengshan Mountain, Banshanting, 26°16.73'N, 112°42.49'E, 620m, 17 X 2015, Ailan He, Bing Zhou, Wang Liu, Chen Zeng, Zhuo'er Chen. **Paratypes**: 1♂ (HNU392) 1♀ (HNU251), same data as the holotype; 1♂ (HNU252) 1♀ (HNU253), CHINA, Hunan Province, Shaoyang City, Xinning County, Tianyixiang, 26°21.22'N, 110°48.25'E, 586m, 21 XI 2014, Haiqiang Yin, Cheng Wang, Jiahui Gan, Bing Zhou, Yuhui Gong; 2♂ (HNU255, HNU256) 2♀ (HNU257, HNU258), CHINA, Hunan Province, Hengyang City, Hengshan Mountain, Wanshou village, 27°31.51'N, 112°10.63'E, 487m, 20 X 2015, Ailan He, Bing Zhou, Wang Liu, Chen Zeng, Zhuo'er Chen; 2♀ (HNU430, HNU431), CHINA, Hunan Province, Zhangjiajie City, Wulingyuan District, Suoxiyu Town, portal of the Laoxiyu Tunnel, 29°17.33'N, 110°29.08'E, 456m, 23 IIII 2016, Wang Liu, Chen Zeng, Tian Tian; 1♂ (HNU479) 3♀ (HNU712–714), CHINA, Guangxi Zhuang Autonomous Region, Laibin City, Jinxiu Yao Autonomous County, Dayaoshan Mountain, Shengtangshan scenic area, 23°59.12'N, 110°8.23'E, 12 X 2021, Ailan He, Jinxin Liu, Zongguang Huang, Rongrong Liao, Qing Li, Xuemei Yang, Yingli Wen, Zhao Ye, Yang Liu. **Other specimens examined**: 2♂ (HNU489, HNU490), CHINA, Hunan Province, Hengshan City, Hengshan Mountain, 14 XI 2007, Xiaoqi Mi [no more information in the label]; 1♂ (HNU691) 1♀ (HNU692), CHINA, Hunan Province, Hengshan City, Hengshan Mountain, 28 VII 2007, Guo Tang,

Xiaoqi Mi [no more information in the label]; 3♂ (HNU264–266) 13♀ (HNU267–279), CHINA, Hunan Province, Chenzhou City, Mangshan Mountain, Hejiawan, 24°55.58'N, 112°50.35'E, 640m, 11 XII 2017, Haiqiang Yin, Ailan He, Jinxin Liu; 1♂ (HNU280) 2♀ (HNU281, HNU282), CHINA, Hunan Province, Chenzhou City, Mangshan Mountain, Yanziyan, 25°2.31'N, 112°47.12'E, 390m, 10 XII 2017, Haiqiang Yin, Ailan He, Jinxin Liu; 1♀ (HNU283), CHINA, Hunan Province, Chenzhou City, Mangshan Mountain, Xiangsikeng, 24°56.98'N, 112°59.33'E, 1300m, 8 XII 2017, Haiqiang Yin, Ailan He, Jinxin Liu; aftermentioned specimens are collected in Langshan Mountain, Xinning County, Shaoyang City, Hunan Province, China, by Haiqiang Yin, Cheng Wang, Jiahui Gan, Bing Zhou and Yuhui Gong: 5♂ (HNU403–407) 6♀ (HNU254, HNU408–412), Tianyixiang, 26°21.22'N, 110°48.25'E, 586m, 21 XI 2014; 1♂ (HNU422), Feiliandong, 26°21.48'N, 110°47.92'E, 403m, 23 XI 2014; 1♂ (HNU425) 3♀ (HNU426–428), Tianyixiang, 26°21.45'N, 110°48.19'E, 556m, 25 XI 2014; 1♀ (HNU423), Zixiadong, 26°23.13'N, 110°48.46'E, 465m, 26 XI 2014; 1♀ (HNU424), Lajiaofeng, 26°23.14'N, 110°48.46'E, 653m, 27 XI 2014; 1♀ (HNU393), Luotuofeng, 26°20.47'E, 110°46.06'E, 482m, 27 XI 2014. The following specimens were collected in Hengshan Mountain, Hengyang City, Hunan Province, China, by Ailan He, Bing Zhou, Wang Liu, Chen Zeng, Zhuo'er Chen: 1♂ (HNU260) 2♀ (HNU259, HNU261), Wanshou village, 27°31.51'N, 112°10.63'E, 487m, 20 X 2015; 3♂ (HNU394–396) 7♀ (HNU262, HNU397–402), Wanshou Village, 27°31.51'N, 112°10.63'E, 487m, 19 X 2015; 1♀ (HNU413), Martyry (Zhonglieci), 27°15.96'N, 112°42.67'E, 427m, 19 X 2015; 1♂ (HNU420) 1♀ (HNU421), Depository of Buddhist texts (Cangjingge), 27°16.06'N, 112°41.53'E, 999m, 21 X 2015; 4♂ (HNU414–417) 1♀ (HNU418), Martyry (Zhonglieci), 27°31.58'N, 112°21.63'E, 487m, 21 X 2015.

Etymology. The species epithet is derived from the Latin word for ring (*annulus*), in reference to the proximal half of the embolus which in prolateral view resembles a ring.

Diagnosis. Males of this new species can be distinguished from those of *Putaoa seediq* Hormiga and Dimitrov, 2017 by having the distal suprategular apophysis more developed and lobate, and the embolic process robust and sclerotized, while the distal suprategular apophysis is small and spiculate and the embolic process thin and membranous in *P. seediq* (compare Figs 2A–D, 6A, B with Figs 2C, D, 3B, D in Hormiga and Dimitrov (2017)). Females of this new species resemble those of *Putaoa titanoverpa* n. sp. in having a flat basal epigynal plate, but can be distinguished by having the posterior margin of the basal plate nearly straight, and the copulatory ducts long and curved, while the medial posterior margin of the basal plate protruded towards apically to form an obtuse triangle, and the copulatory ducts are short and thick in *P. titanoverpa* n. sp. (compare Figs 1E–G, 5C with Figs 3E, F, 5F).

Description. Male (holotype; HNU250, Figs 1A, 2). Total length 9.12. Cephalothorax 4.94 long, 3.82 wide. Sternum 2.16 long, 1.92 wide. Abdomen 4.40 long, 3.38 wide. Anterior median eye diameter 0.18. Clypeus height 1.5 times one anterior median eye diameter. Carapace with shallow and longitudinal fovea (Fig. 1A). Chelicerae with four prolateral and four retrolateral teeth (Fig. 5A); stridulatory striae absent. Legs annulated with spines and with annulations alternating brown and black. Leg measurements: I 15.26 (4.33, 1.46, 3.71, 3.89, 1.87), II 14.01 (4.12, 1.39, 3.38, 3.51, 1.61), III 1.16 (3.33, 1.25, 2.58, 2.69, 1.31), IV 13.60 (3.94, 1.26, 3.28, 3.66, 1.46). Metatarsus I and II trichobothria (TmI and TmII) 0.25 approximately; Metatarsus III and IV trichobothria (TmIII and TmIV) 0.33 approximately. All metatarsal trichobothria located on the dorsum, near the retrolateral surface. Abdomen with some large brown patches and a few of white spots dorsally. *Palp*: tibia short, with three retrolateral trichobothria, one distal prolateral seta and one thick and short dorsal macroseta retrolaterally (Figs 2C, D, 6A, B). Cymbium with a conical ectal process (Figs 2B, 6A), apically pointed, and two basal cymbial apophyses near the edge of paracymbium (Figs 2E, 6A). Paracymbium glabrous, concave and bowl-like, apically hooked, with edge of median margin curved inward (Figs 2E, 6A), connected to cymbial base by means of a membrane, ventral to a bipartite basal cymbial apophysis. Tegulum large and pointed apically, and with base connecting to suprategulum which is prolonged and divided into three processes, embolus, embolic process and distal suprategular apophysis (Figs 2C, 6B). Embolus sinuous, well developed, with proximal half ring-like, flat and wide, and distal half gradually becoming narrow and somewhat sharp (Figs 2A, 6A). Embolic process sclerotized, pointed apically, running parallel to embolus end (Figs 2A, C, 6B). Distal suprategular apophysis sclerotized and lobate, almost in contact with apicoventral area of cymbium, extending towards tegulum apex across gap between bulb and cymbium (Figs 2B, C, 6A, B). Conductor membranous, on apical end on tegulum (Figs 2A, C, 6A, B). Median apophysis absent.

Female (paratype, HNU251). Total length 9.95 (Fig. 1B). Cephalothorax 4.56 long, 3.47 wide. Sternum 2.33 long, 2.06 wide (Fig. 1D). Abdomen 5.68 long, 4.83 wide. Anterior median eye diameter 0.19. Clypeus height 1.4 times one anterior median eye diameter. Chelicerae with five prolateral and five retrolateral teeth (Fig. 5B); stridulatory striae absent. Legs annulated with sporadic spines. Leg measurements: I 15.73 (4.48, 1.51, 3.83, 4.01, 1.90), II 14.48 (4.22,

1.53, 3.51, 3.60, 1.62), III 11.46 (3.40, 1.31, 2.70, 2.70, 1.35), IV 13.92 (4.05, 1.31, 3.48, 3.61, 1.47). Metatarsus I trichobothrium (TmI) 0.25 approximately; Metatarsus II, III and IV trichobothria (TmII–IV) 0.33 approximately. All metatarsal trichobothria located on the dorsum, near the retrolateral surface. Similar to males in somatic features. *Epigynum*: basal plate trapeziform, anterior margin 1.5 times longer than posterior margin, and the posterior margin nearly straight but with slightly protruded in the middle. Atrium separated into two parts by septum. Copulatory openings visible (Fig. 1E). Copulatory ducts elongated, flat and looping. Spermathecae small and spherical, approximately one spermatheca diameter from each other (Figs 1F, G, 5C). Fertilization ducts medially oriented (Figs 1G, 5C).

Distribution. China (Hunan, Guangxi) (Fig. 8).

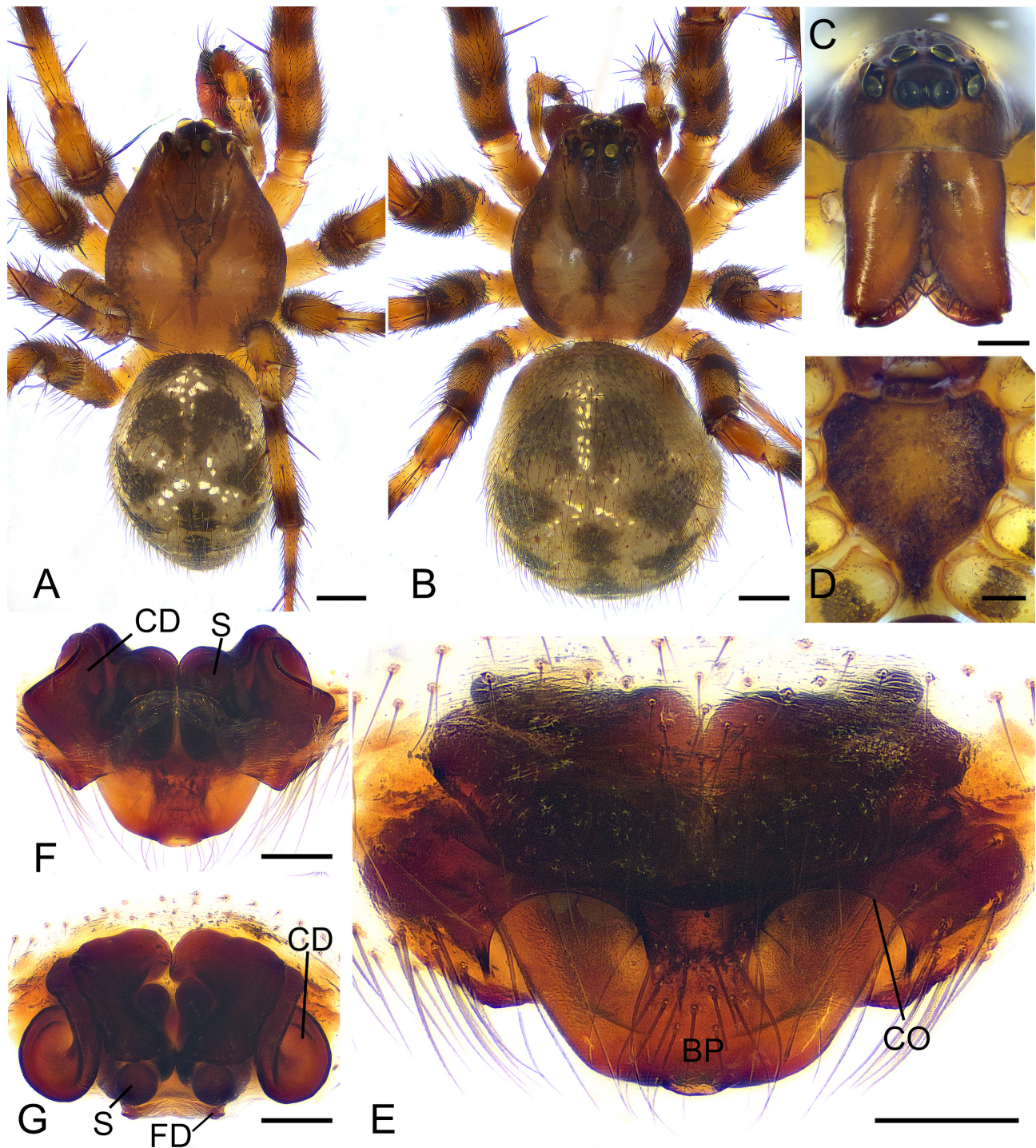


FIGURE 1. *Putaoa annulata* n. sp. A, male, holotype; B–G, female, paratype HNU251. A, habitus, dorsal; B, habitus, dorsal; C, prosoma, front; D, prosoma, ventral; E, epigynum, ventral; F, epigynum, dorsal; G, epigynum, front. Abbreviations: BP = basal plate; CD = copulatory duct; CO = copulatory opening; FD = fertilization duct; S = spermatheca. Scale bars: A, B, 1mm; C, E–G, 0.3mm; D, 0.5mm.

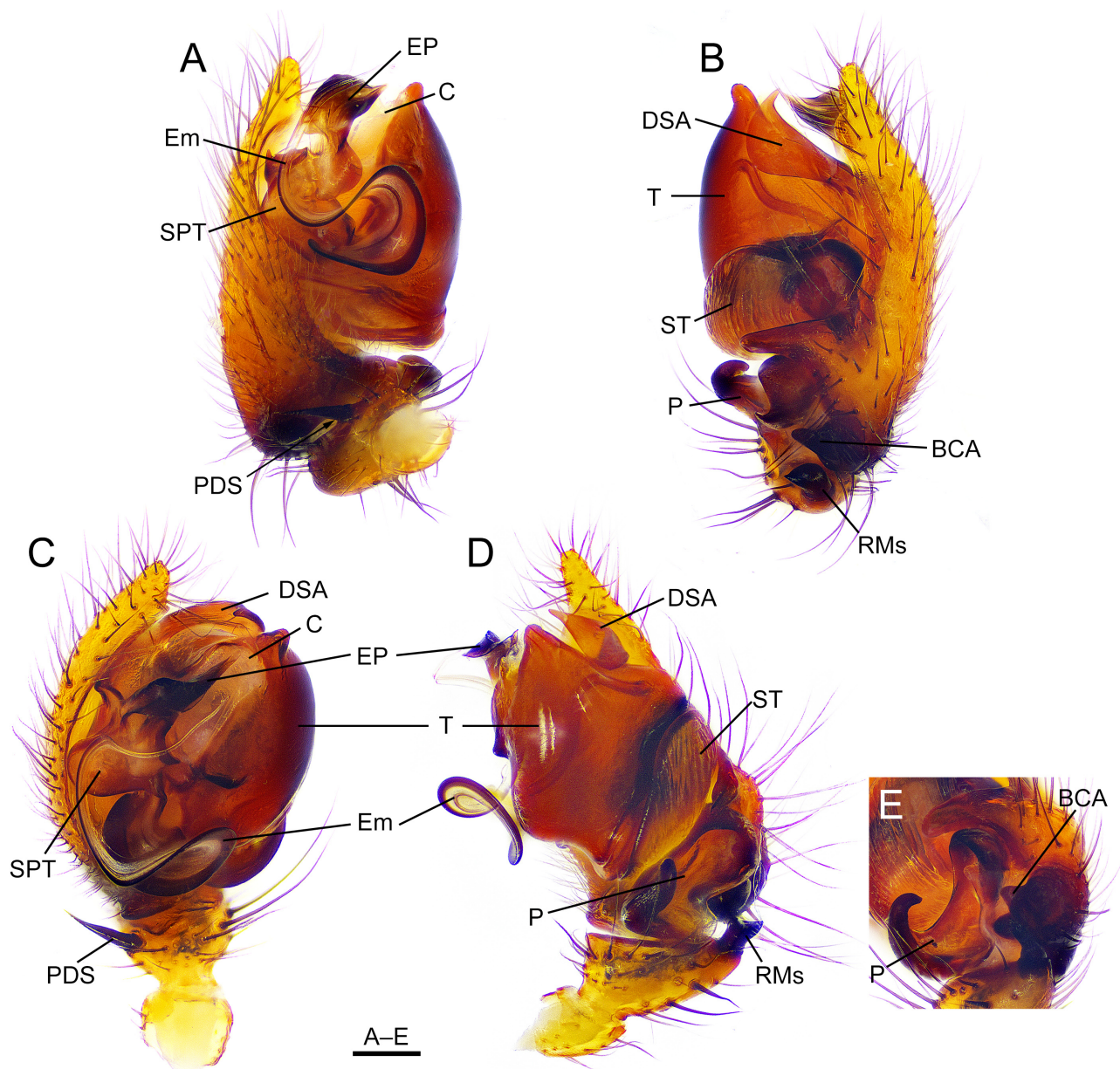


FIGURE 2. *Putaoa annulata* n. sp., male palp, holotype. A, prolateral; B, retrolateral; C, apical; D, ectoventral; E, paracymbium. Abbreviations: BCA = basal cymbial apophysis; C = conductor; DSA = distal suprategular apophysis; Em = embolus; EP = embolic process; P = paracymbium; PDS = prolateral distal seta; RMs = retrolateral macroseta; SPT = suprategulum; ST = subtegulum; T = tegulum. Scale bars, 0.2mm.

Putaoa titanoverpa new species

(巨雄葡萄蛛)

Figures 3, 4, 5D–F, 6C, D

Holotype ♂ (HNU284): CHINA, Hunan Province, Liuyang City, Daweishan Mountain, 28°26.09'N, 114°10.09'E, 530m, 17 I 2018, Keke Liu, Luyu Wang, Guchun Zhou. **Paratypes:** 1♂ (HNU285) 4♀ (HNU286–289), same data as the holotype. **Additional specimens examined:** 8♀ (HNU290–297), same data as the types.

Etymology. The species epithet refers to the robust and strongly sclerotized embolus and is derived from the Greek word *titan* (in the sense of large size) and the Latin word *verpa* (penis).

Diagnosis. Males of this new species are similar to those of *Putaoa huaping* Hormiga and Tu, 2008 in having “U” shaped and sclerotized embolus (compare Figs 4A, 6D with fig. 3C in Hormiga and Tu, 2008), but can be

distinguished by having the palpal tibia with one distal macroseta (cuspule-like), and the suprategulum with a lamelliform distal suprategular apophysis, while in *P. huaping* the palpal tibia has several distal macrosetae and the suprategulum has a stronger distal suprategular apophysis (compare Figs 4A–D, 6C, D with fig. 3 in Hormiga and Tu 2008). The diagnosis of the females of this new species is given under that of *Putaoa annulata* n. sp.

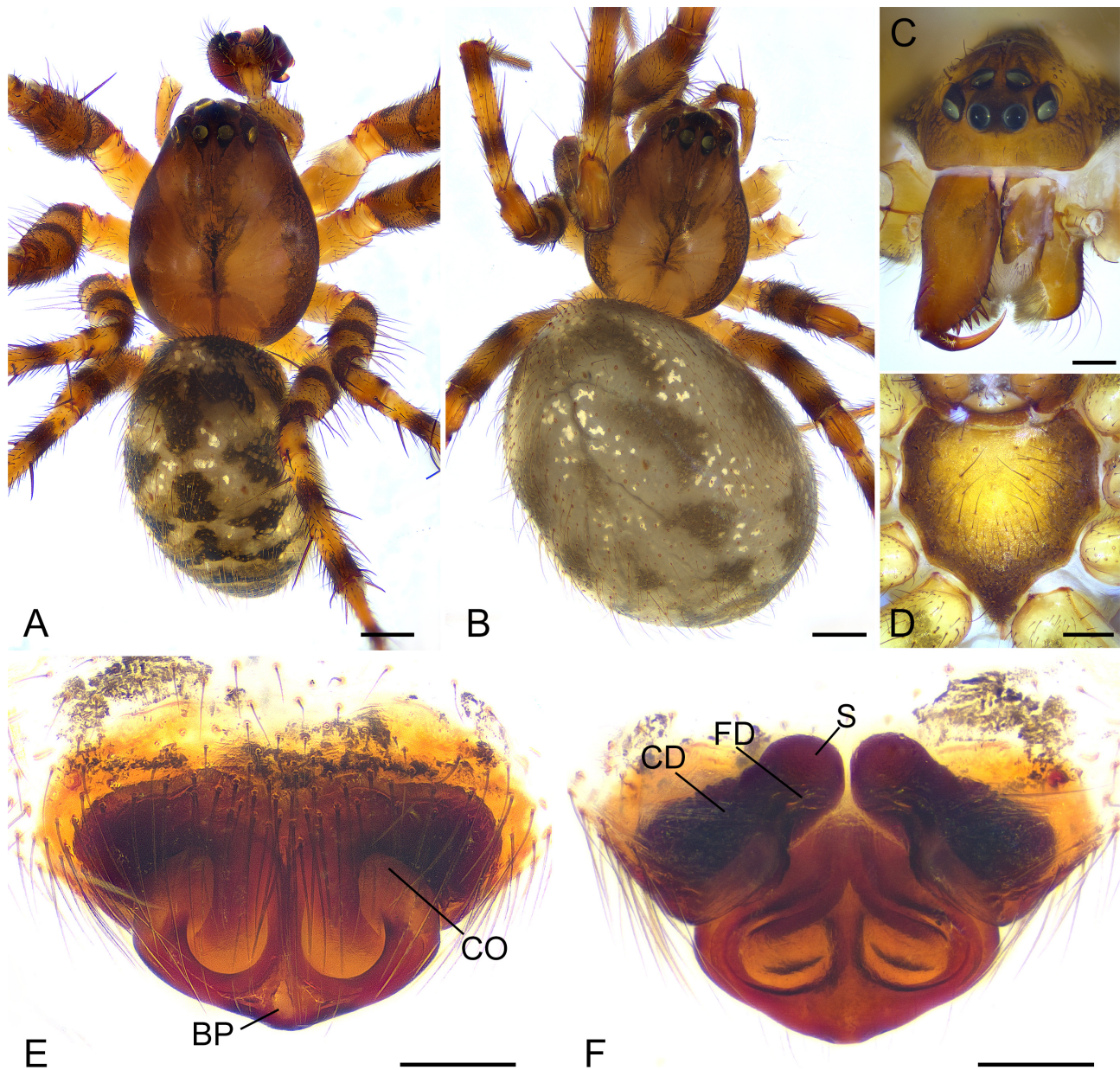


FIGURE 3. *Putaoa titanoverpa* n. sp. A, male, holotype; B–F, female, paratype HNU287. A, habitus, dorsal; B, habitus, dorsal; C, prosoma, front; D, prosoma, ventral; E, epigynum, ventral; F, epigynum, dorsal. Abbreviations: CD = copulatory duct; CO = copulatory opening; FD = fertilization duct; S = spermatheca. Scale bars: A, B, 1mm; C, E, F, 0.3mm; D, 0.5mm.

Description. Male (holotype; HNU284, Figs 3A, 4). Total length 9.68. Cephalothorax 4.33 long, 3.56 wide. Sternum 2.22 long, 1.99 wide. Abdomen 5.07 long, 3.69 wide. Anterior median eye diameter 0.17. Clypeus height 1.5 times one anterior median eye diameter. Carapace with shallow and longitudinal fovea (Fig. 3A). Chelicerae with six prolateral and six retrolateral teeth (Fig. 5D); stridulatory striae absent. Legs annulated with spines and with annulations alternating brown and black. Leg measurements: I 15.06 (4.25, 1.45, 3.78, 3.81, 1.77), II 13.68 (4.04, 1.34, 3.27, 3.45, 1.58), III 10.68 (3.20, 1.19, 2.47, 2.56, 1.26), IV 13.16 (3.83, 1.20, 3.18, 3.55, 1.40). All metatarsal trichobothria 0.33 approximately (TmI–IV), located on the dorsum near the retrolateral surface. Abdomen with white spots in anterior part and irregular patches dorsally. *Palp*: tibia short, with one dorsal and two retrolateral trichobothria and one distal seta prolaterally (Figs 4A, C, D, 6C, D). Cymbium with a conical ectal process in

medial retrolateral margin (Figs 4B, 6C), apically pointed. Paracymbium glabrous, concave and bowl-like, with apical end broad and nearly square in ventral view, connected to cymbial base by means of a membrane, ventral to a sclerotized cymbial apophysis (Figs 4B–D, 6C). Tegulum large and pointed apically, with tegular base connecting to suprattegulum which is divided into three processes, embolus, embolic process and distal suprattegular apophysis (Figs 4C, E, 6D). The embolus “U” shaped (especially in prolateral view), developed and sclerotized, flattening in distal half part (Figs 4A, C, E, 6D). Embolic process thin and small, close to embolus apex (Figs 4C, E, 6D). Distal suprattegular apophysis short and spiculate, curved in retrolateral view, extending towards end of tegulum across the gap between bulb and cymbium (Figs 4C, D, 6C, D). Conductor triangular, membranous, pointing apically end of tegulum (Figs 4D, 6D). Median apophysis absent.

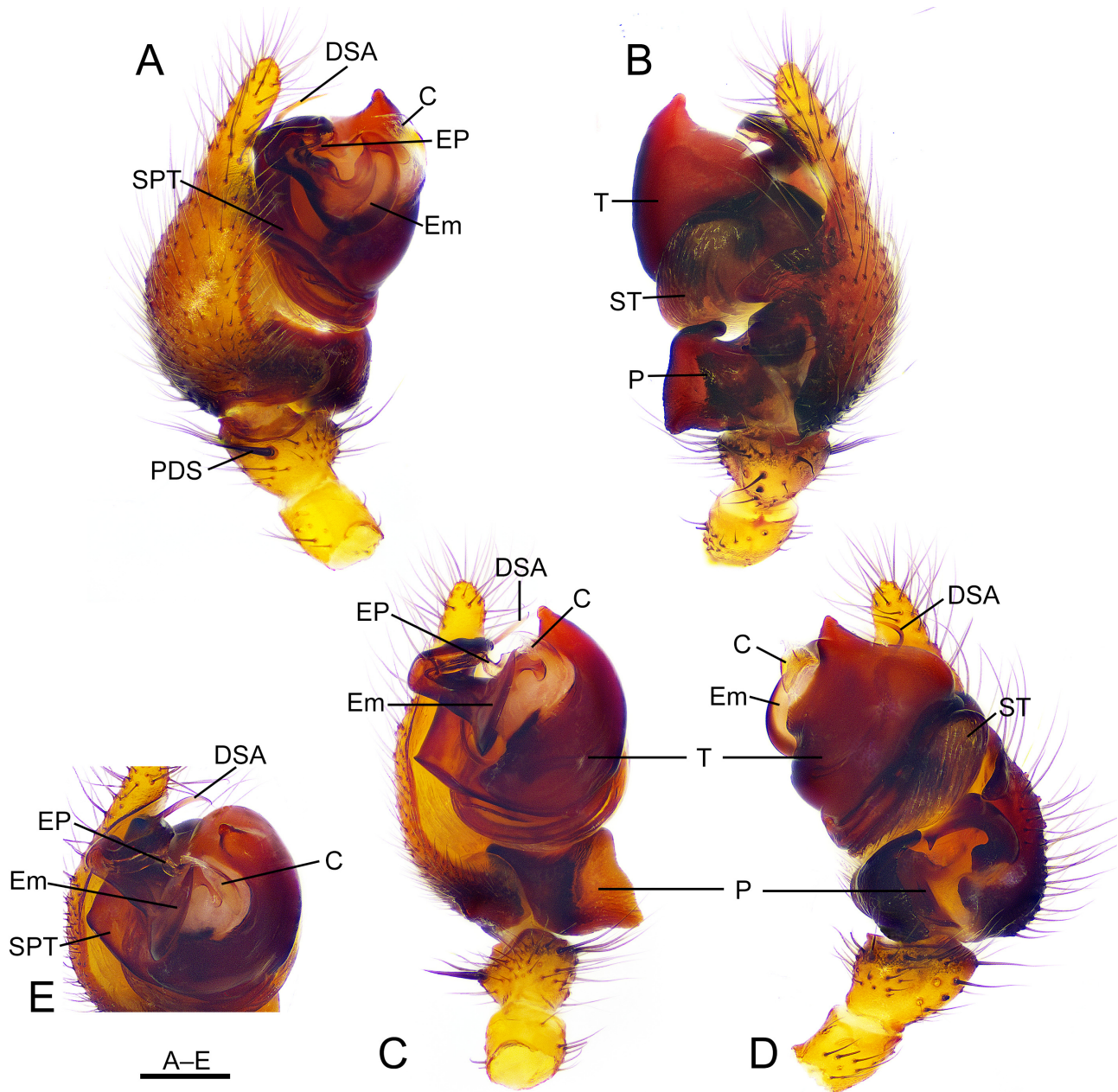


FIGURE 4. *Putaoa titanoverpa* n. sp., male palp, holotype. A, prolateral; B, retrolateral; C, ventral; D, ectoventral; E, apical. Abbreviations: C = conductor; DSA = distal suprattegular apophysis; Em = embolus; EP = embolic process; P = paracymbium; PDS = prolateral distal seta; SPT = suprattegulum; ST = subtegulum; T = tegulum. Scale bars, 0.2mm.

Female (paratype, HNU287). Total length 9.85 (Fig. 3B). Cephalothorax 4.06 long, 3.01 wide. Sternum 2.27 long, 2.08 wide (Fig. 4D). Abdomen 6.86 long, 5.13 wide. Anterior median eye diameter 0.18. Clypeus height 1.4 times one anterior median eye diameter. Chelicerae with five prolateral and five retrolateral teeth (Fig. 5E);

stridulatory striae absent. Legs annulated with spines and with annulations alternating brown and black. Leg measurements: I 15.68 (4.44, 1.50, 3.89, 3.97, 1.88), II 14.62 (4.18, 1.54, 3.60, 3.60, 1.70), III 11.57 (3.38, 1.35, 2.68, 2.73, 1.40), IV 13.96 (4.10, 1.34, 3.46, 3.55, 1.51). All metatarsal trichobothria 0.33 approximately (TmI–IV), located on the dorsum near the retrolateral surface. Similar to male in somatic features. *Epigynum*: basal plate slightly forming an obtuse triangle, and with the median area of posterior margin protruding caudally (Figs 3E, F, 5F). Atrium divided in two by septum. Copulatory openings visible ventrally (Fig. 3E). Copulatory ducts short and thick. Spermathecae spherical, almost in contact with each other. Fertilization ducts medially oriented, arising from the middle of spermathecae (Figs 3F, 5F).

Distribution. China (Hunan) (Fig. 8).

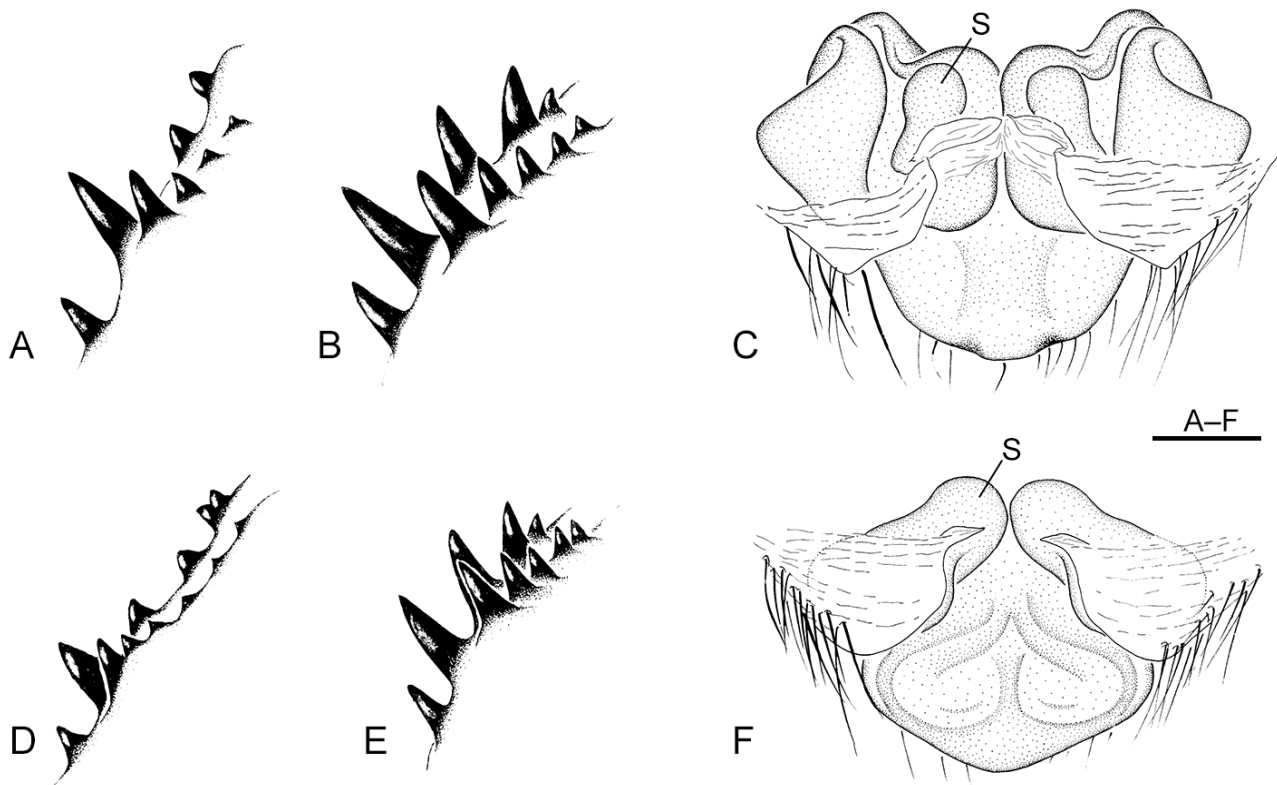


FIGURE 5. Cheliceral teeth and epigynum of new *Putaoa* species in this study. A–C, *Putaoa annulata* n. sp.; D–F, *Putaoa titanoverpa* n. sp. A, male cheliceral teeth, retrolateral view; B, female cheliceral teeth, retrolateral view; C, epigynum, dorsal view; D, male cheliceral teeth, retrolateral view; E, female cheliceral teeth, retrolateral view; F, epigynum, dorsal view. Abbreviations: S = spermatheca. Scale bars: A, B, D, E, 0.2mm; C, F, 0.3mm.

Discussion

The two new species of *Putaoa* described here are morphologically very similar to those known so far, including the type species. Hormiga & Tu (2008) and Hormiga & Dimitrov (2017) had hypothesized that the monophyly of *Putaoa* was supported by four unambiguous synapomorphies: the large and long macrosetae on cymbium and on male pedipalpal tibiae, absence of a median apophysis and a relatively short, non-filiform embolus. A recent reassessment of the genitalic morphology of pimoids and stemonyphantine linyphiids (Hormiga *et al.* 2021) suggests that the synapomorphies of *Putaoa* need to be tested considering the new hypothesis and with an expanded character matrix that includes as many *Putaoa* and *Weintrauboa* species as possible, but this is beyond of the scope of this paper and the goal of a future study. For now, the large macrosetae on the male pedipalpal tibiae are hypothesized as putative synapomorphies of *Putaoa*, shared by the new species described here, as well as the enlarge macrosetae at the base of the cymbium. The basal processes of the cymbium, near the paracymbium attachment, may provide an additional synapomorphy.

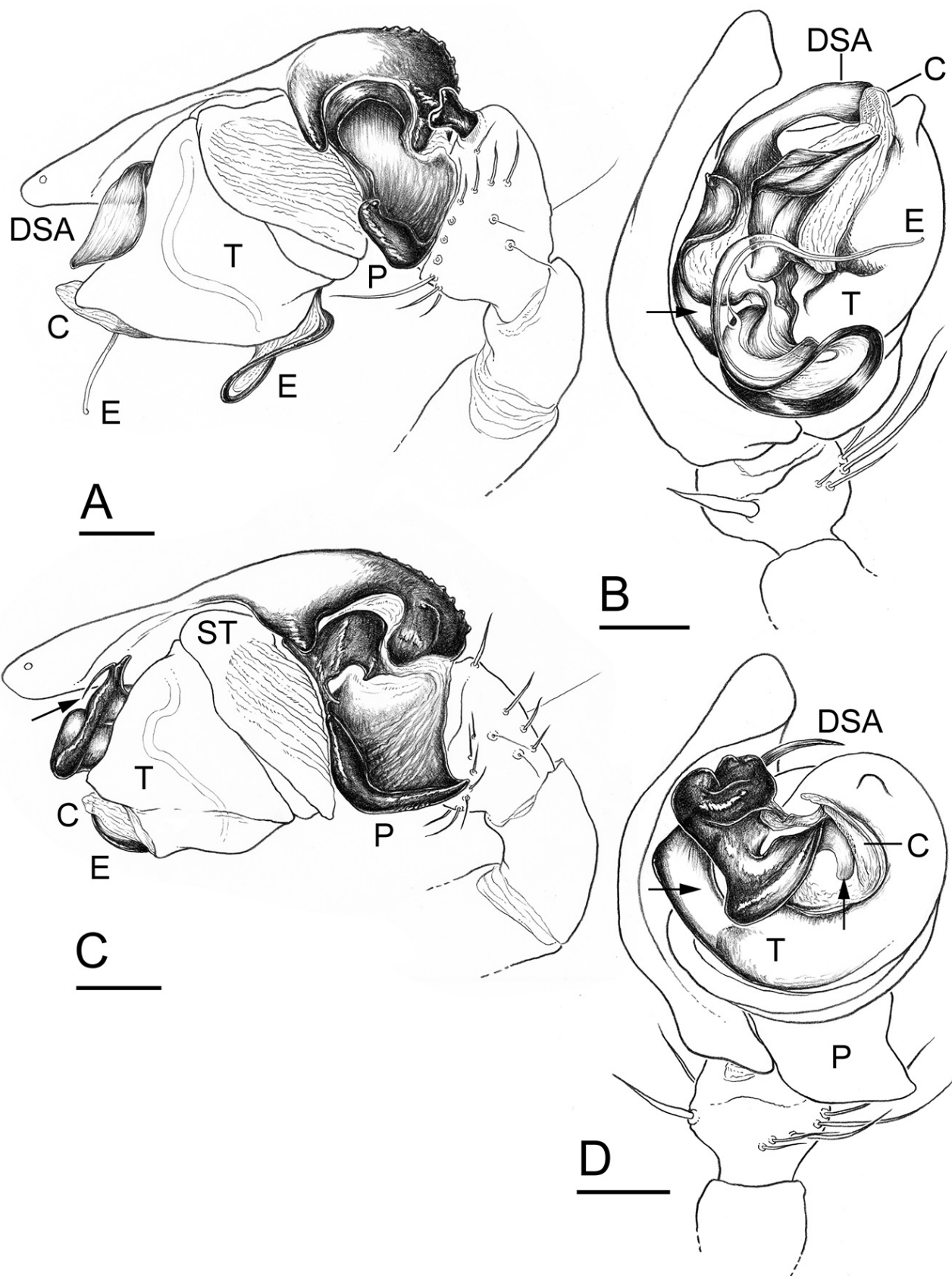


FIGURE 6. Male palps of *Putaoa annulata* n. sp. (A, B) and *P. titanoverpa* n. sp. (C, D); most macrosetae are not depicted. A, ectal. B, ventral (arrow, suprategulum base). C, ectal (arrow, distal suprategular apophysis). D, ventral (right pointing arrow, suprategulum base; up pointing arrow, embolic apex). Abbreviations: C = conductor, DSA = distal suprategular apophysis, E = embolus, P = paracymbium, ST = subtegulum, T = tegulum. Scale bars, 0.2 mm.

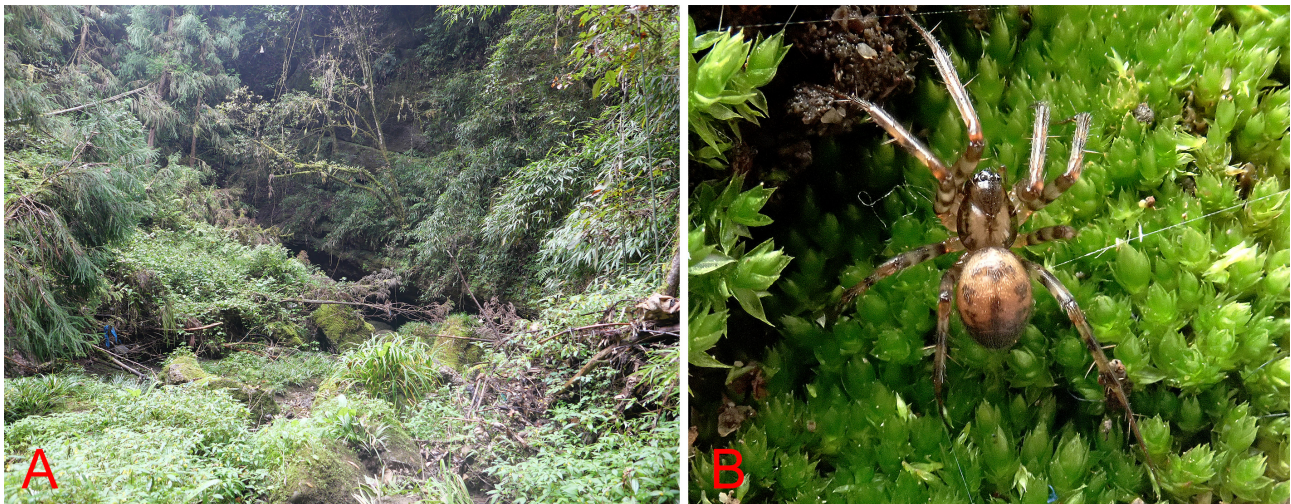


FIGURE 7. *Putaoo annulata* n. sp. A, showing its natural habitat in Guangxi Zhuang Autonomous Region; B, live habitus.

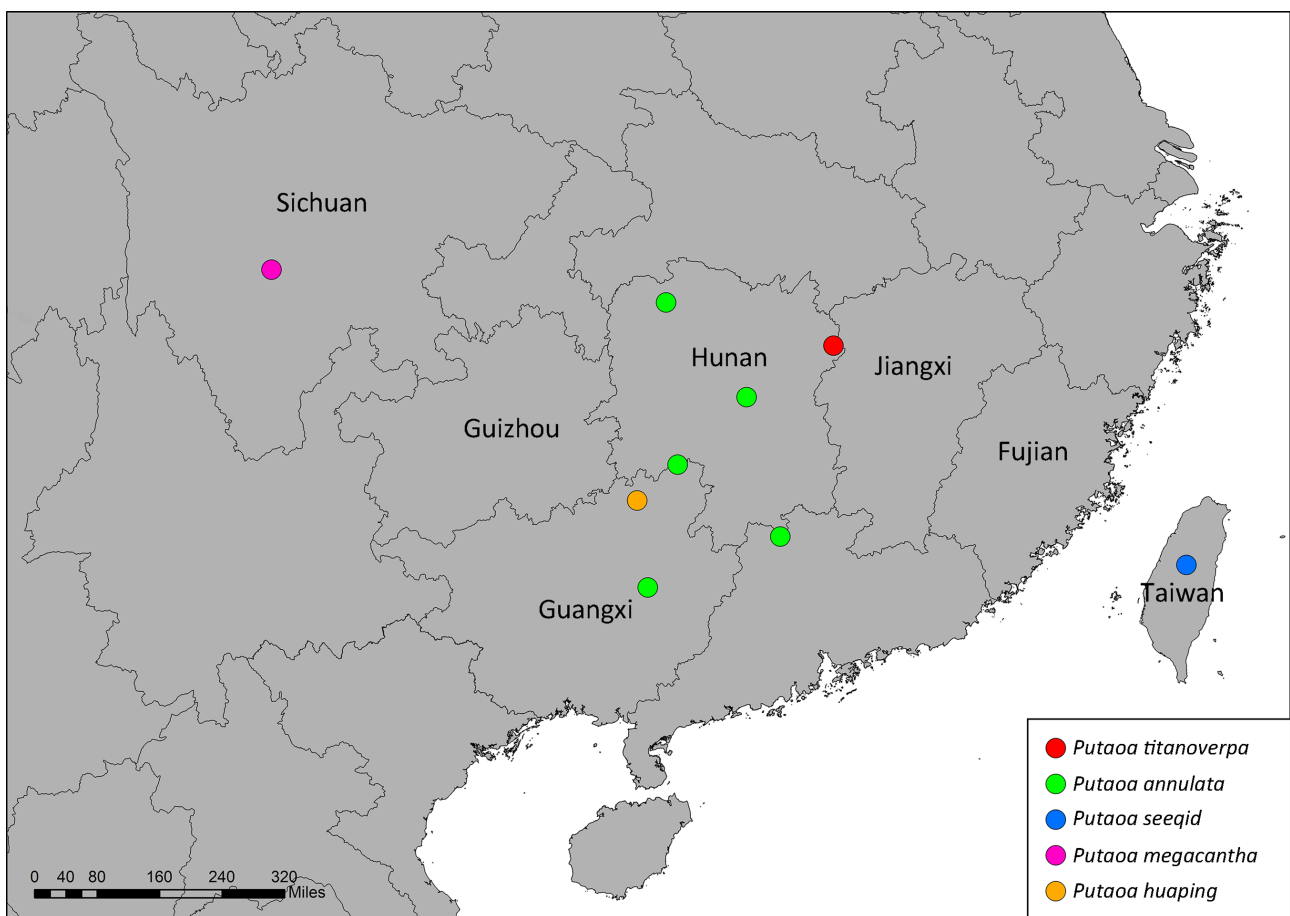


FIGURE 8. Collecting localities of *Putaoo* species.

In terms of the known number of species, *Putaoo* is a relatively small genus in an extremely large and diverse family. Given the position of Stemonyphantinae as the sister clade of a lineage that includes all other linyphiids, the study of the systematics of *Putaoo* is important to better understand the phylogeny and evolution of Linyphiidae. Our knowledge of the biogeographic patterns of *Putaoo* is very limited due to the very few specimens and distribution records of this genus. Unlike the situation with the previously described *Putaoo* species, which are known from only a single locality, one of two new species described here, *P. annulata* n. sp., has been recorded from a relatively broad area. In addition, *P. huaping* is also distributed not only in the type locality, a narrow site of Guangxi, but also in a series of adjacent regions, the southwestern region of Hunan Province and the eastern region of Guizhou Province

(unpublished data). The addition of the new distribution records of *Putaoa* show that the genus is distributed across the central region of southern China with a parapatric distribution pattern. This biogeographic pattern suggests that the areas between the recorded localities of each species of *Putaoa*, such as Fujian Province and Jiangxi Province, will also harbor species of this genus, possibly undescribed. In addition, the discovery of new species will help to resolve the phylogenetic relationships between *Putaoa* and *Weintrauboa* in the future, so that both genera can be properly circumscribed to be monophyletic.

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