



First records of the genus *Phrurotimpus* Chamberlin & Ivie, 1935 from China, with two new species and one new combination (Araneae: Phrurolithidae)

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Abstract

The genus *Phrurotimpus* Chamberlin & Ivie, 1935, previously known only from the Nearctic, is found in Asia for the first time, with species recorded from the Yunnan Province of China. Two new species are described from both sexes, *P. daliensis* **sp. n.** and *P. baoshanensis* **sp. n.**, and one new combination, *P. lasiolepis* (Fu, Chen & Zhang, 2016) **comb. n.**, are reported in this study.

Key words: habitus, taxonomy, mating behavior, diversity, Yunnan Province

Introduction

The genus *Phrurotimpus* Chamberlin & Ivie, 1935 contains 23 species distributed in the Nearctic Region, from Canada, U.S.A. and Mexico (World Spider Catalog 2021). The type species, *Phrurotimpus alarius*, was initially described as *Herpyllus alarius* by Hentz (1847) as a Gnaphosidae species with a poor description.

The most recent revision of *Phrurotimpus* was provided by Platnick (2019), who studied the *P. palustris* species group. In this study, Platnick discussed the taxonomic history of *Phrurotimpus* and assigned the genus into two groups: members of the *P. alarius* species group with iridescent scales tend to have the dorsum and sides of the abdomen dark, with light markings, and have a distinctive, thumb-shaped distal lobe on the retrolateral side of the palpal tegulum. Members of the other group (the *palustris* group) without iridescent scales have the dorsum and sides of the abdomen white, with dark markings, and have strongly annulated legs.

The genus *Phrurotimpus* was identified from a 2021 field study in Yunnan, China. In addition, we found that the characters of *Phrurolithus lasiolepis* Fu, Chen & Zhang, 2016 are consistent with the genus *Phrurotimpus*, such as the body with iridescent scales (lacking in *Phrurolithus*), white tip of the tibiae (Fig. 3D in Fu *et al.* 2016) (absent in *Phrurolithus*), sperm duct long (total length more than twice longer than tegulum) and broad (nearly half as wide as tegulum), a thumb-shaped lobe on the tegulum in prolateral view (short sperm duct, without thumb-shaped lobe in *Phrurolithus*) (Fig. 3 in Fu *et al.* 2016). According to these characters, we placed these two new species and one new combination in *Phrurotimpus*.

However, there are some characteristics that differ between the Asian and North American species (see Platnick 2019): 1) the posterior margin of the tegulum is nearly straight and blunt in Asian species while forming a rounded lobe in North American species; 2) the tibiae I–IV are black with a white tip except tibia III in Asian species, while annulated or with light markings in North American species; 3) the bursa oval in Asian species, while U-shaped in North American species; and 4) the lack of secondary spermathecae in the Asian species, while they are present in the North American species. Therefore, we decided to assign these three Asian species to a new species group, the *daliensis* group.

Material and methods

All measurements in the text are given in millimeters. The measurements of legs are shown as total length (femur, patella, tibia, metatarsus, tarsus). The epigyne was removed and cleared in a pancreatin solution (Álvarez-Padilla & Hormiga 2007) and then transferred to 95% ethanol. All specimens are preserved in 95% alcohol. Photographs were taken using the Leica M205A stereomicroscope equipped with a DFC 550 CCD. All specimens studied are deposited in the Museum of Hebei University (MHBUE), Baoding, China.

The following abbreviations are used: ALE—anterior lateral eye; AME—anterior median eye; CH—clypeal height; CRW—cephalic region width; CW—carapace width; EAW—eye area width; MOA—median ocular area; PLE—posterior lateral eye; PME—posterior median eye. Spinination: d—dorsal, pl—prolateral; v—ventral, pv—prolateral ventral; rv—retrolateral ventral.

Taxonomy

Family: Phrurolithidae Banks, 1892

Genus: *Phrurotimpus* Chamberlin & Ivie, 1935

Type species: *Herpyllus alarius* Hentz, 1847

Phrurotimpus daliensis sp. n. (大理提普蛛)

Figs 1–4, 10

Type material. Holotype ♂: **CHINA:** *Yunnan Province:* Dali Bai Autonomous Prefecture, Fengyi Town (25°35'26.61"N, 100°18'8.57"E), 2026 m elev., 15.VII.2021, leg. Yunnan Mu.

Paratypes: 10♂ 33♀, same data as holotype.

Etyymology. The specific name is derived from the type locality; adjective.

Diagnosis. This new species can be distinguished from *P. baoshanensis* sp. n. by 1) RTA wider than in the latter species, and the distance between the RTA and cymbium smaller than *P. baoshanensis* sp. n.; 2) bursa triangular and positioned above the spermathecae, and separated by about half the diameter of spermathecae (vs close in *P. baoshanensis* sp. n.); 3) spermathecae large and round as opposed to small and oval in *P. baoshanensis* sp. n..

Description. Male (Holotype): total length 1.74, carapace 0.85 long, 0.69 wide; abdomen 0.89 long, 0.55 wide. Eye sizes and interdistances: AME 0.06, ALE 0.06, PME 0.05, PLE 0.05; AME–AME 0.03, AME–ALE 0.01, ALE–ALE 0.14, PME–PME 0.04, PME–PLE 0.03, PLE–PLE 0.20, ALE–PLE 0.04. EAW 0.27, CRW 0.37, EAW/CRW 0.73, CRW/CW 0.54. MOA 0.15 long, anterior width 0.14, posterior width 0.14. CH 0.07, CH/AME 1.17. Labium 0.08 long, 0.14 wide. Sternum 0.57 long, 0.44 wide. Carapace oval, dark in color, with several slight lighter bands either side of fovea (Figs 1A, 2A); middle of carapace with sparse iridescent scales, margin of carapace with ring of iridescent scales (Fig. 2C). Sternum gray, without pattern. Abdomen darker than carapace, large dorsal scutum covering most of dorsum, with iridescent scales on side and behind dorsal scutum (Fig. 2B). All femora and patella black, tibiae I–IV black with white tip except tibia III yellow, all metatarsi and tarsi yellowish without markings (Fig. 3).

Palp as in Figs 4A–D. Femur without apophysis, swollen ventrally at middle parts, without setae. Patella and tibia short, cymbium longer than femur. Tibia with single large retrolateral apophysis and small dorsal apophysis. Tegulum narrower than cymbium, sperm duct two times longer than tegulum and half as wide as tegulum, curved as S-shaped in prolateral view. Embolus short, directed retrodistally. Conductor membranous, triangular.

Female: One paratype: total length 2.34, carapace 1.05 long, 0.83 wide; abdomen 1.29 long, 0.83 wide. Eye sizes and interdistances: AME 0.06, ALE 0.08, PME 0.06, PLE 0.06; AME–AME 0.04, AME–ALE 0.01, ALE–ALE 0.17, PME–PME 0.05, PME–PLE 0.03, PLE–PLE 0.23, ALE–PLE 0.05. EAW 0.33, CRW 0.46, EAW/CRW 0.72, CRW/CW 0.55. MOA 0.18 long, anterior width 0.16, posterior width 0.17. CH 0.09, CH/AME 1.50. Labium 0.10 long, 0.17 wide. Sternum 0.69 long, 0.41 wide. Other characters as for male, except larger body size, broad band with dense iridescent scales posterior to eye area, and without dorsal scutum on abdomen (Fig. 2E–F).

Epigyne as in Fig. 4E–H. Copulatory openings large, situated medially, separated by about 2.5 times spermathecae diameter. Copulatory ducts short, thick. Bursa triangular, semi-transparent. Connecting tube between bursae and spermathecae thinner than copulatory ducts. Spermathecae round, separated by more than half their width. Fertilization ducts located on dorsal side of spermathecae.



FIGURE 1. Habitus, male holotype and female paratype, *Phrurotimpus daliensis* sp. n.: A. Male, dorsal view; B. Same, ventral view; C. Female, dorsal view; D. same, ventral view.

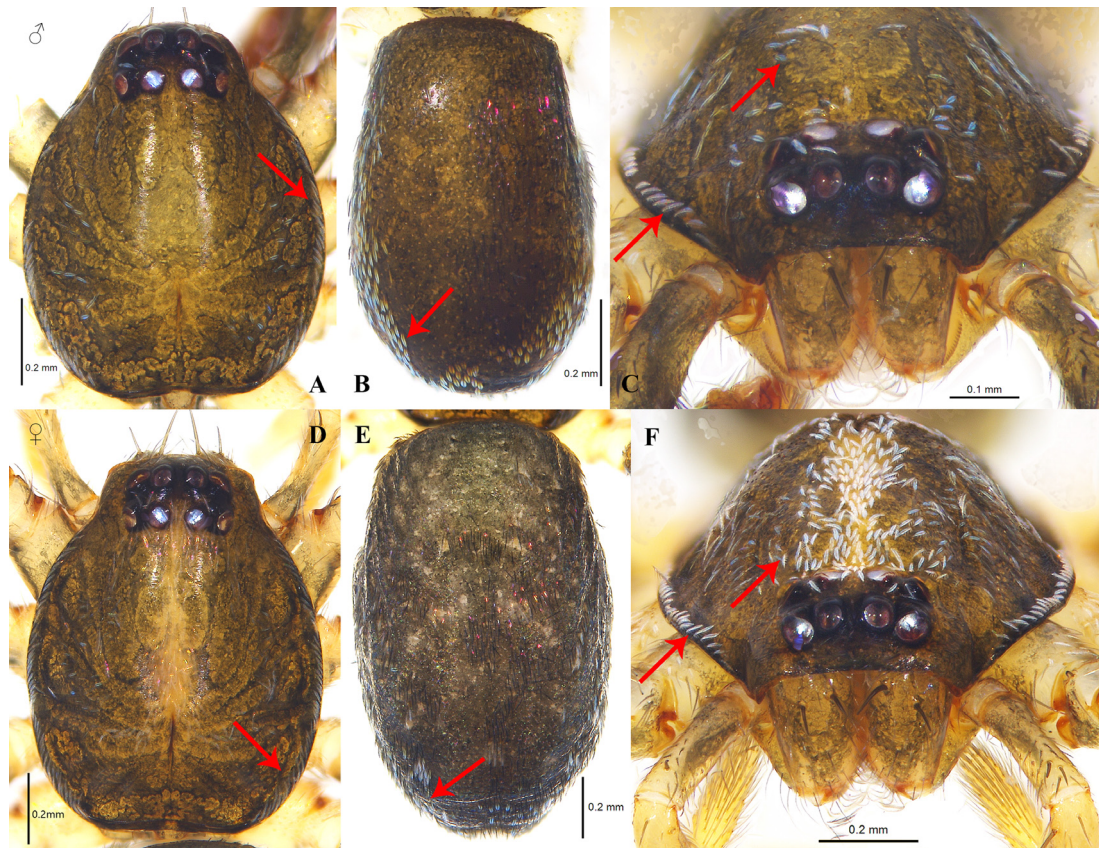


FIGURE 2. Iridescent scales of *Phrurotimpus daliensis* sp. n.: A. Male, carapace dorsal view; B. Same, abdomen, dorsal view; C. Same, carapace frontal view; D. Female, carapace, dorsal view; E. Same, abdomen, dorsal view; F. Same, carapace frontal view. Red arrow: iridescent scales.



FIGURE 3. Left legs of *Phrurotimpus daliensis* sp. n. (male holotype): A. Leg I; B. Leg II; C. Leg III; D. Leg IV.



FIGURE 4. Copulatory organs of *Phrurotimpus daliensis* sp. n.: A. Male left palp, prolateral view; B. Same, retrolateral view; C. Same, ventral view; D. Same, dorsal view; E. Epigyne, ventral view; F. Same, dorsal view. Abbreviations: E—embolus; C—conductor; dTA—dorsal tibial apophysis; SD—sperm duct; RTA—retrolateral tibial apophysis; B—bursa; CO—copulatory opening; CD—copulatory duct; CT—connecting tube; FD—fertilization duct; S—spermathecae.

Measurement of legs:

♂/♀	Fe	Pa	Ti	Mt	Ta	Total
Leg I	0.73/0.96	0.28/0.30	0.73/1.05	0.64/0.87	0.40/0.48	2.78/3.66
Leg II	0.61/0.78	0.27/0.34	0.51/0.71	0.54/0.64	0.37/0.46	2.30/2.93
Leg III	0.54/0.70	0.25/0.33	0.41/0.51	0.50/0.61	0.33/0.44	2.03/2.59
Leg IV	0.83/1.09	0.30/0.37	0.70/0.95	0.80/1.04	0.45/0.61	3.08/4.06

Spination of legs:

		Fe	Pa	Ti	Mt	Ta
♂	Leg I	d 1 pl 2	–	pv 5 rv 5	pv 4 rv 3	–
	Leg II	d 1	–	pv 5 rv 3	pv 4 rv 2	–
	Leg III	d 1	–	–	–	–
	Leg IV	d 1	–	–	–	–
♀	Leg I	d 1 pl 3	–	pv 6 rv 7	pv 5 rv 4	–
	Leg II	d 1	–	pv 6 rv 5	pv 4 rv 3	–
	Leg III	d 1	–	–	–	–
	Leg IV	d 1	–	–	–	–

Distribution. China (Yunnan Province)

Phrurotimpus baoshanensis sp. n. (保山提普蛛)

Figs 5–8

Type material. Holotype ♂: **CHINA:** Yunnan Province: Baoshan City, Longyang District, Taibao Park (25°07'26.83"N, 99°08'49.28"E), 1849 m elev., 20.VII.2021, leg. Yannan Mu.

Paratypes: 7♂ 19♀, same data as holotype.

Etymology. The specific name is derived from the type locality; adjective.

Diagnosis. This new species is similar to *P. lasiolepis* **comb. n.**, but can be distinguished by: 1) the thinner and curved conductor; 2) the larger RTA, and the position of the base of the RTA, which extends to the cymbium with a broad gap; 3) the bursa close to each other and more strongly curved, forming a J-shape.

Description. Male (Holotype): total length 2.06, carapace 0.97 long, 0.78 wide; abdomen 1.09 long, 0.61 wide. Eye sizes and interdistances: AME 0.06, ALE 0.08, PME 0.05, PLE 0.06; AME–AME 0.03, AME–ALE 0.01, ALE–ALE 0.15, PME–PME 0.05, PME–PLE 0.04, PLE–PLE 0.22, ALE–PLE 0.05. EAW 0.30, CRW 0.38, EAW/CRW 0.79, CRW/CW 0.49. MOA 0.15 long, anterior width 0.15, posterior width 0.14. CH 0.09, CH/AME 1.50. Labium 0.10 long, 0.14 wide. Sternum 0.62 long, 0.47 wide. Carapace oval, brown in color, with several slightly lighter bands either side of fovea (Fig. 5A, 6A); middle of carapace with sparse iridescent scales, margin of carapace with ring of iridescent scales (Fig. 6C). Sternum mottled gray, without pattern (Fig. 5B). Abdomen black, large dorsal scutum covering most of dorsum, with iridescent scales on side and behind dorsal scutum (Fig. 6B). Femora and patella I–II black, femora and patella III–IV yellow, tibiae I–IV black with white tip except tibia III yellow, all metatarsi and tarsi yellowish without markings, except metatarsus IV black with yellow tip (Fig. 7).

Palp as in Figs 8A–D. Femur without apophysis, with asetose swelling ventrally at the middle. Patella and tibia short, cymbium longer than femur. Tibia with single large retrolateral apophysis and small dorsal apophysis; gap to cymbium wider than in *P. daliensis* **sp. nov.**. Bulb narrower than cymbium, distinct sperm duct tapering from retrolateral side to prolateral side, S-shaped in prolateral view. Embolus short, spike-shaped. Conductor membranous, triangular.

Female (one paratype): total length 2.85, carapace 1.14 long, 0.95 wide; abdomen 1.71 long, 1.12 wide. Eye sizes and interdistances: AME 0.08, ALE 0.08, PME 0.06, PLE 0.07; AME–AME 0.04, AME–ALE 0.01, ALE–ALE 0.18, PME–PME 0.05, PME–PLE 0.04, PLE–PLE 0.25, ALE–PLE 0.05. EAW 0.35, CRW 0.47, EAW/CRW 0.74, CRW/CW 0.49. MOA 0.18 long, anterior width 0.18, posterior width 0.16. CH 0.09, CH/AME 1.13. Labium 0.10 long, 0.19 wide. Sternum 0.77 long, 0.62 wide. Other characters as for male, except larger body size, broad

band with more iridescent scales behind of eye area than male and without dorsal scutum on abdomen (Figs 5C–D, 6D–F).

Epigyne as in Figs 8E–H. Copulatory openings large, situated medially, separated by about 3 times broader than spermathecae diameter. Copulatory ducts short and thick. Bursa J-shaped. Connecting tubes thinner than CDs. Spermathecae small, oval. Fertilization ducts located at anterior margin of spermathecae.



FIGURE 5. Habitus, male holotype and female paratype, *Phrurotimpus baoshanensis* sp. n.: A. Male, dorsal view; B. Same, ventral view; C. Female, dorsal view; D. Same, ventral view.

Measurement of legs:

♂/♀	Fe	Pa	Ti	Me	Ta	Total
Leg I	0.87/1.08	0.33/0.45	0.87/1.17	0.84/1.03	0.46/0.60	3.37/4.33
Leg II	0.74/0.91	0.31/0.41	0.61/0.81	0.67/0.78	0.42/0.53	2.75/3.44
Leg III	0.66/0.78	0.29/0.34	0.50/0.63	0.62/0.75	0.34/0.50	2.41/3.00
Leg IV	1.08/1.23	0.36/0.47	0.87/1.07	0.99/1.22	0.57/0.66	3.87/4.65

Spinination of legs:

		Fe	Pa	Ti	Me	Ta
♂	Leg I	d 1 pl 2	–	v 222222	pv 4 rv 3	–
	Leg II	d 1	–	v 22222	pv 4 rv 2	–
	Leg III	d 1	–	–	–	–
	Leg IV	d 1	–	–	–	–
♀	Leg I	d 1 pl 2	–	v 2222222	v 2222	–
	Leg II	d 1	–	v 222222	pv 4 rv 3	–
	Leg III	d 1	–	–	–	–
	Leg IV	d 1	–	–	–	–

Distribution. China (Yunnan Province)

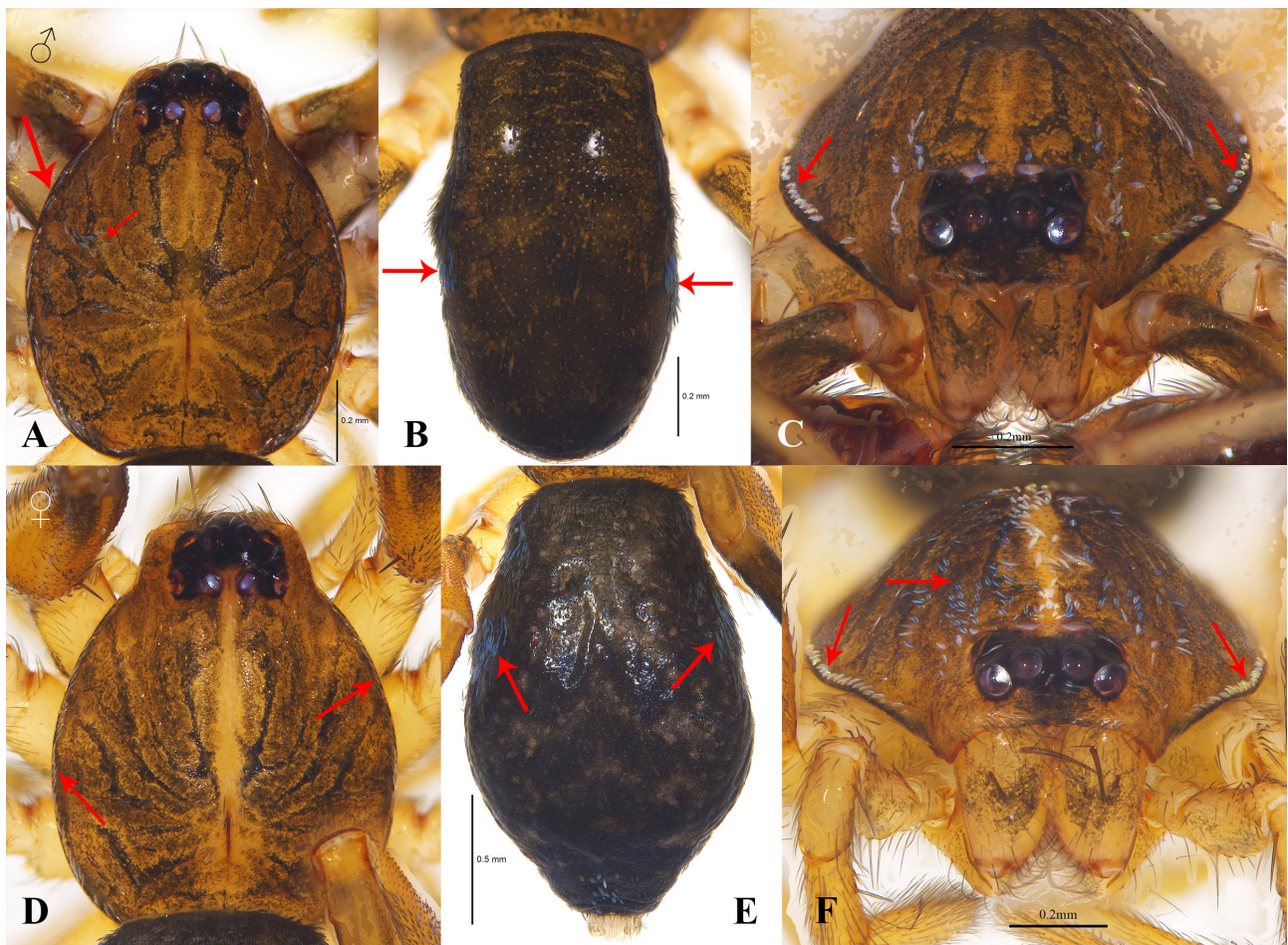


FIGURE 6. Iridescent scales of *Phrurotimpus baoshanensis* sp. n.: A. Male, carapace dorsal view; B. Same, abdomen, dorsal view; C. Same, carapace frontal view; D. Female, carapace, dorsal view; E. Same, abdomen, dorsal view; F. Same, carapace frontal view. Red arrow: iridescent scales.

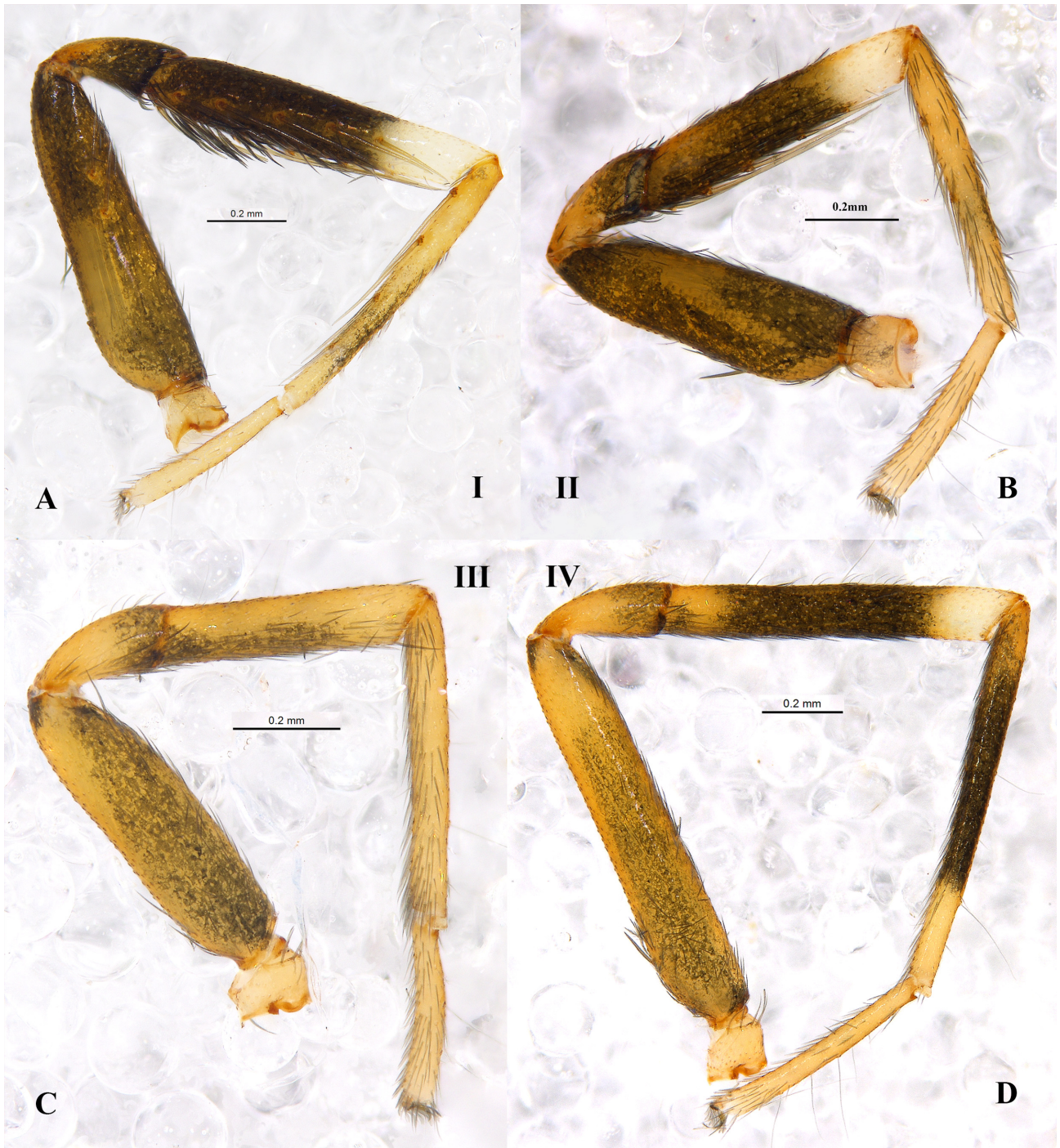


FIGURE 7. Left legs of *Phrurotimpus baoshanensis* sp. n. (male holotype): A. Leg I; B. Leg II; C. Leg III; D. Leg IV.

***Phrurotimpus lasiolepis* (Fu, Chen & Zhang, 2016) comb. nov.**

Phrurolithus lasiolepis Fu, Chen & Zhang, 2016: 276, figs 3A–I, 4A–E.

Remark. As explained in the Introduction, the morphology of this species is consistent with the two species of *Phrurotimpus* described in this paper, and we therefore transfer this species to the latter genus.

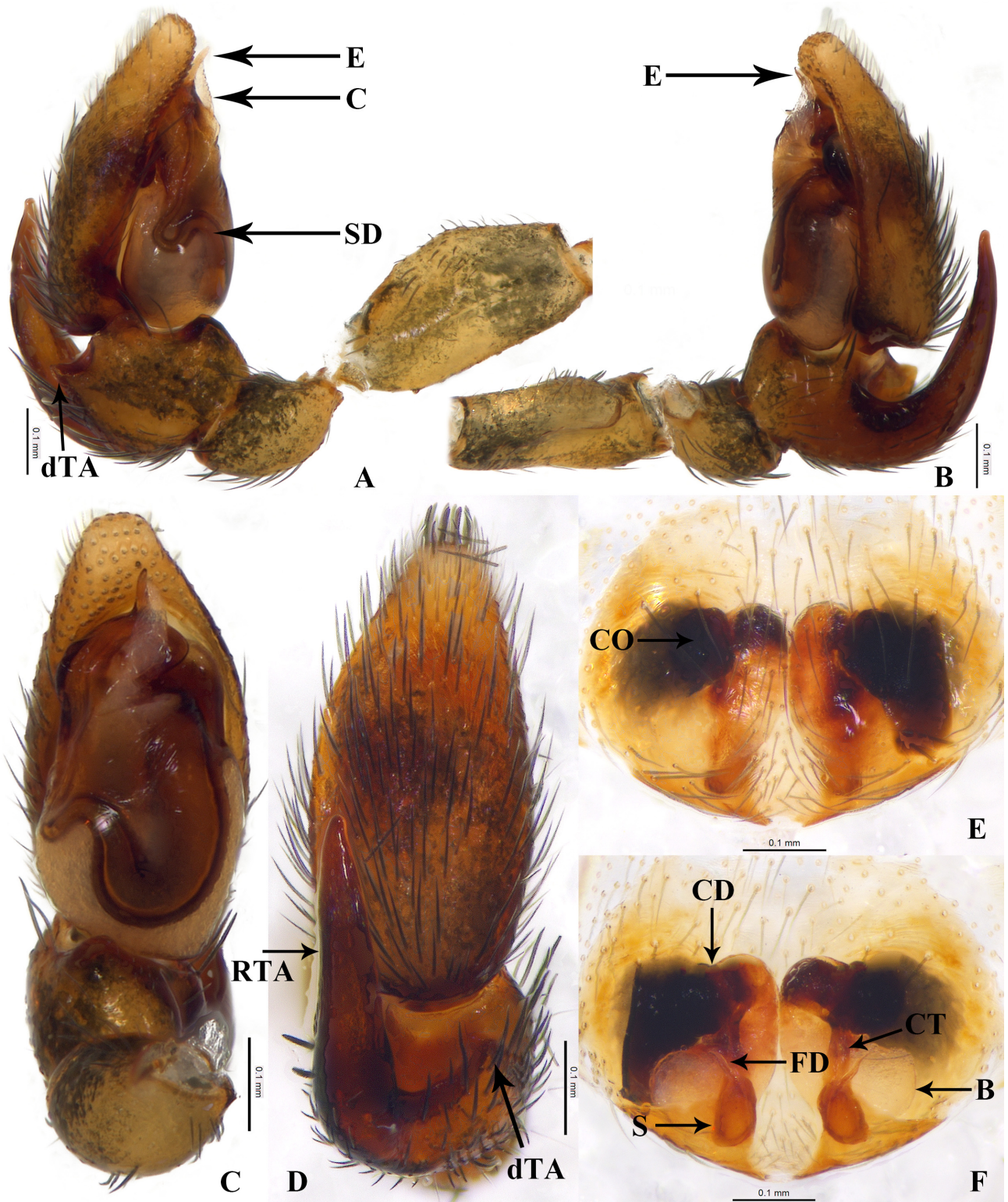


FIGURE 8. Copulatory organs of *Phrurotimpus baoshanensis* sp. n.: A. Male left palp, prolateral view; B. same, retrolateral view; C. same, ventral view; D. same, dorsal view; E. Epigyne, ventral view; F. same, dorsal view. Abbreviations: E—embolus; C—conductor; dTA—dorsal tibial apophysis; SD—sperm duct; RTA—retrolateral tibial apophysis; B—bursa; CO—copulatory opening; CD—copulatory duct; CT—connecting tube; FD—fertilization duct; S—spermathecae.



FIGURE 9. Habitats of new species: A–B. *Phrurotimpus daliensis* sp. n. (photographs by Junxia Zhang); C–D. *Phrurotimpus baoshanensis* sp. n. (photographs by Yannan Mu).

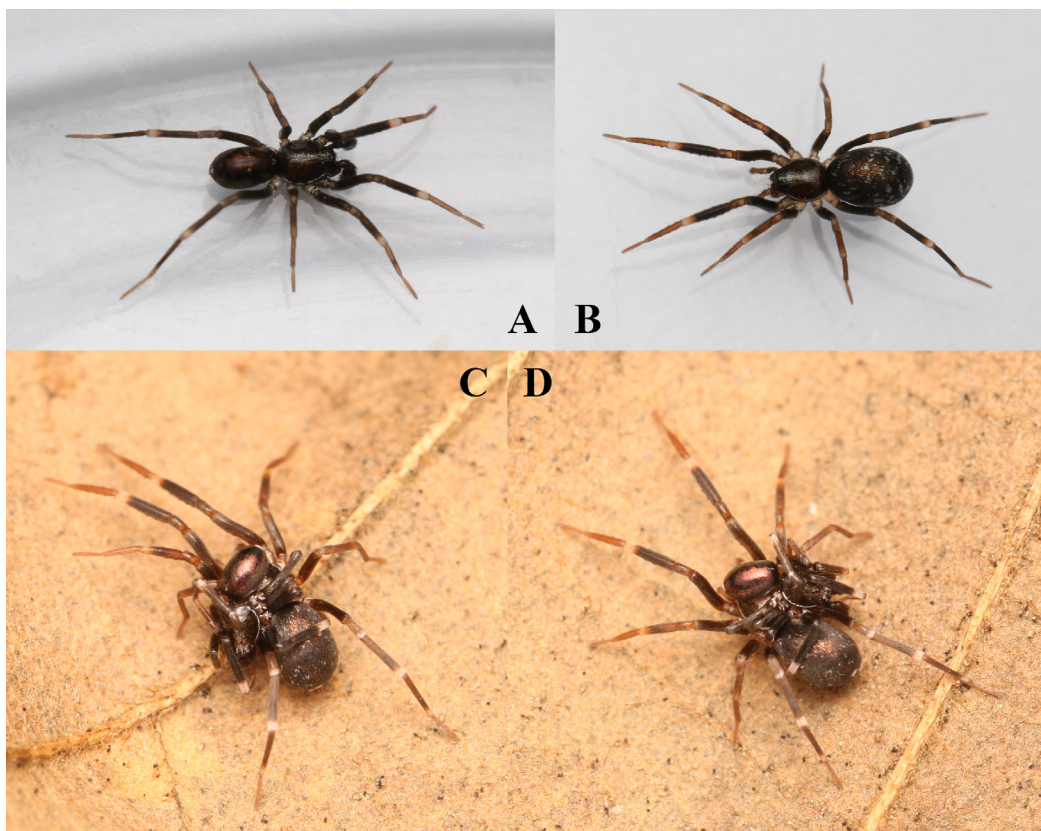


FIGURE 10. Living photos and mating behavior of *Phrurotimpus daliensis* sp. n.: A. Male; B. Female; C. First stage mating behavior; D. Second stage mating behavior (photographs by Kun Yu).

Natural history

The Asian spiders of this genus live under leaves in grass (Fig. 9), and are extremely difficult to detect because of their small size. Fortunately, during the process of collection, we were privileged to observe the mating behavior of *P. daliensis* **sp. n.** and recorded it (Fig. 10C–D). During the mating, the male orientates his body towards the posterior of the female, and uses the left leg I to hold the female abdomen, while legs II–IV hold the female carapace; the right legs curl up and support his body on the substrate. Then the male inserts the embolus of the left palp into the copulatory opening of the epigyne to complete the sperm transfer (Fig. 10C). This process only lasts for between two to three minutes. Subsequently, the male adjusts his position and moves to the opposite side of the abdomen, using the right legs to fix and hold the female while the left legs curl up and support his body, while transfer of sperm by the right palp is completed (Fig. 10D).

Acknowledgements

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