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## Research article

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# Two new species in the genus *Atractides* Koch, 1837 (Acari: Hydrachnidia: Hygrobatidae), with the first descriptions of the female of two species from China

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**Abstract.** In this paper, two new species of Acari are described, i.e., *Atractides* (*Atractides*) *cardiacus* Zhang & Guo sp. nov. and *Atractides* (*Atractides*) *fodingensis* Zhang & Guo sp. nov. Moreover, the females of *Atractides* (*Atractides*) *bitergumus* Zhang & Guo, 2023 and *Atractides* (*Tympanomegapus*) *tergumus* Zhang & Guo, 2023 from Hainan Province and Guizhou Province of Oriental Region in China are described and illustrated for the first time.

**Keywords.** Water mite, *Atractides*, new species, taxonomy, China.

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## Introduction

*Atractides* Koch, 1837 is a genus of Hygrobatidae Koch, 1842, and divided into four subgenera: *Atractides* Koch, 1837, *Tympanomegapus* Thor, 1923, *Polymegapus* Viets, 1926, and *Maderomegapus* Lundblad, 1941 (Gerecke 2003; Gerecke *et al.* 2016; Smit 2020). Up to now, there are about 426 species of *Atractides* described all over the world (Lundblad 1969; Imamura 1976; Viets 1987; Conroy & Bilyj 1992; Jin 1997; Pešić 2002; Pešić & Asadi 2002; Gerecke 2003; Tuzovskij 2004, 2010a, 2010b, 2011, 2013; Pešić *et al.* 2004, 2005; Pešić & Smit 2009, 2015a, 2015b, 2018, 2021a, 2021b, 2022; Yi *et al.* 2010; Wang & Jin 2012, 2013; Wang *et al.* 2015; Smit 2020; Zhang *et al.* 2022, 2023; Pešić *et al.* 2023;

<http://www.watermite.org/>), but only two subgenera (*Atractides* and *Tympanomegapus*) and 25 species have been reported in China. This means that the genus *Atractides* in China is still poorly studied (Lundblad 1969; Imamura 1976; Jin 1997; Yi *et al.* 2010; Wang & Jin 2012, 2013; Wang *et al.* 2015; Zhang *et al.* 2022, 2023).

China covers a huge geographical area and spans two zoogeographical regions: Palaearctic Region and Oriental Region (Zhang 1999). The geographic diversity of China provides abundant habitats for plants and animals, so China is one of the world's “megabiodiversity countries” (Tang *et al.* 2006).

The present study is based on material collected in 2023 from Hainan Province and Guizhou Province of the Oriental Region in China. Four species of the genus *Atractides* are described and illustrated: two species new to science, i.e., *Atractides (Atractides) cardiacus* Zhang & Guo sp. nov. and *A. (A.) fodingensis* Zhang & Guo sp. nov. The females of *A. (A.) bitergumus* Zhang & Guo, 2023 and *A. (Tympanomegapus) tergumus* Zhang & Guo, 2023 are reported and described for the first time.

## Material and methods

Water mites were collected by hand netting, sorted on the spot from the living material and preserved in Koenike-fluid. Habitat photos of the collection sites were taken with a Vivo X60 mobile phone. After the specimens were brought back to the laboratory, they were dissected under a Motic SMZ-168 stereo microscope following Jin (1997). Specimens were observed and drawn under a Leica DM3000 microscope, measurements and optical microscope photographs were taken with a Nikon Ni-E microscope (with a mounted Nikon DS-Ri2 camera). Moreover, specimens were also photographed with a JCM6000 Desktop SEM, and the detailed specimens processing and photography methods follow Li *et al.* (2022). A Canon 5D Mark IV digital camera and a Mitutoyo Plan NIR 10\* lens with Godox MF12 flash were used to take color pictures of water mites. All illustrations were edited with Adobe Photoshop 2024. All measurements are given in  $\mu\text{m}$ .

## Abbreviations for morphological terms and measurements

The terminology and abbreviations used are modified from Jin (1997) and Gerecke (2003).

$A_1$	= preantennal glandularia
$A$	= postantennal glandularia
Ac	= acetabulum (pl. acetabula, numbered 1 to 3)
ACG	= anterior coxal group (Cx-I+Cx-II)
$C_2, C_4$	= coxoglandularia 2, coxoglandularia 4
Cx-I–IV	= coxae I–IV
$D_1–D_4$	= dorsoglandularia 1–4
dL	= dorsal length
HB	= entral height
IL	= lateral length
I-L-1–6, etc.	= first to sixth segment of the first leg, etc.
L	= length
$L_1–L_4$	= lateroglandularia 1–4
mL	= median length
$O_1$	= preocularia
$O_2$	= postocularia
P-1–P-5	= first to fifth segment of palp (from proximal to distal)
PCG	= posterior coxal group (Cx-III+Cx-IV)
S-1	= proximal large ventral seta at I-L-5
S-2	= distal large ventral seta at I-L-5



$So_1$ – $So_5$  = slit organs 1–5  
 $V_1$ – $V_4$  = ventroglandularia 1–4  
W = width

The holotypes and paratypes are deposited in the Institute of Entomology, Guizhou University, Guiyang, China (GUGC).

## Results

### Taxonomy

Class Arachnida Lamarck, 1801  
Subclass Acari Leach, 1817  
Order Trombidiformes Reuter, 1909  
Superfamily Hygrobatoidea Koch, 1842  
Family Hygrobatidae Koch, 1842  
Genus *Atractides* Koch, 1837

*Atractides (Atractides) cardiacus* Zhang & Guo sp. nov.

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Figs 1–15, 25

### Diagnosis

#### Male

Apodemes of ACG curved hook-shaped, and posterior margin of Cx-IV almost straight. Anterior margin of genital plate slightly indented, posterior margin slightly convex, three pairs of acetabula forming an obtuse triangle.  $V_1$  separated from  $V_2$ , excretory pore smooth. Sword seta on P-4 at same level of proximoventral hair. I-L-6 thick at base, tapering distally.

#### Female

Similar to male. Ac in weakly curved line, Ac2 at middle of Ac1 and Ac3. Palp more slender than in male.

### Etymology

The new species is named after the heart-like genital plate of the male.

### Type material

#### Holotype

P.R. CHINA • ♂; Hainan Province, Qionghai City, Longjiang Town; 19.1730° N, 110.3459° E; 4 m a.s.l.; 11 Apr. 2023; Hai-Tao Li, Yu-Lin Zheng and Yu-Hao Zhang leg.; main river (Wanquan River) with wide surface, slowly flowing, with sandy soil and humus on bottom; slide no. HN-HY-2023041101; GUGC.

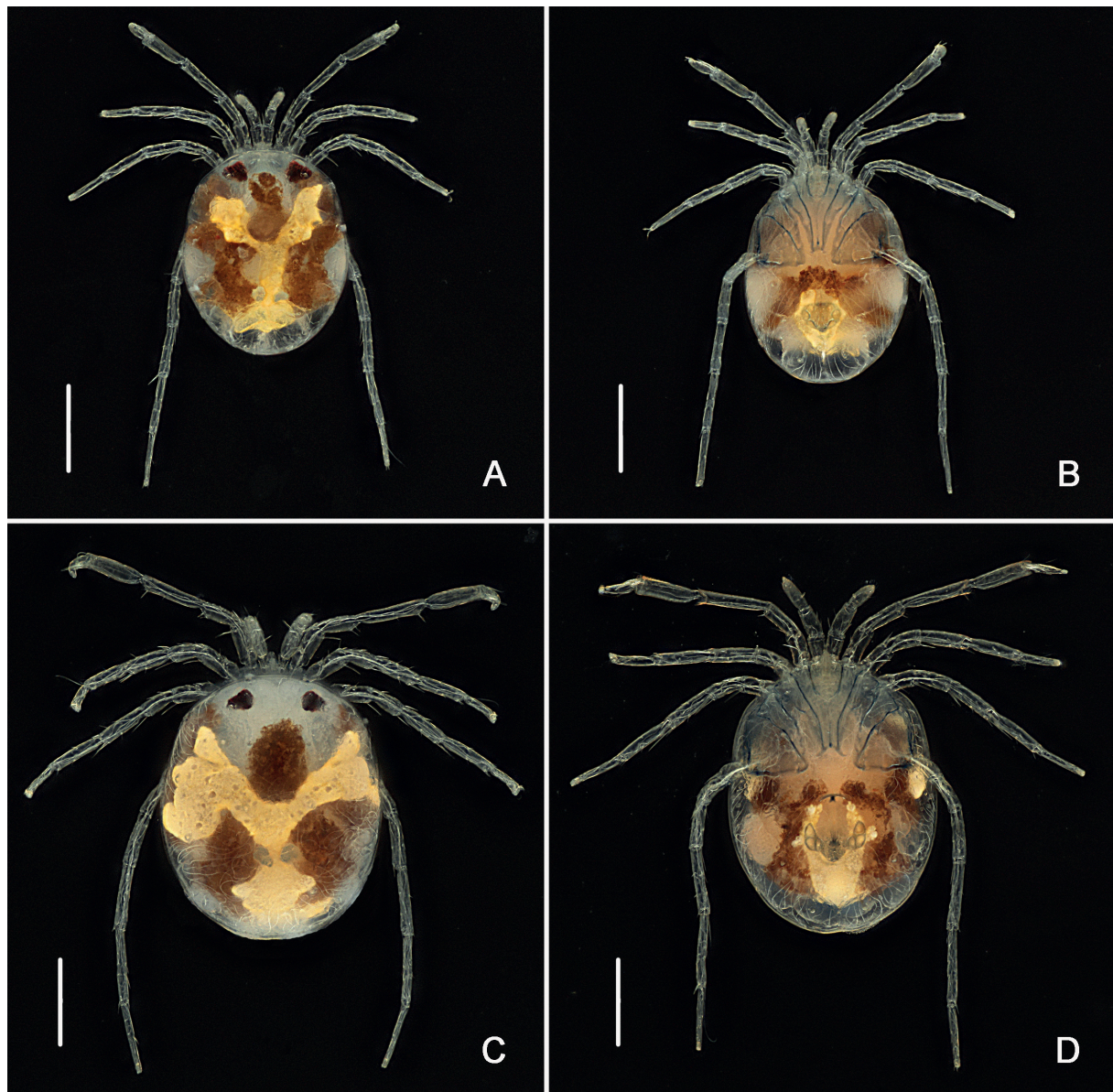
#### Paratypes

P.R. CHINA • 3 ♂♂, 3 ♀♀; same data as for holotype; slides nos. HN-HY-2023041102 to 2023041107; GUGC.

## Description

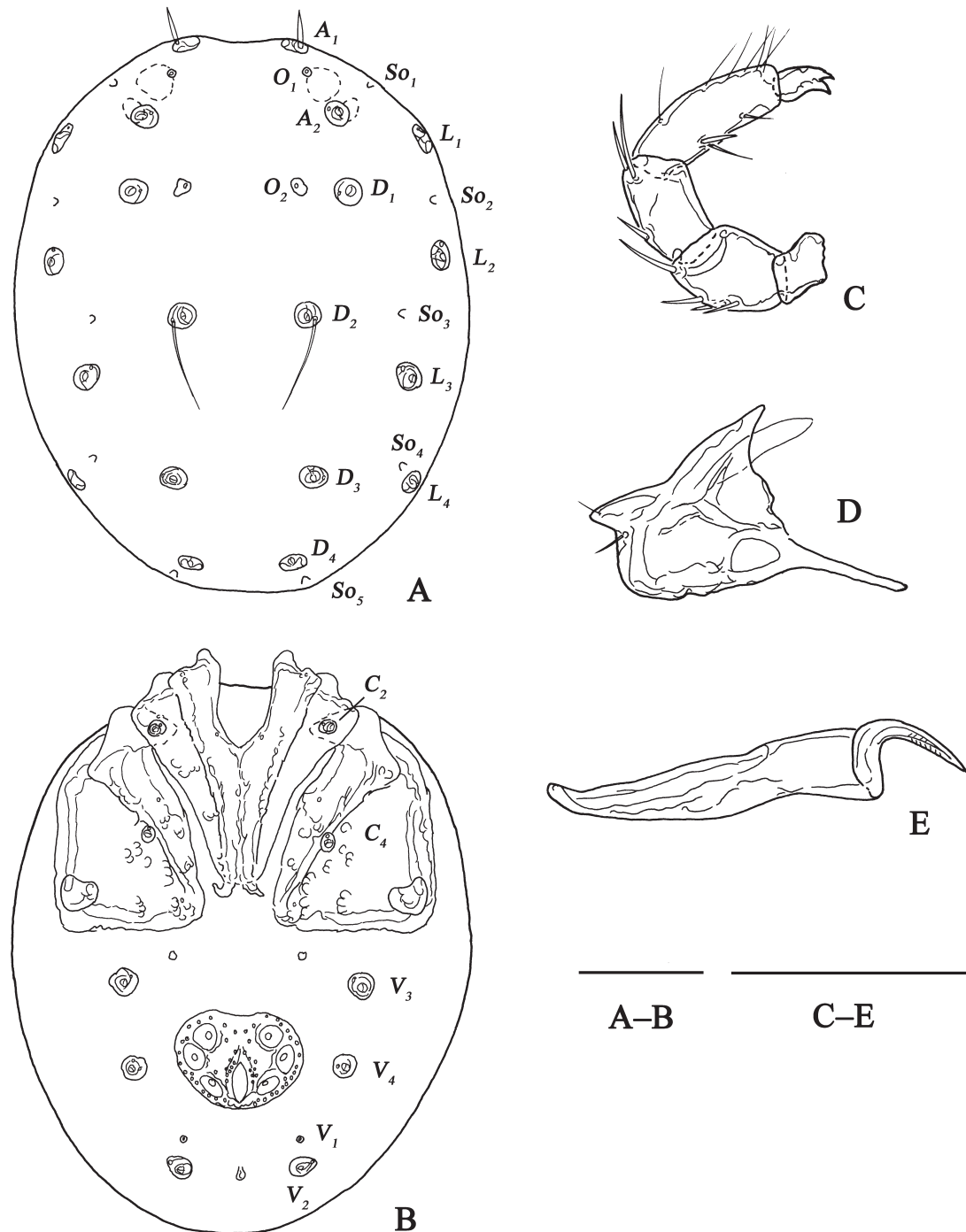
### Male (n = 4)

Idiosoma soft and oval;  $O_1$  between  $A_1$  and  $A_2$ , but closer to  $A_1$ ,  $O_2$  between  $D_1$  and at same level of  $D_1$ ; all slit organs visible,  $So_1$  near  $A_2$ ,  $So_2$  at same level of  $D_1$  and  $O_2$ ,  $So_3$  at same level of  $D_2$ ,  $So_4$  close to  $L_4$ ,  $So_5$  behind of  $D_4$  (Figs 2A, 6A). ACG fused together and with suture line, apodemes of ACG curved hook shape; PCG separated, posterior margin of Cx-IV almost straight,  $C_4$  near suture line between Cx-III and Cx-IV, suture line of Cx-III and Cx-IV in medial part nearly straight (Fig. 8A). Anterior margin of genital plate slightly indented, posterior margin slightly convex, three pairs of acetabula forming obtuse



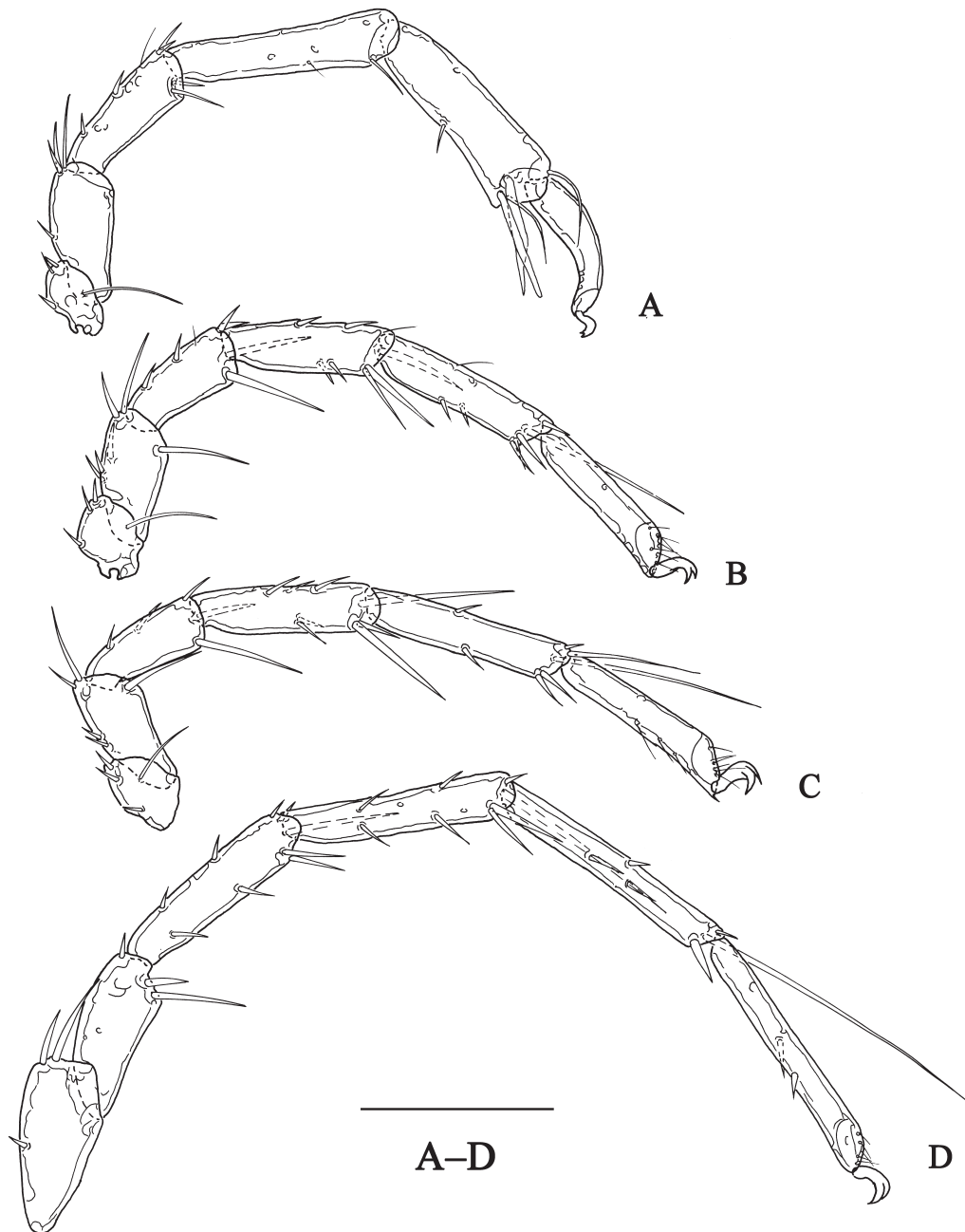
**Fig. 1.** *Atractides (Atractides) cardiacus* Zhang & Guo sp. nov. **A–B.** Paratype, ♂ (slide no. HN-HY-2023041102, GUGC). **C–D.** Paratype, ♀ (slide no. HN-HY-2023041106, GUGC). **A.** Idiosoma, dorsal view. **B.** Idiosoma, ventral view. **C.** Idiosoma, dorsal view. **D.** Idiosoma, ventral view. Scale bars = 200  $\mu$ m.

triangle, Ac2 near Ac1 (Fig. 9D).  $V_1$  separated from  $V_2$ ,  $V_2$  posterior to  $V_1$  (Fig. 8B),  $V_4$  at same level of Ac2,  $V_3$  and  $V_4$  arranged in inverted trapezoid; excretory pore smooth and between  $V_2$  (Figs 2B, 6B).



**Fig. 2.** *Atractides (Atractides) cardiacus* Zhang & Guo sp. nov., holotype, ♂ (slide no. HN-HY-2023041101, GUGC). **A.** Idiosoma, dorsal view. **B.** Idiosoma, ventral view. **C.** Palp. **D.** Gnathosoma. **E.** Chelicera. Scale bars = 100  $\mu$ m.

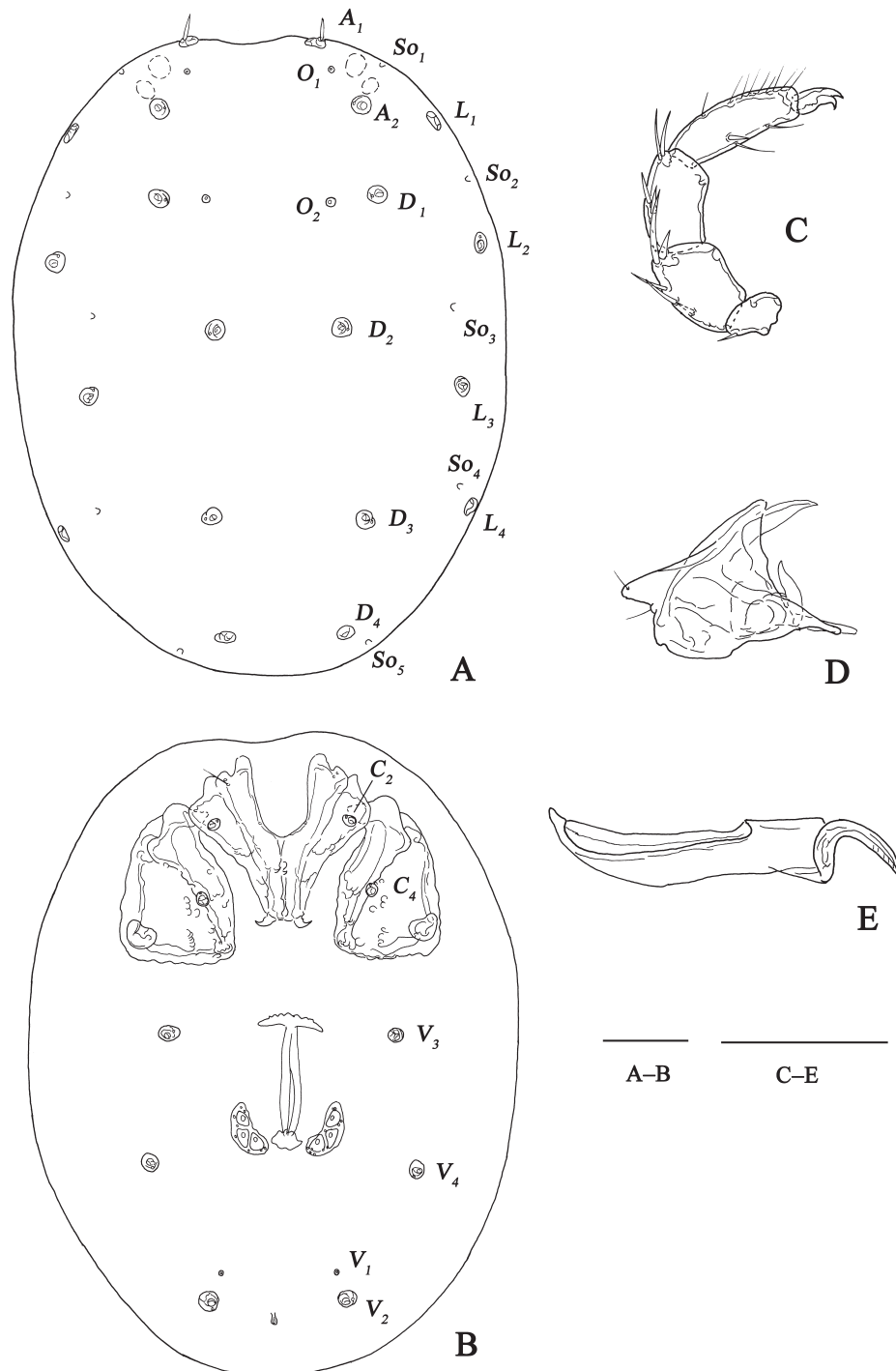
Palp five-segmented, without obvious sexual dimorphism; P-1 short, P-2 and P-3 short with straight ventral margin, P-4 with some dorsal hairs and two ventral hairs, dividing P-4 in sectors 3:2:2, sword seta at same level of proximoventral hair (Figs 2C, 9A–B). Ventral margin of I-L-5 slightly longer than dorsal margin, S-1 close to S-2 and S-2 thickens at three-fifth position and then narrows immediately, whip-like seta at anterior distal margin; I-L-6 thick at base, distally tapering. IV-L-5 with swimming seta at distal margin and almost as long as IV-L-6 (Figs 3, 10).



**Fig. 3.** *Atractides (Atractides) cardiacus* Zhang & Guo sp. nov., holotype, ♂ (slide no. HN-HY-2023041101, GUGC), I-L–IV-L. Scale bar = 100 µm.



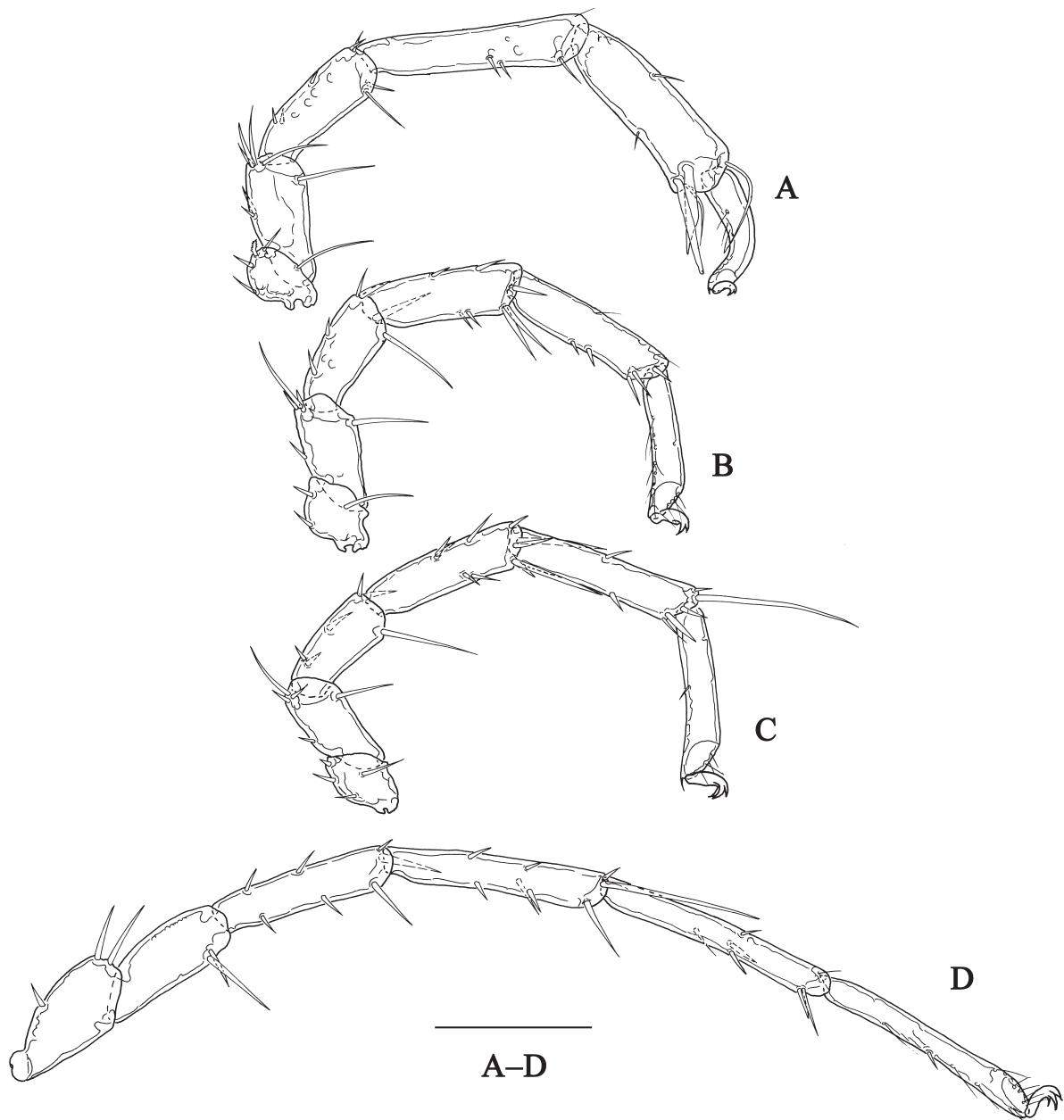
MEASUREMENTS (measurements of paratypes in parentheses). Idiosoma L 450 (420–460), W 385 (371–386); coxal field L 245 (216–245), Cx-III W 263 (238–263), ACG IL 180 (163–180), mL 116 (112–123), W 192 (183–192); gnathosoma bay L 83 (68–83); genital field L 81 (70–82), W 109 (92–109); Ac1–3



**Fig. 4.** *Atractides (Atractides) cardiacus* Zhang & Guo sp. nov., paratype, ♀ (slide no. HN-HY-2023041105, GUGC). **A.** Idiosoma, dorsal view. **B.** Idiosoma, ventral view. **C.** Palp. **D.** Gnathosoma. **E.** Chelicera. Scale bars = 100  $\mu$ m.



L 20 (19–21), 22 (20–22), 24 (21–24); chelicera L 166 (155–171), cheliceral claw L 43 (42–47), basal segment L 126 (123–138); gnathosoma L 136 (131–139); palp dL: P-1 22 (19–22), P-2 51 (48–54), P-3 49 (45–50), P-4 73 (67–74), P-5 27 (24–28); leg segments: I-L-1 dL 39 (36–41), I-L-2 dL 66 (65–73), I-L-3 dL 80 (74–84), I-L-4 dL 125 (115–128), I-L-5 dL 117 (103–117), HB 37 (33–37), I-L-6 dL 65 (65–73), HB 15 (11–15), S-1 L 61 (57–61), W 6 (5–6), S-2 L 57 (55–59), W 7 (6–8); dL: II-L-1 39 (37–43), II-L-2 62 (55–71), II-L-3 68 (60–69), II-L-4 89 (76–90), II-L-5 98 (86–104), II-L-6 85 (82–91); dL: III-L-1 42 (36–46), III-L-2 62 (61–66), III-L-3 67 (64–69), III-L-4 96 (87–96), III-L-5 112 (101–112), III-L-6 108 (95–108); dL: IV-L-1 88 (78–88), IV-L-2 85 (71–85), IV-L-3 106 (102–109), IV-L-4 122 (118–127), IV-L-5 137 (125–139), IV-L-6 134 (118–134).

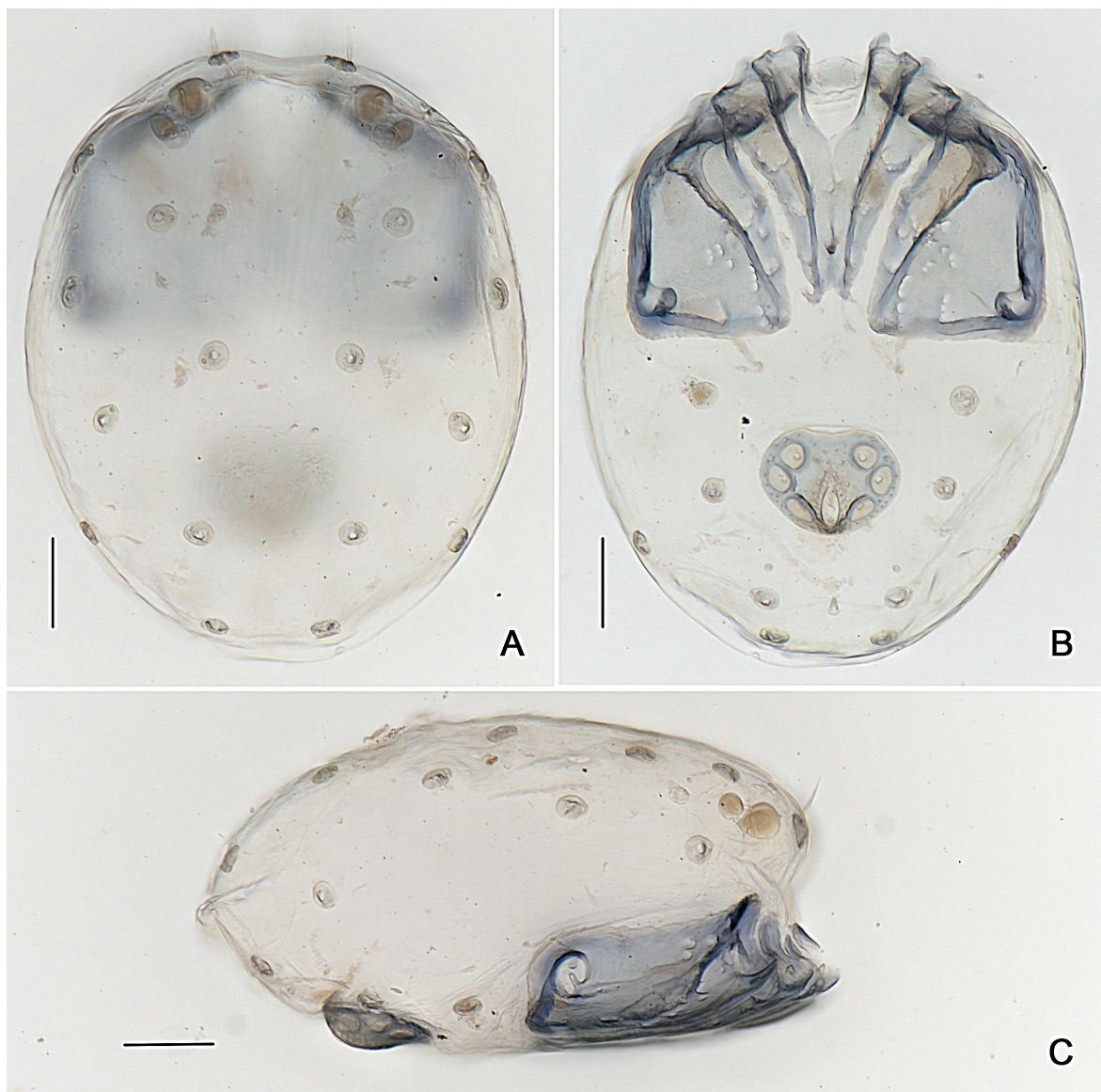


**Fig. 5.** *Atractides (Atractides) cardiacus* Zhang & Guo sp. nov., paratype, ♀ (slide no. HN-HY-2023041105, GUGC). **A–D.** I-L– IV-L. Scale bar = 100 µm.

**Female** (n = 3)

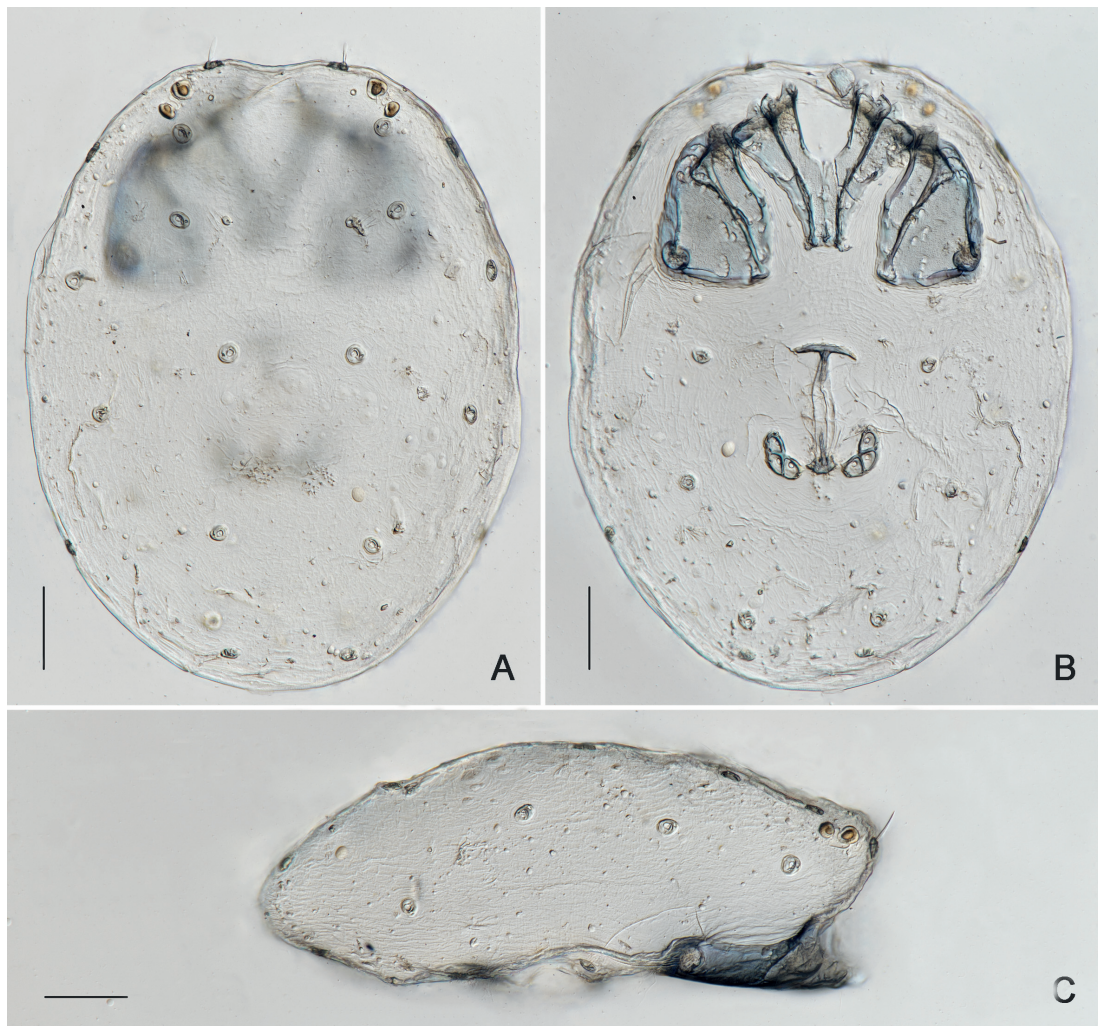
Similar to male. Ac in weakly curved line, Ac2 at middle of Ac1 and Ac3,  $V_3$  at same level of pregenital sclerite, distance between pregenital sclerite and postgenital sclerite longer,  $V_3$  and  $V_4$  arranged in trapezoid; excretory pore slightly posterior to level of  $V_2$ . Palp more slender than in male (Figs 4–5, 7, 12–15).

MEASUREMENTS (measurements of paratypes in parentheses). Idiosoma L 783 (722–807), W 621 (621–678); coxal field L 254 (254–293), Cx-III W 327 (327–363), ACG IL 176 (176–212), mL 101 (101–115), W 223 (223–259); gnathosoma bay L 97 (97–120); gonopore L 141 (99–141), pregenital sclerite L 79 (61–79), postgenital sclerite L 37 (33–40); Ac1–3 L 22 (22–26), 28 (23–28), 25 (25–28); chelicera L 219 (219–240), cheliceral claw L 58 (58–66), basal segment L 175 (175–186); gnathosoma L 146 (146–184); palp dL: P-1 26 (25–26), P-2 64 (64–77), P-3 65 (65–74), P-4 85 (85–96), P-5 31 (31–34);

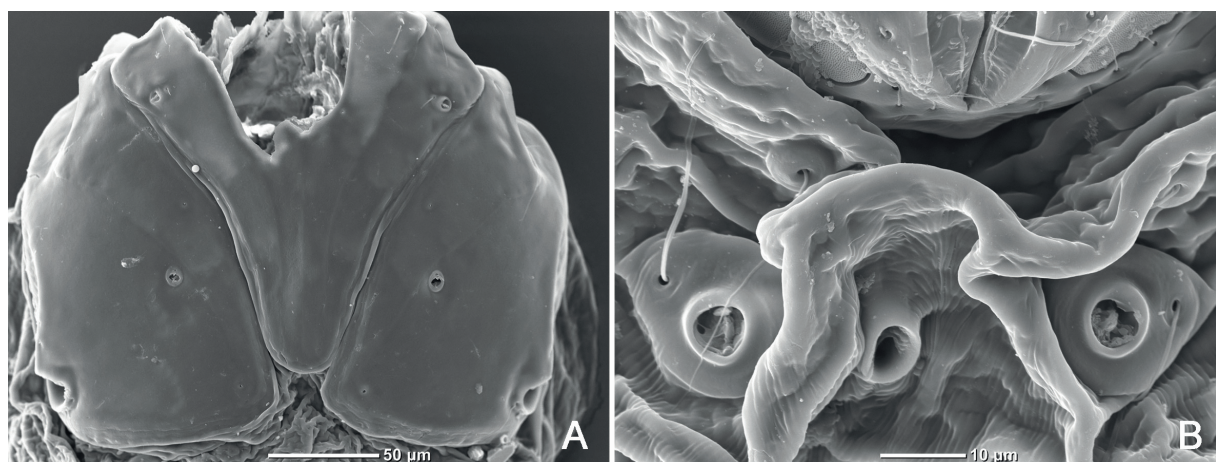


**Fig. 6.** *Atractides (Atractides) cardiacus* Zhang & Guo sp. nov., holotype, ♂ (slide no. HN-HY-2023041101, GUGC), light microscope photographs. **A.** Idiosoma, dorsal view. **B.** Idiosoma, ventral view. **C.** Idiosoma lateral view. Scale bars = 100  $\mu$ m.





**Fig. 7.** *Atractides (Atractides) cardiacus* Zhang & Guo sp. nov., paratype, ♀ (slide no. HN-HY-2023041105, GUGC), light microscope photographs. **A.** Idiosoma, dorsal view. **B.** Idiosoma, ventral view. **C.** Idiosoma lateral view. Scale bars = 100  $\mu\text{m}$ .



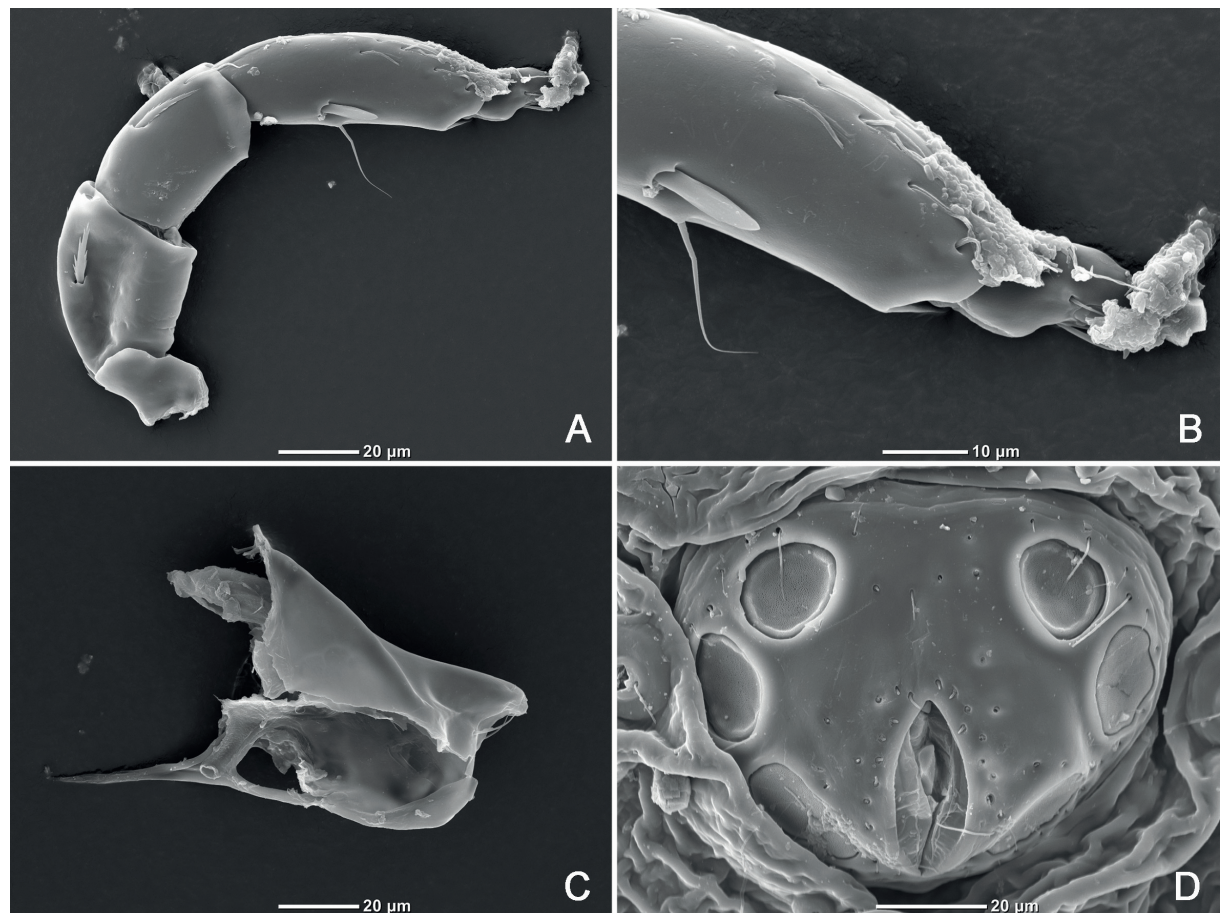
**Fig. 8.** *Atractides (Atractides) cardiacus* Zhang & Guo sp. nov., paratype, ♂ (slide no. HN-HY-2023041103, GUGC), SEM photographs. **A.** ACG and PCG. **B.**  $V_1$ ,  $V_2$  and excretory pore.



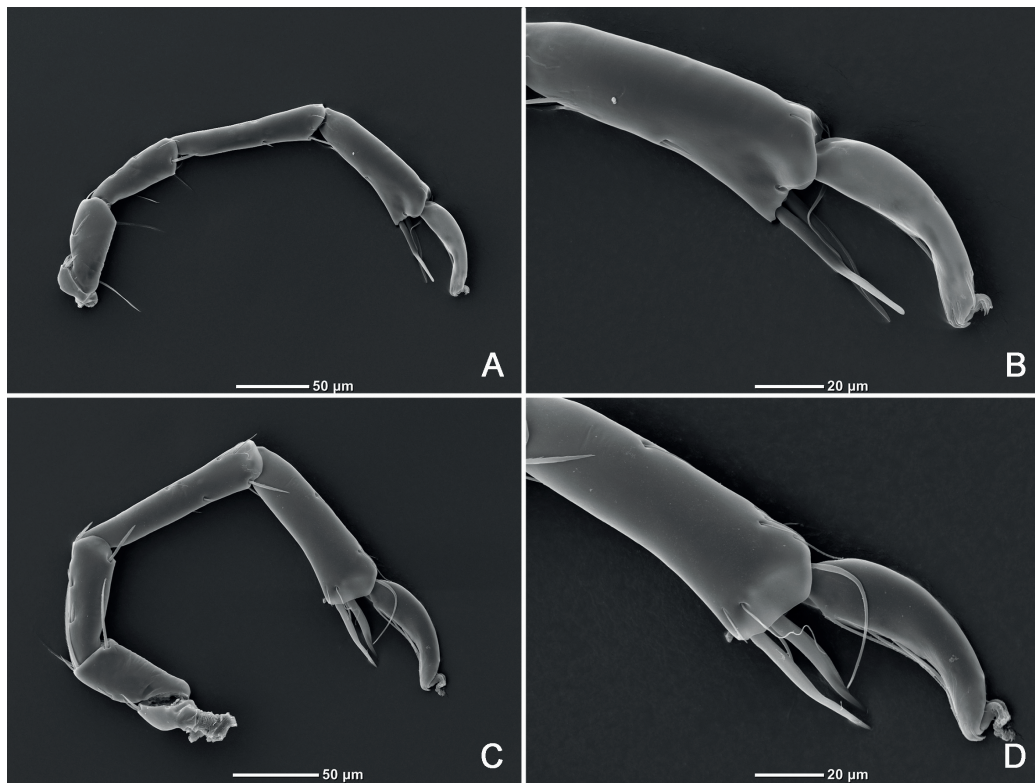
leg segments: I-L-1 dL 43 (43–48), I-L-2 dL 80 (80–92), I-L-3 dL 95 (95–104), I-L-4 dL 148 (148–168), I-L-5 dL 131 (131–143), HB 44 (44–49), I-L-6 dL 78 (77–85), HB 12 (11–13), S-1 L 63 (63–71), W 6 (6–7), S-2 L 59 (59–68), W 8 (8–10); dL: II-L-1 48 (48–56), II-L-2 70 (70–88), II-L-3 78 (78–87), II-L-4 107 (107–116), II-L-5 115 (115–126), II-L-6 94 (94–104); dL: III-L-1 48 (48–57), III-L-2 71 (71–91), III-L-3 79 (79–87), III-L-4 109 (109–125), III-L-5 125 (125–140), III-L-6 109 (109–122); dL: IV-L-1 87 (87–106), IV-L-2 84 (84–98), IV-L-3 121 (121–133), IV-L-4 146 (146–163), IV-L-5 156 (156–177), IV-L-6 151 (151–154).

### Remarks

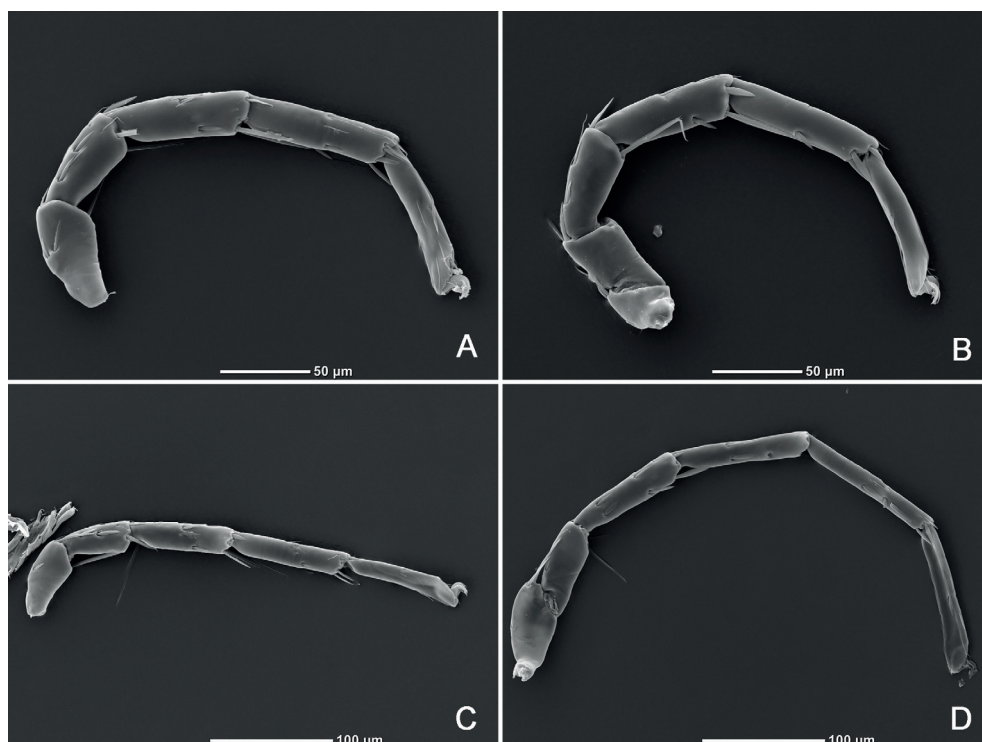
The new species *Atractides (Atractides) cardiacus* Zhang & Guo sp. nov. is similar to *Atractides putihi* Wiles, 1991 in the following points: (1) the posterior margin of Cx-IV almost straight; (2)  $V_1$  separated from  $V_2$ ; (3) excretory pore smooth. But *A. (A.) cardiacus* differs from *A. putihi* in the following points: (1) the posterior margin of the new species genital field is narrow, but wider in *A. putihi*; (2) the gonopore of the male new species is short but longer in *A. putihi* (Pešić & Smit 2009).



**Fig. 9.** *Atractides (Atractides) cardiacus* Zhang & Guo sp. nov., paratype, ♂ (slide no. HN-HY-2023041103, GUGC), SEM photographs. **A.** Palp. **B.** Sword seta of P-4. **C.** Gnathosoma. **D.** Genital field.

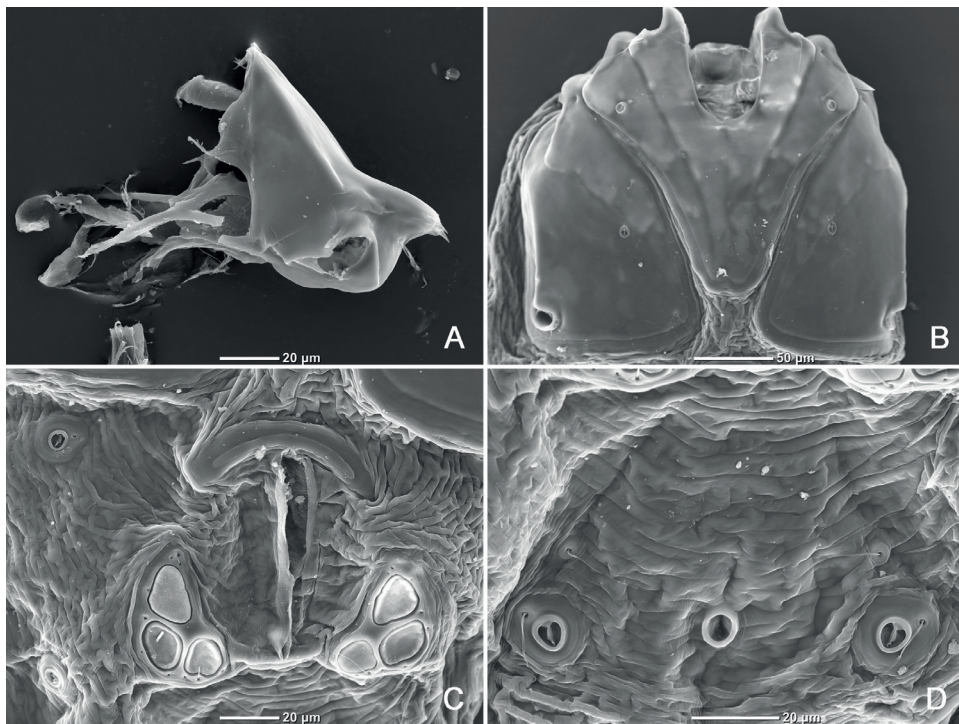


**Fig. 10.** *Atractides (Atractides) cardiacus* Zhang & Guo sp. nov., paratype, ♂ (slide no. HN-HY-2023041103, GUGC), SEM photographs. A. I-L. B. I-L-5-6. C. I-L. D. I-L-5-6.

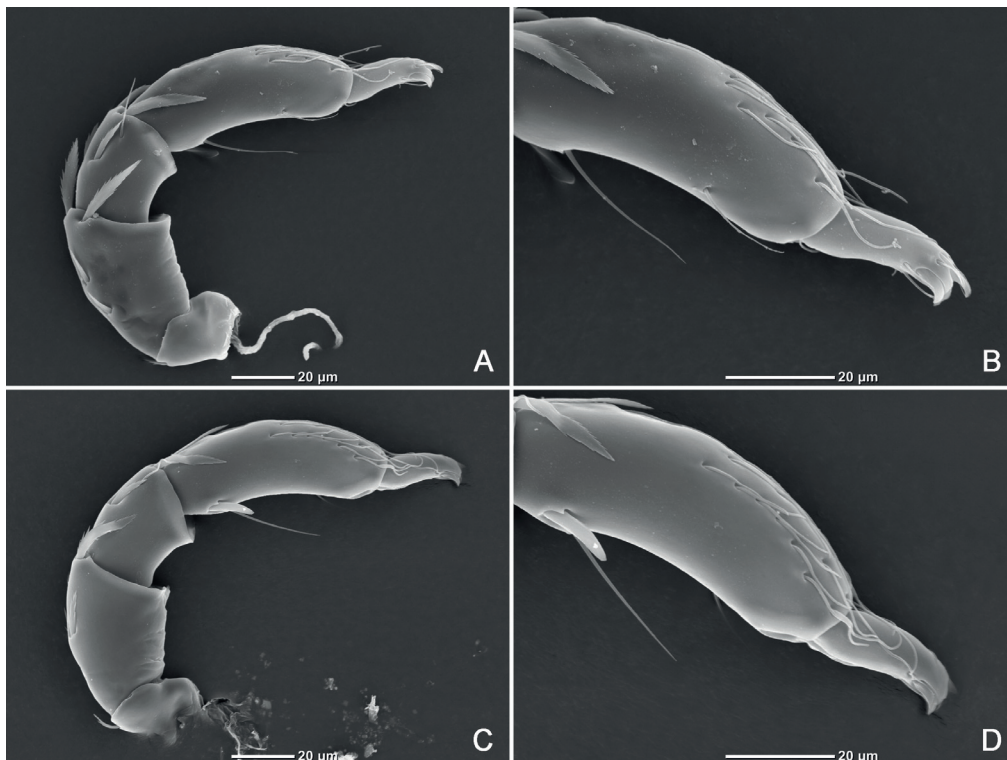


**Fig. 11.** *Atractides (Atractides) cardiacus* Zhang & Guo sp. nov., paratype, ♂ (slide no. HN-HY-2023041103, GUGC), SEM photographs. A. II-L. B. II-L. C. III-L. D. IV-L.

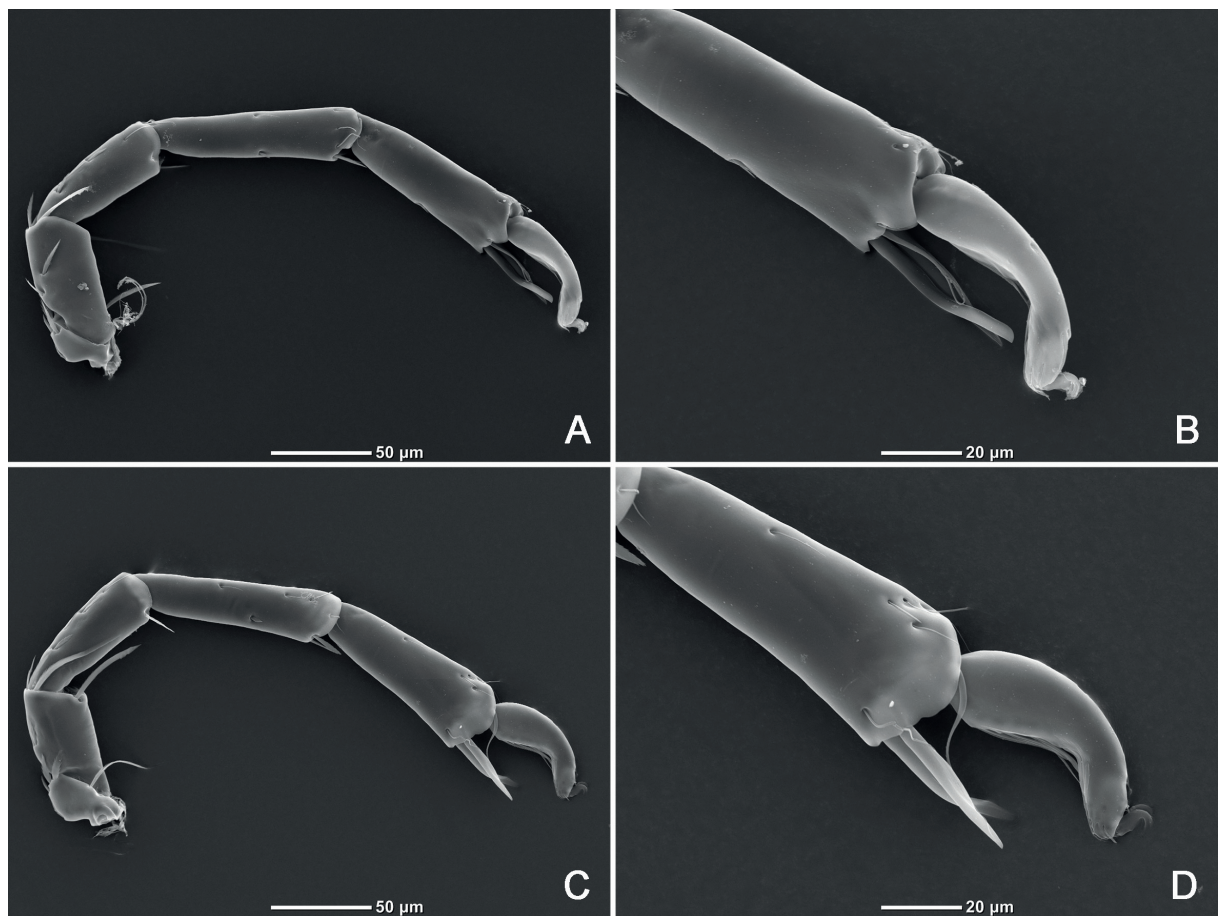




**Fig. 12.** *Atractides (Atractides) cardiacus* Zhang & Guo sp. nov., paratype, ♀ (slide no. HN-HY-2023041107, GUGC), SEM photographs. **A.** Gnathosoma. **B.** ACG and PCG. **C.** Genital field. **D.**  $V_1$ ,  $V_2$  and excretory pore.

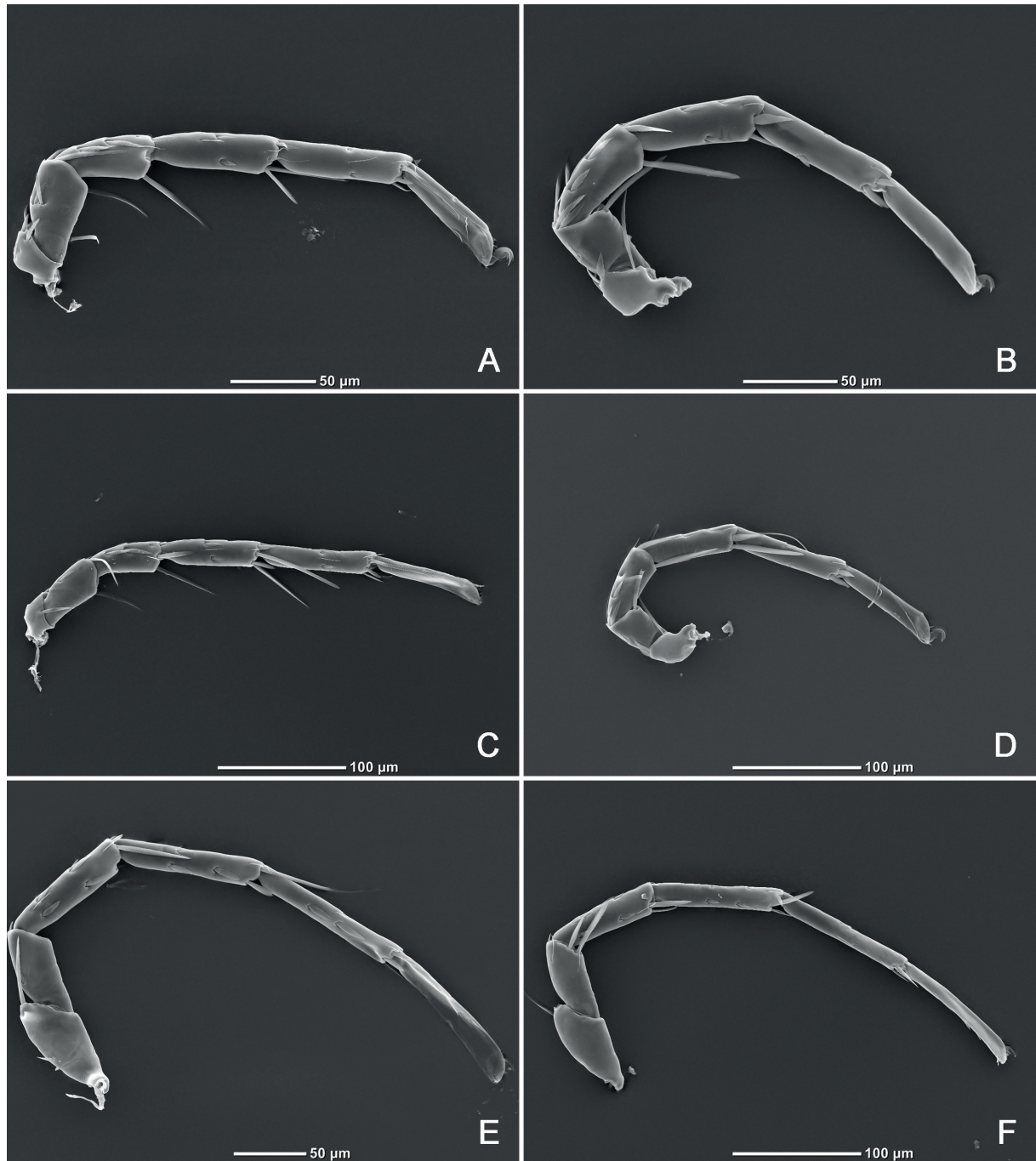


**Fig. 13.** *Atractides (Atractides) cardiacus* Zhang & Guo sp. nov., paratype, ♀ (slide no. HN-HY-2023041107, GUGC), SEM photographs. **A.** Palp. **B.** P-4 and P-5. **C.** palp. **D.** Sword seta of P-4.



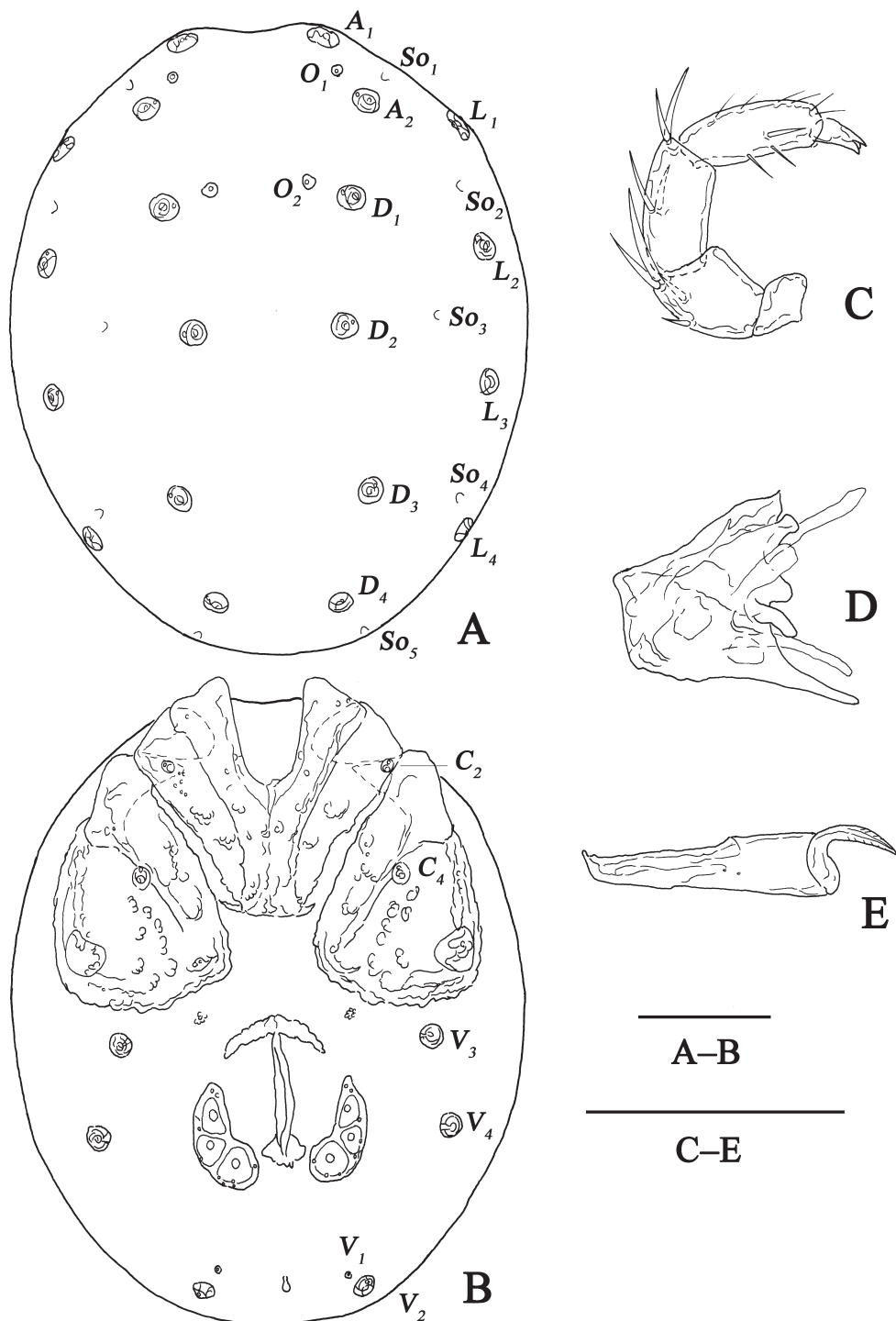
**Fig. 14.** *Atractides (Atractides) cardiacus* Zhang & Guo sp. nov., paratype, ♀ (slide no. HN-HY-2023041107, GUGC), SEM photographs. **A.** I-L. **B.** I-L-5-6. **C.** I-L. **D.** I-L-5-6.





**Fig. 15.** *Atractides (Atractides) cardiacus* Zhang & Guo sp. nov., paratype, ♀ (slide no. HN-HY-2023041107, GUGC), SEM photographs. **A.** II-L. **B.** II-L. **C.** III-L. **D.** III-L. **E.** IV-L. **F.** IV-L.

*Atractides (Atractides) fodingensis* Zhang & Guo sp. nov.  
urn:lsid:zoobank.org:act:00A65086-590B-431B-AB50-F7C9A01B8CA8  
Figs 16–18



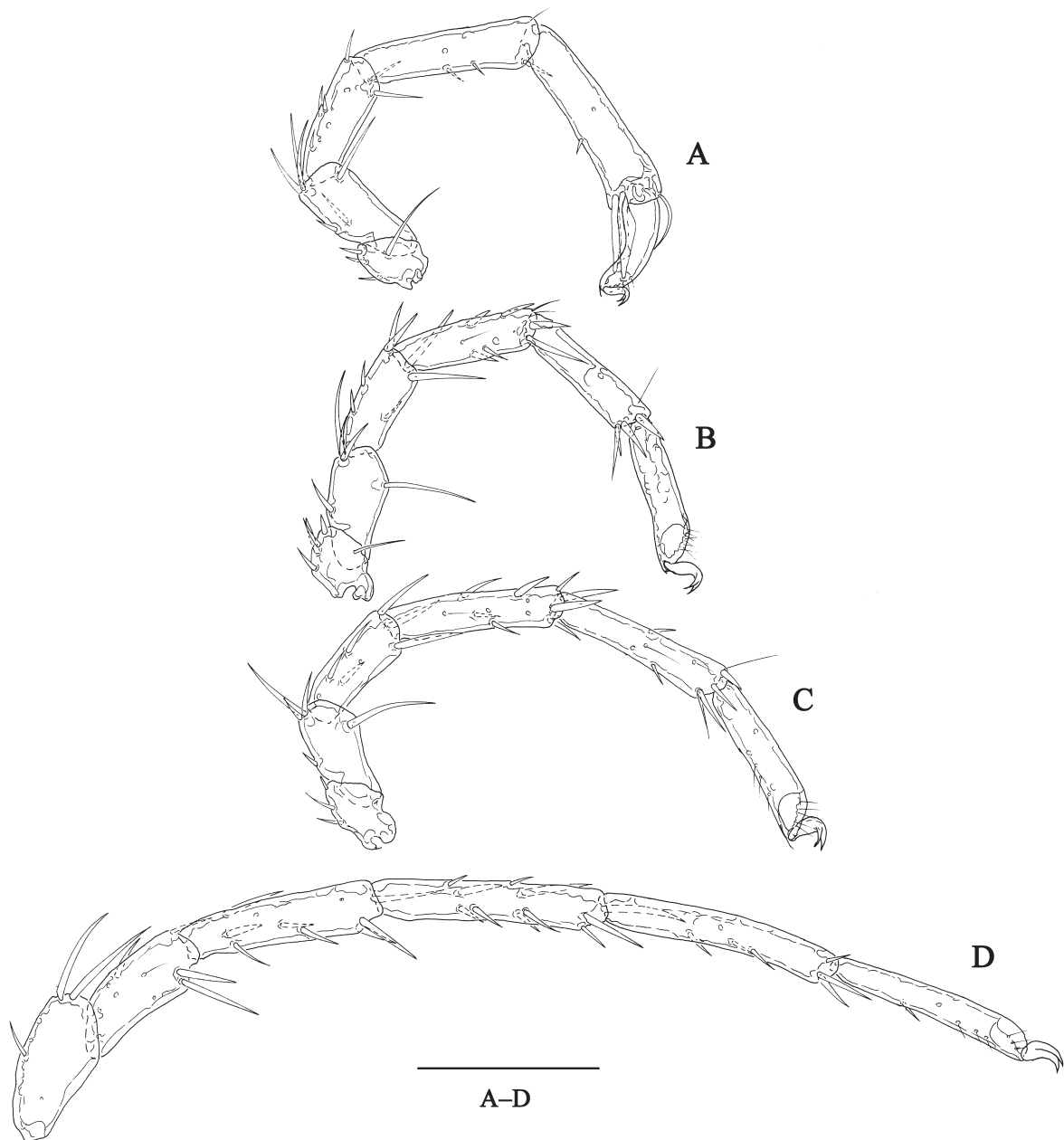
**Fig. 16.** *Atractides (Atractides) fodingensis* Zhang & Guo sp. nov., holotype, ♀ (slide no. GZ-HY-2023061901, GUGC). **A.** Idiosoma, dorsal view. **B.** Idiosoma, ventral view. **C.** Palp. **D.** Gnathosoma. **E.** Chelicera. Scale bars = 100 µm.

### Diagnosis

The apodemes of ACG almost transverse. Pregenital sclerite relatively large,  $V_1$  separated from  $V_2$ ,  $V_3$  at same level of pregenital sclerite and near Cx-IV, excretory pore smooth. P-4 with straight ventral margin and two ventral hairs dividing it in 2:1:2, sword seta at same level of distoventral hair.

### Etymology

The new species is named after the Foding Mountain, where the specimens were collected.



**Fig. 17.** *Atractides (Atractides) fodingensis* Zhang & Guo sp. nov., holotype, ♀ (slide no. GZ-HY-2023061901, GUGC). **A–D.** I-L– IV-L. Scale bar = 100 µm.



## Type material

### Holotype

P.R. CHINA • ♀; Guizhou Province, Tongren City, Foding Mountain; 27.3113° N, 108.1363° E; 693 m a.s.l.; 19 Jun. 2023; Ri-Xin Jiang, Ping Li and Lan Jia leg.; waterfall in the mountain, with fast running water, and many plants along the shore; slide no. GZ-HY-2023061901; GUGC.

### Paratype

P.R. CHINA • 1 ♀; same data as for holotype; slide no. GZ-HY-2023061902; GUGC.

## Description

### Female (n = 2)

Idiosoma soft and oval, frontal edge slightly concave;  $O_1$  between  $A_1$  and  $A_2$ ,  $O_2$  between  $D_1$  and slightly front of  $D_2$ ; all slit organs visible,  $So_1$  near  $A_2$ ,  $So_2$  at the middle of  $L_1$  and  $L_2$ ,  $So_3$  at same level of  $D_2$ ,  $So_4$



**Fig. 18.** *Atractides (Atractides) fodingensis* Zhang & Guo sp. nov., holotype, ♀ (slide no. GZ-HY-2023061901, GUGC), light microscope photographs. **A.** Idiosoma, dorsal view. **B.** Idiosoma, ventral view. **C.** Idiosoma lateral view. Scale bars = 100  $\mu$ m.

near  $L_4$ ,  $So_5$  behind of  $D_4$  (Figs 16A, 18A). ACG fused and with suture line, apodemes of ACG almost transverse; PCG separated. Pregenital sclerite relatively large, three pairs of acetabula in weakly curved line, Ac3 largest.  $V_1$  separated from  $V_2$ ,  $V_3$  at same level of pregenital sclerite and near Cx-IV,  $V_4$  at horizontal line between Ac1 and Ac2,  $V_3$  and  $V_4$  forming trapezoid; excretory pore smooth and between  $V_2$  (Figs 16B, 18B).

Palp five-segmented; P-1 short, P-2 and P-3 without projection, P-4 with straight ventral margin and two ventral hairs, dividing P-4 in 2:1:2, sword seta at same level of distoventral hair (Fig. 16C). Ventral margin of I-L-5 as long as dorsal margin, S-1 close to S-2, S-2 longer and thicker than S-1, ventrally curved whip-like seta at end of I-L-5, and near dorsal slide; I-L-6 stout, thick at its base, tapering towards end (Fig. 17).

MEASUREMENTS (measurements of paratypes in parantheses). Idiosoma L 495 (443), W 408 (368); coxal field L 295 (264), Cx-III W 252 (289), ACG IL 161 (179), mL 104 (116), W 210 (226); gnathosoma bay L 80 (86); gonopore L 95 (95), pregenital sclerite L 76 (65), postgenital sclerite L 37 (30); Ac1–3 L 31 (33), 23 (31), 29 (34); chelicera L 125 (114), cheliceral claw L 37 (39), basal segment L 94 (96); gnathosoma L 107 (131); palp dL: P-1 22 (25), P-2 46 (49), P-3 54 (59), P-4 57 (63), P-5 23 (23); leg segments: I-L-1 dL 42 (49), I-L-2 dL 60 (68), I-L-3 dL 78 (83), I-L-4 dL 106 (113), I-L-5 dL 117 (124), HB 31 (35), I-L-6 dL 61 (62), HB 12 (14), S-1 L 46 (53), W 6 (8), S-2 L 51 (51), W 7 (12); dL: II-L-1 40 (45), II-L-2 50 (56), II-L-3 62 (66), II-L-4 81 (85), II-L-5 84 (96), II-L-6 83 (88); dL: III-L-1 44 (44), III-L-2 60 (65), III-L-3 69 (76), III-L-4 97 (111), III-L-5 102 (112), III-L-6 90 (105); dL: IV-L-1 85 (93), IV-L-2 79 (78), IV-L-3 110 (117), IV-L-4 129 (137), IV-L-5 132 (143), IV-L-6 115 (130).

### Remarks

This new species is similar to *Atractides (Atractides) cardiacus* Zhang & Guo sp. nov. in the following characters: (1)  $V_1$  separated from  $V_2$ ; (2) excretory pore smooth; (3) I-L-6 stout, thick at its base, tapering towards the end. However, the new species differs from *A. (A.) cardiacus* in the following aspects: (1) sword seta of P-4 at the same level of distoventral hair in the new species, but at the same level of proximoventral hair in *A. (A.) cardiacus*; (2) ACG and PCG occupy half of the venter in the new species, but ACG and PCG of the female *A. (A.) cardiacus* occupy one third of the ventral view; (3) excretory pore between  $V_2$  in the new species, but slightly behind the parallel line of  $V_2$  in the female *A. (A.) cardiacus*.

### *Atractides (Atractides) bitergumus* Zhang & Guo, 2023 Figs 19–21, 25

### Diagnosis

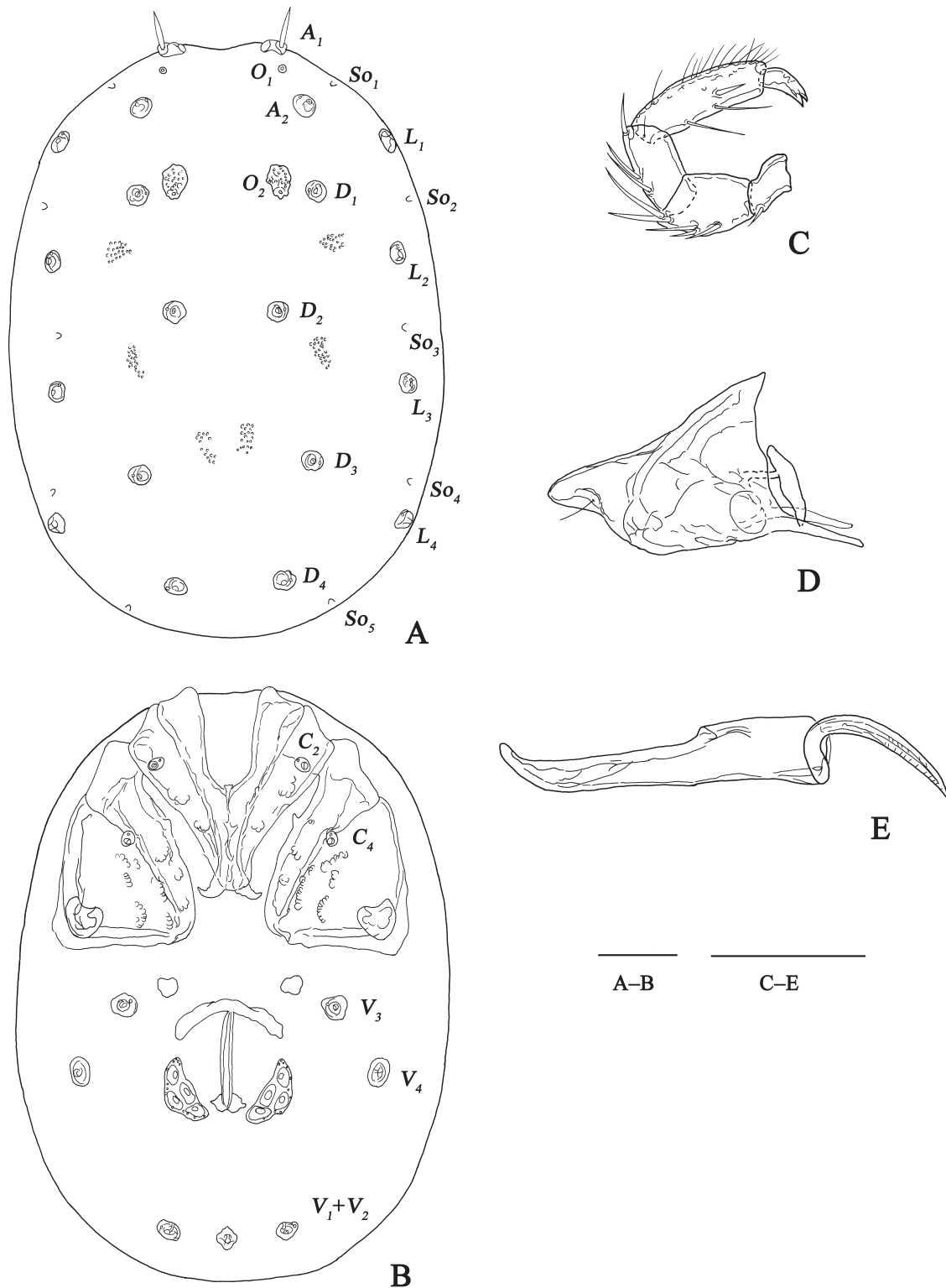
Genital field with four pairs of acetabula,  $V_1$  fused with  $V_2$ , excretory pore surrounded by sclerotized ring and between  $V_1$  and  $V_2$ , P-4 with numerous dorsal hairs and two hair-like ventral setae, sword seta near distoventral hair. I-L-5 thicken from base to end, S-2 longer than S-1, both with blunt tips and similar in shape; I-L-6 curved, and distally little thicker than base.

### Material examined

P.R. CHINA • 1 ♀; Hainan Province, Qionghai City, Longjiang Town; 19.1730° N, 110.3459° E; 4 m a.s.l.; 11 Apr. 2023; Hai-Tao Li, Yu-Lin Zheng and Yu-Hao Zhang leg.; main river (Wanquan River) with wide surface, slowly flowing, with sandy soil and humus on bottom; slide no. HN-HY-2023041108; GUGC.

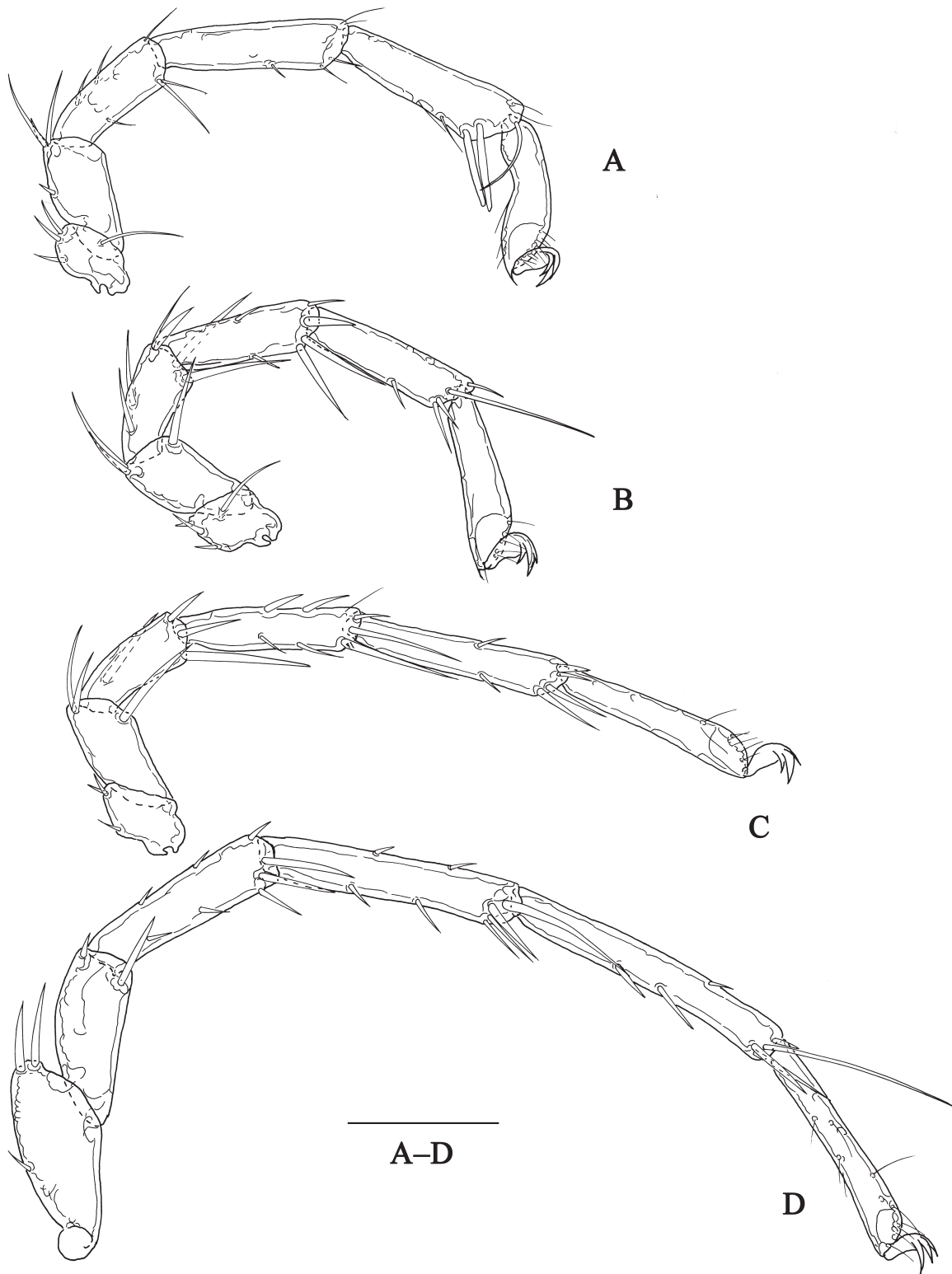
### Description

**Female** (n = 1)



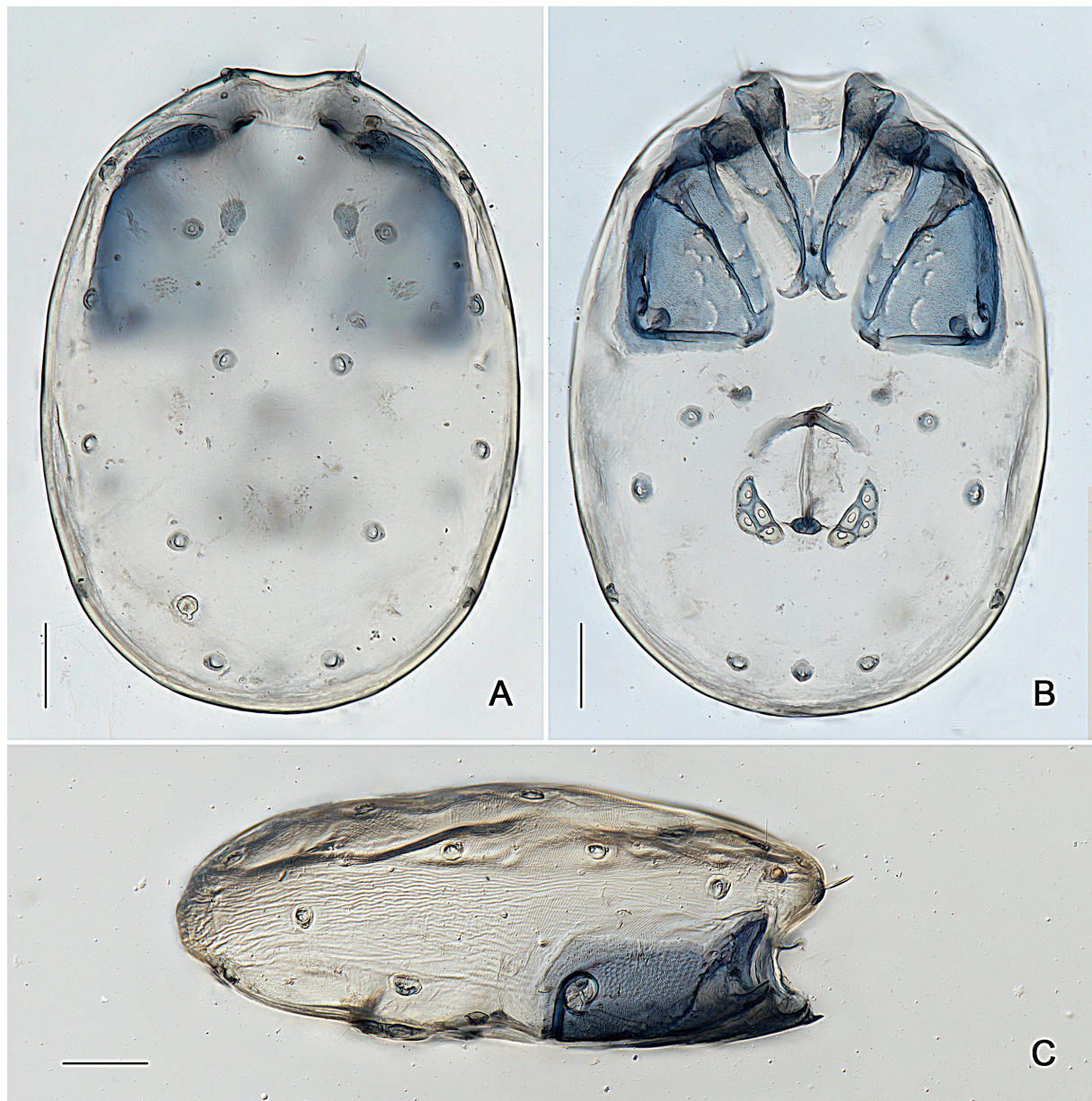
**Fig. 19.** *Atractides (Atractides) bitergumus* Zhang & Guo, 2023, paratype, ♀ (slide no. HN-HY-2023041108, GUGC). **A.** Idiosoma, dorsal view. **B.** Idiosoma, ventral view. **C.** Palp. **D.** Gnathosoma. **E.** Chelicera. Scale bars = 100 µm.





**Fig. 20.** *Atractides (Atractides) bitergumus* Zhang & Guo, 2023, paratype, ♀ (slide no. HN-HY-2023041108, GUGC). **A–D.** I-L– IV-L. Scale bar = 100  $\mu$ m.

Idiosoma oval;  $O_1$  between  $A_1$  and  $A_2$  but closer to  $A_1$ ,  $O_2$  between  $D_1$  and surrounded by pair of platelets; dorsum with three pairs of muscle attachments: pair of muscle attachments between  $L_2$ , pair of muscle attachments near  $D_2$ , and pair of muscle attachments between  $D_3$ ; all slit organs visible,  $So_1$  near  $A_1$ ,  $So_2$  at same level of  $D_1$ ,  $So_3$  between  $L_2$  and  $L_3$  but closer to  $L_3$ ,  $So_4$  near  $L_4$ ,  $So_5$  behind of  $D_4$  (Figs 19A, 21A). ACG fused and with suture line, medial posterior margin of ACG ligulate, apodemes of ACG strong and horn-like; PCG separated, and suture line of Cx-III and Cv-IV nearly straight. Genital field with four pairs of acetabula, pregenital sclerite longer than postgenital sclerite.  $V_1$  fused to  $V_2$ ,  $V_4$  at same level of Ac1,  $V_3$  near pregenital sclerite, pair of sclerites anterior to pregenital sclerite and approximately between  $V_3$ ,  $V_3$  and  $V_4$  forming trapezoid; excretory pore surrounded by sclerotized ring and between  $V_1$  and  $V_2$  (Figs 19B, 21B).



**Fig. 21.** *Atractides (Atractides) bitergumus* Zhang & Guo, 2023, paratype, ♀ (slide no. HN-HY-2023041108, GUGC), light microscope photographs. **A.** Idiosoma, dorsal view. **B.** Idiosoma, ventral view. **C.** Idiosoma lateral view. Scale bars = 100  $\mu$ m.



Palp five-segmented and without obvious sexual dimorphism; P-2 short and stout with straight ventral margin, P-3 straight, P-4 with numerous dorsal hairs and two hair-like ventral setae, ventral sectors 3:2:3, sword seta near distoventral hair (Fig. 19C). I-L-5 thickening from base to end, S-2 longer than S-1, both with blunt tips and similar in shape; I-L-6 curved, and end little thicker than base (Fig. 20).

MEASUREMENTS. Idiosoma L 745, W 579; coxal field L 330, Cx-III W 390, ACG IL 228, mL 132, W 272; gnathosoma bay L 122; gonopore L 107, pregenital sclerite L 142, postgenital sclerite L 52; Ac1–4 L 29, 29, 29, 30; chelicera L 288, cheliceral claw L 93, basal segment L 202; gnathosoma L 218; palp dL: P-1 30, P-2 66, P-3 63, P-4 97, P-5 36; leg segments: I-L-1 dL 41, I-L-2 dL 78, I-L-3 dL 90, I-L-4 dL 131, I-L-5 dL 130, HB 39, I-L-6 dL 98, HB 23, S-1 L 52, W 5, S-2 L 51, W 5; dL: II-L-1 55, II-L-2 73, II-L-3 81, II-L-4 108, II-L-5 119, II-L-6 114; dL: III-L-1 56, III-L-2 69, III-L-3 85, III-L-4 122, III-L-5 148, III-L-6 129; dL: IV-L-1 121, IV-L-2 91, IV-L-3 137, IV-L-4 170, IV-L-5 187, IV-L-6 159.

### Distribution

China (Hainan Province).

### Remarks

Due to the genital field with four pairs of acetabula and similar shape of the palp, chelicera and gnathosoma, the specimen from Hainan Province matches the description of *A. (A.) bitergumus* Zhang & Guo, 2023. The collection site is very close to type locality, all in Hainan Province (Zhang *et al.* 2023). This is the first description of the female.

### *Atractides (Tympanomegapus) tergumus* Zhang & Guo, 2023 Figs 22–25

### Diagnosis

$O_2$  slightly anterior to  $D_1$ . Genital field with three pairs of acetabula forming triangle,  $V_1$  separated from  $V_2$ , excretory pore smooth and slightly posterior to level of  $V_1$  and  $V_2$ . P-4 ventral margin straight and divided by two ventral hairs in sectors 3:2:3, sword seta near distoventral hair, P-5 without lateral cheeks. I-L-5 thickens from base to end, S-1 and S-2 both with blunt tips and similar in shape; I-L-6 slightly straight and end little thicker than base.

### Material examined

P.R. CHINA • 1 ♂, 2 ♀♀; Hainan Province, Lingshui Li Autonomous County, Diaoluo Mountain National Forest Park; 18.6683° N, 109.9227° E; 84 m a.s.l.; 13 Apr. 2023; Hai-Tao Li, Yu-Lin Zheng and Yu-Hao Zhang leg.; main river (Diaoluo River) 40–50 cm deep, with sand and rotten leaves on bottom, plants around, shore with helophytes (Fig. 25B); slide nos. HN-HY-2023041301 to 2023041303; GUGC.

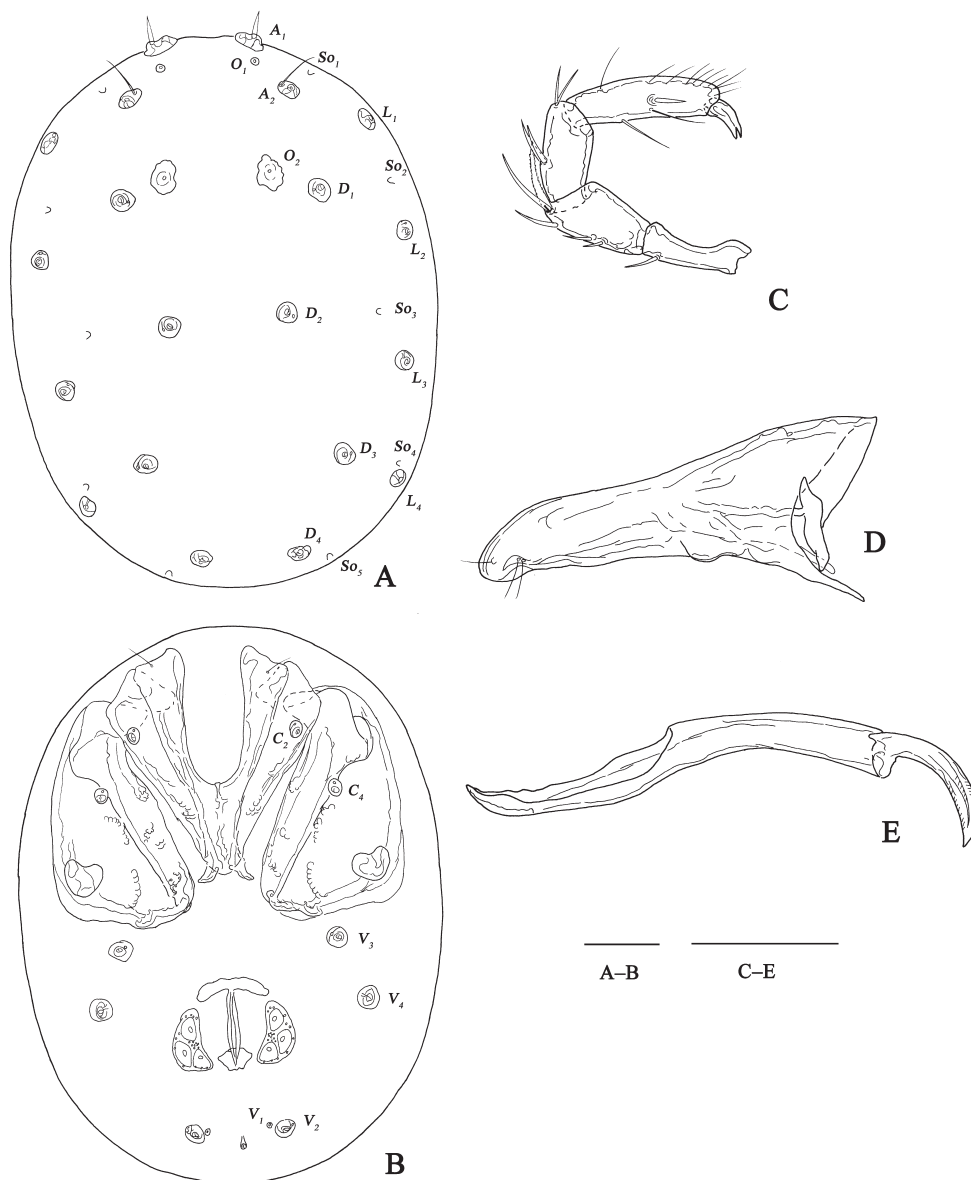
### Description

#### Female (n = 2)

Idiosoma oval,  $O_1$  posterior to  $A_1$ ,  $O_2$  slightly anterior to  $D_1$  and on platelets; all slit organs visible,  $So_1$  near  $A_2$ ,  $So_2$  at same level of  $D_1$ ,  $So_3$  at same level of  $D_2$ ,  $So_4$  located in front of  $L_4$ ,  $So_5$  behind of  $D_4$  and out (Figs 22A, 24A). ACG fused and with suture line, apodemes of ACG strong and horn-like, and interspace between two apodemes; PCG separated, and suture line of Cx-III and Cv-IV nearly straight,  $C_4$  near suture line between Cx-III and Cv-IV. Genital field with three pairs of acetabula forming triangle,  $V_1$  separated from  $V_2$ ,  $V_3$  close to PCG,  $V_4$  at same level of pregenital sclerite,  $V_3$  and  $V_4$  forming trapezoid, excretory pore smooth and slightly posterior to level of  $V_1$  and  $V_2$  (Figs 22B, 24B).

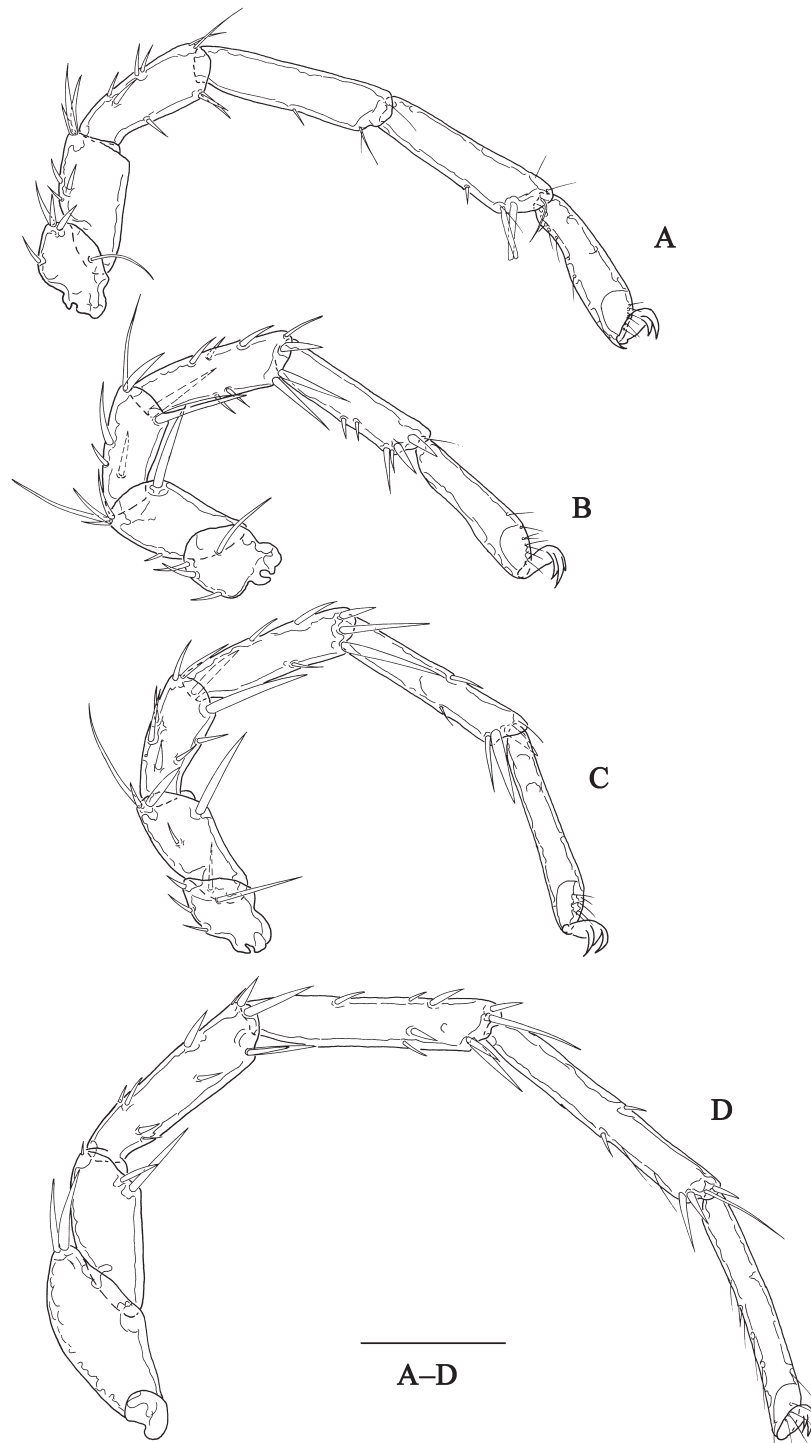
Palp five-segmented; P-1 elongated, P-2 and P-3 ventral margins more or less straight; P-4 with numerous dorsal hairs, ventral margin straight and divided by two ventral hairs in sectors 3:2:3, sword seta near to distoventral hair, P-5 without lateral cheeks (Fig. 22C). I-L-5 thickens from base to end, S-1 and S-2 both with blunt tips and similar in shape; I-L-6 slightly straight and end little thicker than base (Fig. 23).

MEASUREMENTS (measurements of other specimens in parentheses). Idiosoma L 730 (746), W 578 (538); coxal field L 384 (366), Cx-III W 408 (410), ACG IL 271 (269), mL 126 (139), W 293 (280); gnathosoma bay L 177 (158); gonopore L 95 (107), pregenital sclerite L 97 (101), postgenital sclerite L 49 (56); Ac1–3 L 30 (33), 36 (34), 29 (34); chelicera L 365 (357), cheliceral claw L 99 (98), basal segment L 291 (283); gnathosoma L 271 (251); palp dL: P-1 71 (60), P-2 69 (70), P-3 73 (64), P-4 107



**Fig. 22.** *Atractides (Tympanomegapus) tergumus* Zhang & Guo, 2023, paratype, ♀ (slide no. HN-HY-2023041302, GUGC). **A.** Idiosoma, dorsal view. **B.** Idiosoma, ventral view. **C.** Palp. **D.** Gnathosoma. **E.** Chelicera. Scale bars = 100  $\mu$ m.

(100), P-5 33 (32); leg segments: I-L-1 dL 58 (57), I-L-2 dL 84 (74), I-L-3 dL 100 (93), I-L-4 dL 141 (129), I-L-5 dL 132 (122), HB 37 (35), I-L-6 dL 108 (100), HB 23 (22), S-1 L 39 (37), W 4 (4), S-2 L 41 (39), W 5 (4); dL: II-L-1 64 (58), II-L-2 72 (72), II-L-3 91 (83), II-L-4 117 (104), II-L-5 126 (114), II-L-6 117 (109); dL: III-L-1 62 (61), III-L-2 95 (81), III-L-3 92 (89), III-L-4 125 (114), III-L-5 143



**Fig. 23.** *Atractides (Tympanomegapus) tergumus* Zhang & Guo, 2023, paratype, ♀ (slide no. HN-HY-2023041302, GUGC). **A–D.** I-L– IV-L. Scale bar = 100 µm.



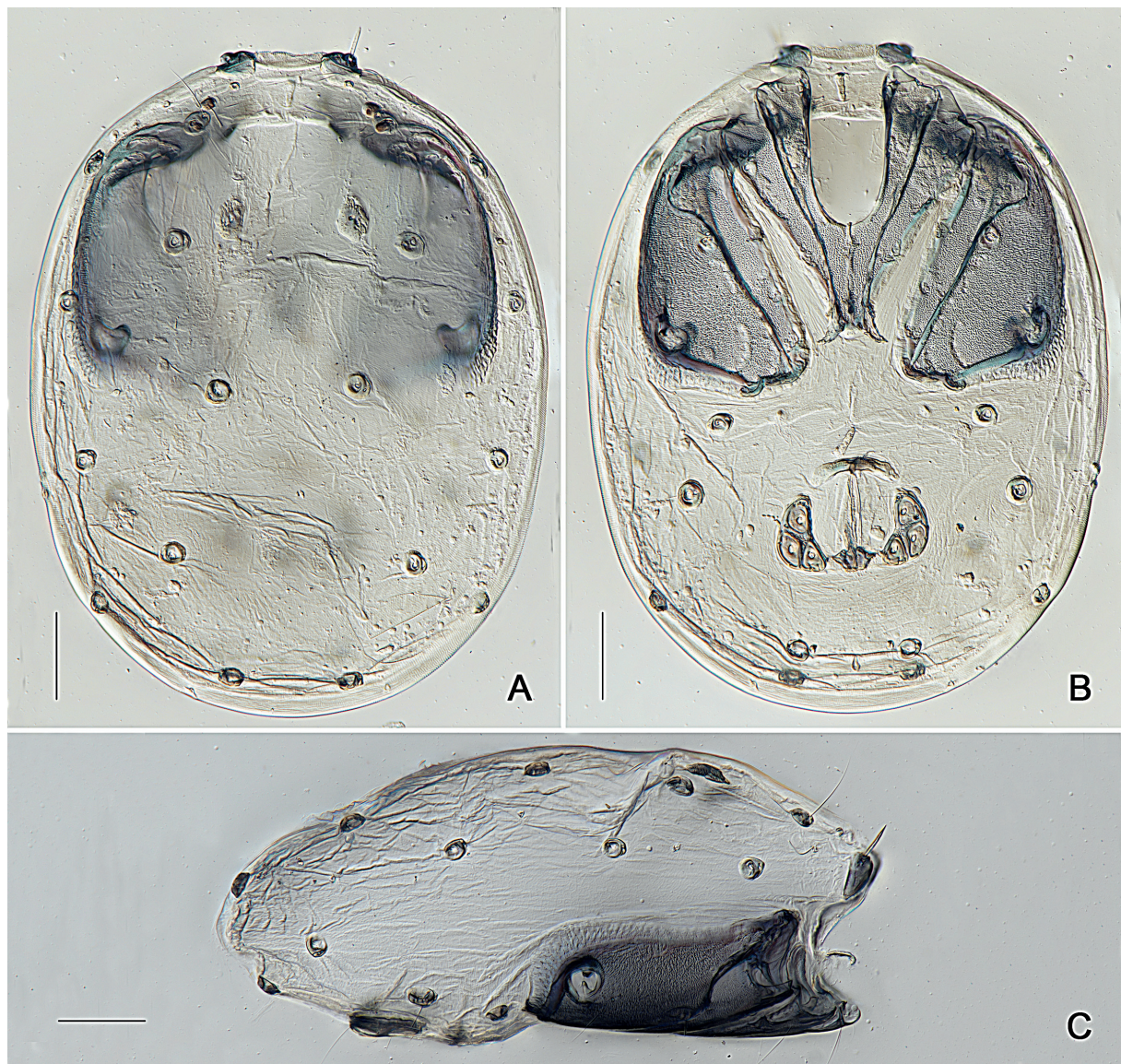
(139), III-L-6 140 (135); dL: IV-L-1 137 (125), IV-L-2 106 (97), IV-L-3 149 (143), IV-L-4 177 (171), IV-L-5 192 (186), IV-L-6 167 (168).

### Distribution

China (Hainan Province).

### Remarks

In this study, we collected one male and two females from Diaoluo Mountain National Forest Park, Lingshui Li Autonomous County, Hainan Province, and found that the male matches the description of the male of *A. (T.) tergumus*. Moreover, the collection site is very close to the site where *A. (T.)*



**Fig. 24.** *Atractides (Tympanomegapus) tergumus* Zhang & Guo, 2023, paratype, ♀ (slide no. HN-HY-2023041302, GUGC), light microscope photographs. **A.** Idiosoma, dorsal view. **B.** Idiosoma, ventral view. **C.** Idiosoma lateral view. Scale bars = 100  $\mu$ m.



*tergumus* was collected. We believe the females we collected belong to *A. (T.) tergumus*, and this is the first description to the female of the species.

## Discussion

The new species *Atractides (Atractides) cardiacus* Zhang & Guo sp. nov. resembles species of *Polymegapus* in the shape of palp, but differs in some features, so it may represent an intermediate species bridging the gap between *Atractides* and *Polymegapus*. In order to solve this doubt, we hope that the introduction of molecular biotechnology in the future can shed light on this question. The species used in molecular biotechnology were also taken from Hainan Province in P.R. China (Smit 2020).

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**Fig. 25.** Photographs of selected sampling sites. **A.** Longjiang Town, Qionghai City, Hainan Province, Wanquan River. (sampling sites of *Atractides (Atractides) cardiacus* Zhang & Guo sp. nov. and *A. (A.) bitergumus* Zhang & Guo, 2023). **B.** Diaoluo Mountain National Forest Park, Lingshui Li Autonomous County, Hainan Province, Diaoluo River (sampling site of *A. (Tympanomegapus) tergumus* Zhang & Guo, 2023).

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