

The rare genus *Deuterothyas* Lundblad, 1941 from China, with the description of three new species (Acari: Hydrachnidia: Hydryphantoidea) and a revised diagnosis of the genus

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The rare genus *Deuterothyas* Lundblad, 1941 from China, with the description of three new species (Acari: Hydrachnidia: Hydryphantoidea) and a revised diagnosis of the genus

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Abstract

Three species new to science, i.e. *Deuterothyas parvtabula* Zhong & Guo **sp. nov.**, *Deuterothyas luzhangensis* Zhong & Guo **sp. nov.** and *Deuterothyas baiyuensis* Zhong & Guo **sp. nov.**, are described and illustrated in detail. They were collected from China. The three new species represent a newly recorded rare genus in the subfamily Euthyadinae K. Viets, 1931 for the Chinese water mite fauna. The diagnosis of the genus *Deuterothyas* Lundblad, 1941 is revised based on the new species.

Key words: water mites, new records, new taxa, *Deuterothyas*, Chinese fauna

Introduction

Euthyadinae Viets, 1931 (Acari: Hydrachnidia: Hydryphantoidea: Hydryphantidae) includes 31 genera occurring in all types of fresh waters (Cook 1974; Smit 2020). In *Deuterothyas* Lundblad, 1941, so far only one species is known from northern Burma (Smit 2020).

During an intensive study of the Hydryphantoidea fauna in China, three species new to science are described and illustrated in detail. *Deuterothyas parvtabula* Zhong & Guo **sp. nov.** and *D. luzhangensis* Zhong & Guo **sp. nov.** were collected in Luzhang County, Yunnan Province, China; *Deuterothyas baiyuensis* Zhong & Guo **sp. nov.** was collected in Chaqingsongduo National Natural Reserve, Baiyu County, Sichuan Province, China. The diagnoses of the genus *Deuterothyas* Lundblad, 1941, a newly recorded genus for the Chinese fauna, is revised based on the three new species.

Material and methods

Water mites were manually collected using a 250 µm mesh size net and subsequently sieved through two stacked sieves (with a mesh size of 4 mm above and 250 µm below). The resulting residue was

then placed in a white tray containing water, and water mites were captured using a pipette. Finally, the specimens were preserved in Koenike's fluid and mounted in glycerin jelly mounting fluid (Jin 1997). The preparation of slides follows Gu *et al.* (2021).

Specimens were observed and illustrated under a Nikon DS-Ri2 microscope, and the illustrations were edited with Adobe Photoshop CS 2022®. Specimens were measured and photographed using Nikon DS-Ri2.

The following abbreviations are used (Jin 1997; Goldschmidt 2007): a.s.l. = above sea level, A_1 , A_2 = antenniform glandularia 1 and 2, Ac-1-3 = genital acetabula 1-3, ACG = anterior coxal group (Cx-I+Cx-II), Ap = anal pore, C_1 - C_4 = coxoglandularia 1-4, Cx-I-Cx-IV = coxae 1-4, D_1 - D_4 = dorsoglandularia 1-4, Dc1-5 = dorsocentralia 1-5, D11-4 = dorsolateralia 1-4, Gf = entire genital field, width measured by outer margin of both sides, Ib = infracapitular bay, Ib-Ap = distance between posterior limit of Ib and edge of Ap, Ib-Gf = distance from Ib to anterior edge of Gf, I-L-1-6, etc = the first leg segments 1-6, II-L-1-6, etc = the second leg segments 1-6, III-L-1-6, etc = the third leg segments 1-6, IV-L-1-6, etc = the fourth leg segments 1-6, L_1 - L_4 = lateroglandularia 1-4, O_1 , O_2 = ocularia 1 and 2, P-I-P-V = palp segments I-V, PCG = posterior coxal group (Cx-III+Cx-IV), V_1 - V_4 = ventroglandularia 1-4.

All measurements are given in μm . The type specimens were deposited in the Institute of Entomology, Guizhou University, Guiyang, P. R. China.

Systematics

Family Hydryphantidae Piersig, 1896

Subfamily Euthyadinae K. Viets, 1931

Genus *Deuterothyas* Lundblad, 1941 new record to China.

Revised diagnosis (after Smit 2020, modified)

Dorsum with frontal plate composed of the pigmentless median eye, the pre- and post- frontalia, Dc1 and the postocularia. Ventralia small. Genital field with three pairs of acetabula, Ac-3 lying free in the integument. Anterior to Ac-1 a pair of sclerites each with 2-6 setae, the large sclerites between Ac-1 and Ac-2 with a fringe of setae along its median margin, posteriorly of Ac-3 a pair of tiny sclerites each with 1-3 setae.

Deuterothyas parvtabula Zhong & Guo sp. nov. (Figs. 1-4)

Habitat. A fast-moving stream with organic detritus and gravel.

Material examined. Holotype: adult male, Luzhang County, Yunnan Province, P. R. China (25.93117°N, 98.7786°E; 1305.1 m a.s.l.), collected by Ping Li and Lan Jia, 26-VII-2023 (Fig. 1). Slide No. YN-HY-2023072601.

Etymology. “*parv-*”, Latin word, means small; “*tabula*”, Latin word, means plate. The species is named after the shape of the D11.

Description. *Male* (n=1). Integument papillate. Idiosoma short elliptical, length 891, width 650 (Fig. 2A-E). A well-developed median eye present, surrounded by the median eye plate, which is formed by the fusion of pre- and post- frontalia and Dc1, including O_2 . O_1 located at the anterior margin of the idiosoma. A_1 smooth. Median eye plate length 180, width 253, more or less polygonal in shape (wider than long), posterior margin concave. The dorsalia are very small and irregularly oval in shape, D11 barely visible, Dc2-5 all free (Fig. 4A). Coxae in four groups. ACG 239 in length, 208

in width. PCG 251 in length, 196 in width (Fig. 4B). Genital field (including pregenital sclerite) 268 in length, 177 in width. Pregenital sclerite rounded. Acetabula large, three pairs arranged more or less in a line on each side; with three pairs of setae on the small sclerites anterior to Ac-1; the median sclerites between Ac-1 and Ac-2 with a fringe of setae along the medial margin, connected with the small sclerites anterior to Ac-1 by narrow chitin strips; medially to Ac-3 a pair of tiny sclerites each with three setae (Fig. 3A). V_1 slightly below the anal pore. Ib-Ap 505. Ib-Gf 117. Dorsal side of P-I with two pinnate setae, P-II with five pinnate setae, and P-III with two pinnate setae (one long and one short on dorsal margin). P-IV slender and long, with a dorsodistal projection, one anteroventral hair-like seta and one short anterodorsal hair-like seta. P-V with two small setae (Figs. 3D, 4E). Dorsal length of palp segments: P-I, 33; P-II, 99; P-III, 45; P-IV, 140 (including distal projection); P-V, 38. Gnathosoma small, 205 in length (Figs. 3B, 4D). Chelicera length 234, chela serrated (Figs. 3C, 4C). Legs with many peg-like setae and without swimming setae (Fig. 4F–I). Dorsal lengths of segments of leg I–IV: I-L-1, 76; I-L-2, 78; I-L-3, 88; I-L-4, 108; I-L-5, 127; I-L-6, 118 (Fig. 3E); II-L-1, 73; II-L-2, 73; II-L-3, 81; II-L-4, 135; II-L-5, 157; II-L-6, 138; III-L-1, 75; III-L-2, 85; III-L-3, 87; III-L-4, 162; III-L-5, 186; III-L-6, 202; IV-L-1, 167; IV-L-2, 136; IV-L-3, 128; IV-L-4, 299; IV-L-5, 207; IV-L-6, 190 (Fig. 3F).



FIGURE 1. Photo of the type locality of *Deuterothyas parvtabula* Zhong & Guo **sp. nov.** and *Deuterothyas luzhangensis* Zhong & Guo **sp. nov.**

Female. Not collected.

Remarks. This species closely resembles *D. variabilis* Lundblad, 1941, but the following differences can be observed: (1) median eye plate more or less polygonal in shape (wider than long), posterior margin concave in the new species, but the posterior margin of the median eye plate is

straight in *D. variabilis*; (2) the dorsalia are very small, D11 are barely visible and Dc2–5 all free in the new species, but the dorsalia are large, with a tendency for Dc3 and the enlarged Dc5 to fuse medially in *D. variabilis*; (3) V_1 slightly below the anal pore in the new species, but V_1 above the anal pore in *D. variabilis*; (4) medially to Ac-3 a pair of tiny sclerites each with three setae in the new species, but each with two setae in *D. variabilis* (Lundblad 1969; Cook 1974; Smit 2020).

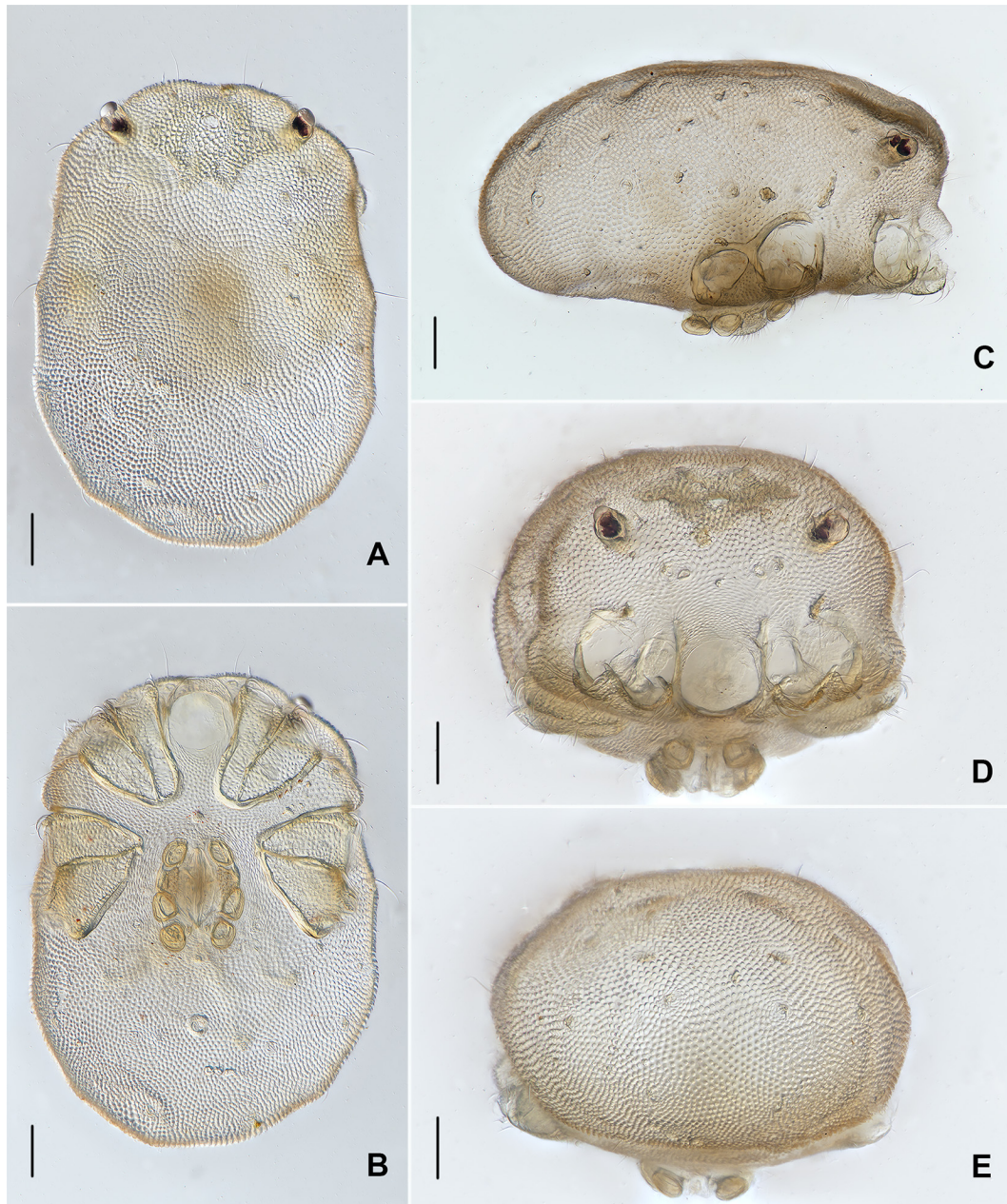


FIGURE 2. *Deuterothyas parvtabula* Zhong & Guo **sp. nov.**, male (YN-HY-2023072601), A = dorsal view; B = ventral view; C = lateral view; D = anteromedial view; E = posteromedial view. Scale bars = 100 μ m.

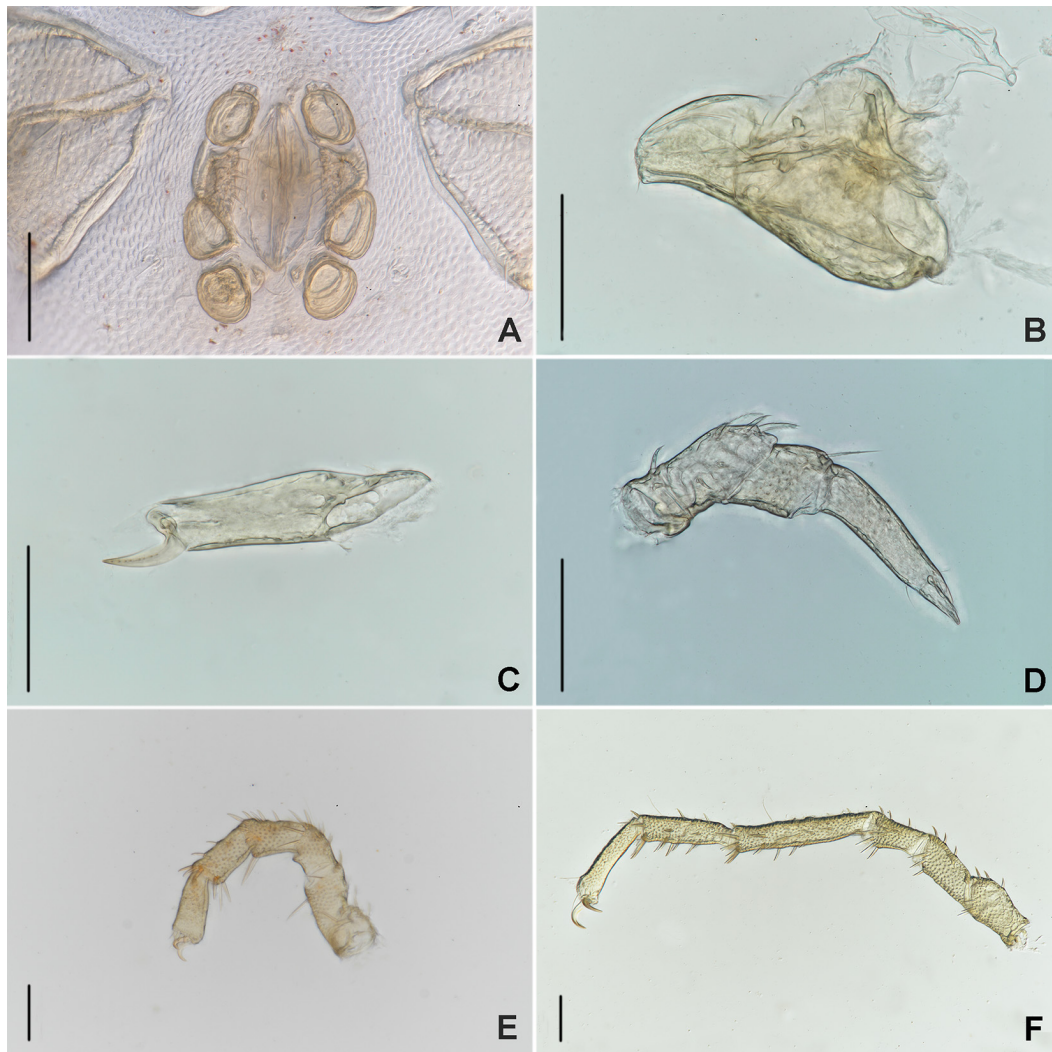


FIGURE 3. *Deuterothyas parvtabula* Zhong & Guo **sp. nov.**, male (YN-HY-2023072601), A = genital field; B = gnathosoma; C = chelicera; D = palp; E = leg I; F = leg IV. Scale bars = 100 μm .

***Deuterothyas luzhangensis* Zhong & Guo **sp. nov.** (Figs. 1, 5–7)**

Habitat. A fast-moving stream with organic detritus and gravel.

Material examined. Holotype: adult female, Luzhang County, Yunnan Province, P. R. China (25.93117°N, 98.7786°E; 1305.1 m a.s.l.), collected by Ping Li and Lan Jia, 26-VII-2023 (Fig. 1). Slide No. YN-HY-2023072602.

Etymology. The species is named after Luzhang County, where the holotype was collected.

Description. *Female* (n=1). Integument papillate, idiosoma short elliptical, length 808, width 591 (Fig. 5A–E). O_1 located anterior idiosoma margin. A_1 smooth. A median eye present and surrounded by median eye plate, which is formed by the fusion of pre- and post- frontalia and Dc1 including O_2 . Median eye plate length 170, width 163, more or less polygonal in shape (slightly longer than wide), different from *Deuterothyas parvtabula* Zhong & Guo **sp. nov.** (compare Figs.

4A and 7A). The dorsalia are small and irregularly oval in shape. ACG 219 in length, 175 in width. PCG 220 in length, 172 in width (Fig. 7B). Genital field (including pregenital sclerite) 251 in length, 163 in width. Pregenital sclerite rounded. Three pairs of acetabula, with four pairs of setae on the small sclerites anterior to Ac-1; the median sclerites between Ac-1 and Ac-2 with a fringe of setae along medial margin, smaller than Ac-2, not connected with the small sclerites anterior to Ac-1; medially of Ac-3 a pair of tiny sclerites each with one seta (Fig. 6A). Gonopore relatively long. V_1 above the anal pore. Ib-Ap 478. Ib-Gf 75. Dorsal side of P-I with one pinnate seta, P-II with five pinnate setae, and P-III with one short pinnate seta and one long pinnate seta. P-IV short and stocky, with a dorsodistal projection, one anteroventral hair-like seta and one short anterodorsal hair-like seta, P-V with two small setae (Figs. 6D, 7E). Dorsal length of palp segments: P-I, 18; P-II, 93; P-III, 43; P-IV, 107 (including distal projection); P-V, 27. Gnathosoma 156 in length (Figs. 6B, 7D). Chelicera length 173, chela short and serrated (Figs. 6C, 7C). Legs short and stout, with many peg-like setae and without swimming setae (Fig. 7F–I). Dorsal lengths of segments of leg I–IV: I-L-1, 79; I-L-2, 72; I-L-3, 63; I-L-4, 76; I-L-5, 83; I-L-6, 79 (Fig. 6E); II-L-1, 64; II-L-2, 66; II-L-3, 79; II-L-4, 150; II-L-5, 90; II-L-6, 101; III-L-1, 72; III-L-2, 80; III-L-3, 60; III-L-4, 106; III-L-5, 125; III-L-6, 159; IV-L-1, 162; IV-L-2, 111; IV-L-3, 100; IV-L-4, 217; IV-L-5, 155; IV-L-6, 162 (Fig. 6F).

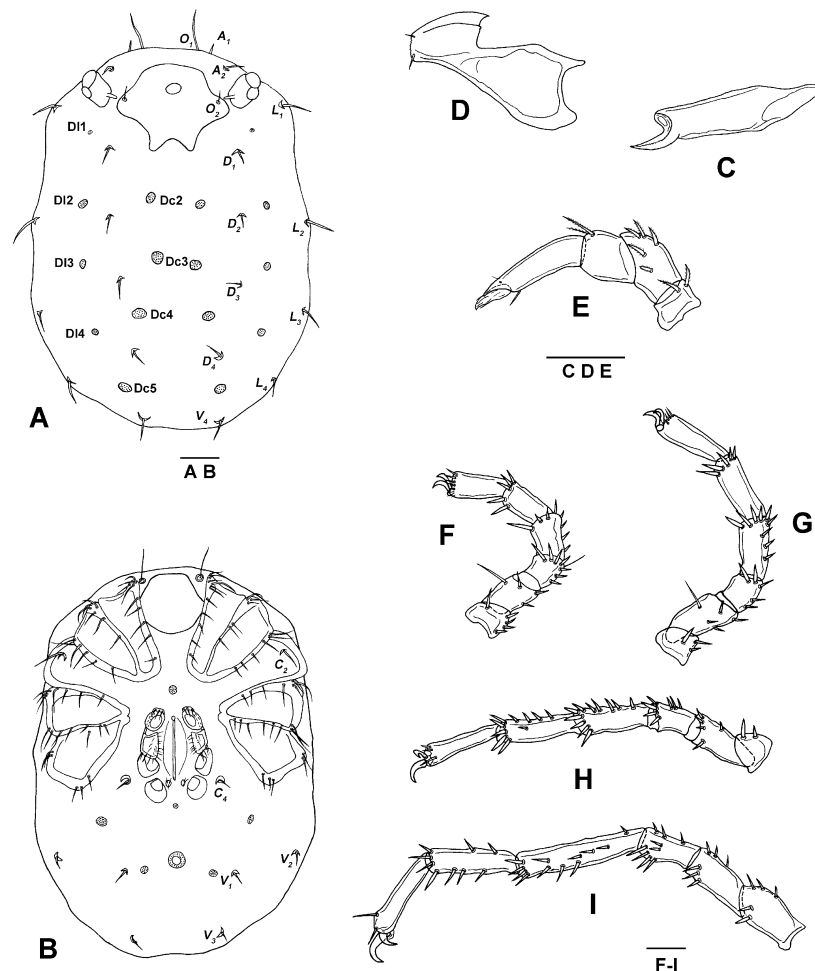


FIGURE 4. *Deuterothyas parvtabula* Zhong & Guo **sp. nov.**, male (YN-HY-2023072601), A = dorsal view; B = ventral view; C = chelicera; D = gnathosoma; E = palp; F = leg I; G = leg II; H = leg III; I = leg IV. Scale bars = 100 μm .

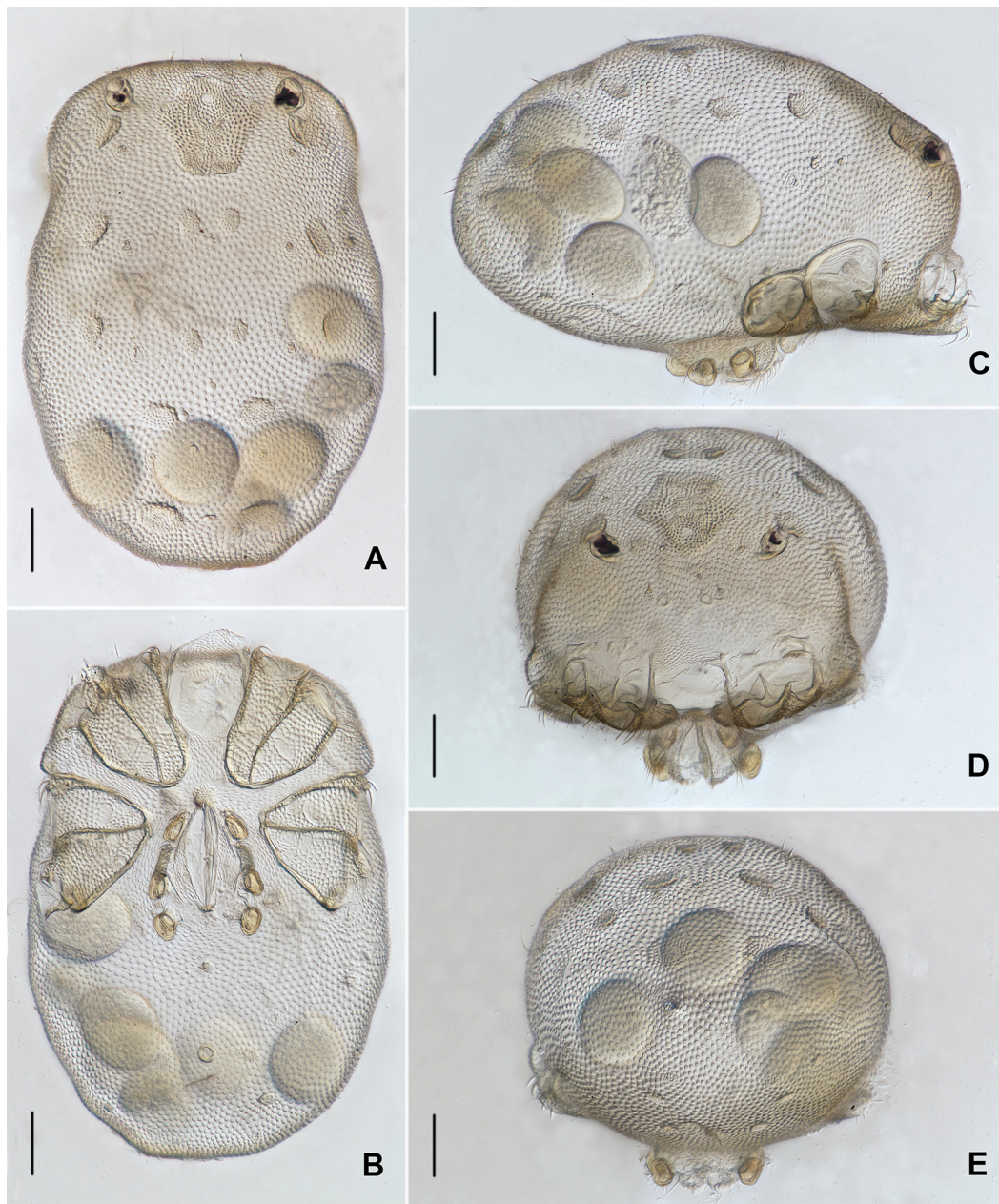


FIGURE 5. *Deuterothyas luzhangensis* Zhong & Guo **sp. nov.**, female (YN-HY-2023072602), A = dorsal view; B = ventral view; C = lateral view; D = anteromedial view; E = posteromedial view. Scale bars = 100 μm .

Male. Not collected.

Remarks. This species closely resembles *D. variabilis* Lundblad, 1941, but the following differences can be observed: (1) the dorsalia are small and Dc2–5 all free in the new species, but the dorsal plates are large, with a tendency for Dc3 and the enlarged Dc5 to fuse medially in *D. variabilis*; (2) between Ac-3 a pair of tiny sclerites each with one seta in the new species, but each with two setae in *D. variabilis*; (3) the median sclerites between Ac-1 and Ac-2 small in the new

species, but the median sclerites between Ac-1 and Ac-2 large in *D. variabilis* (Lundblad 1969; Cook 1974; Smit 2020).

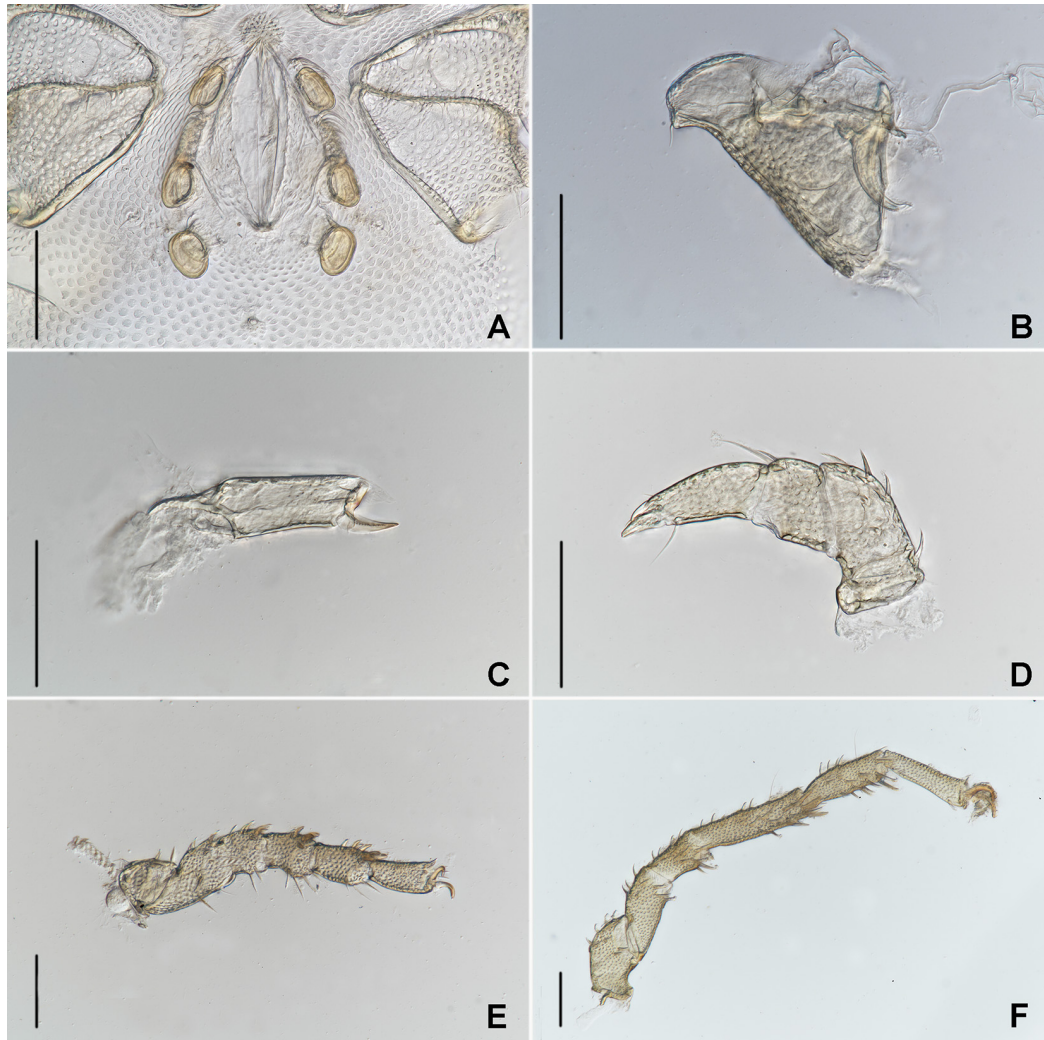


FIGURE 6. *Deuterothyas luzhangensis* Zhong & Guo **sp. nov.**, female (YN-HY-2023072602), A = genital field; B = gnathosoma; C = chelicera; D = palp; E = leg I; F = leg IV. Scale bars = 100 μm .

In *D. variabilis* the sexual dimorphism is weak, especially the frontal plate of male and female are similar (Lundblad 1969, Cook 1974). Although sex-different *D. parvtabula* Zhong & Guo **sp. nov.** and *D. luzhangensis* Zhong & Guo **sp. nov.** were collected at the same site, there were clear differences between the two new species, such as: (1) the shapes of the median eye plate and D11; (2) in male *D. parvtabula* Zhong & Guo **sp. nov.** P-IV slender and long, but stocky and short in female *D. luzhangensis* Zhong & Guo **sp. nov.**; (3) in male *D. parvtabula* Zhong & Guo **sp. nov.** genital acetabula large, but small in female *D. luzhangensis* Zhong & Guo **sp. nov.**; (4) the location of V_j ; (5) the sclerotized ring shape of the anal pore.

Therefore, the differences between *D. parvtabula* Zhong & Guo **sp. nov.** and *D. luzhangensis* Zhong & Guo **sp. nov.** are not the result of sexual dimorphism.

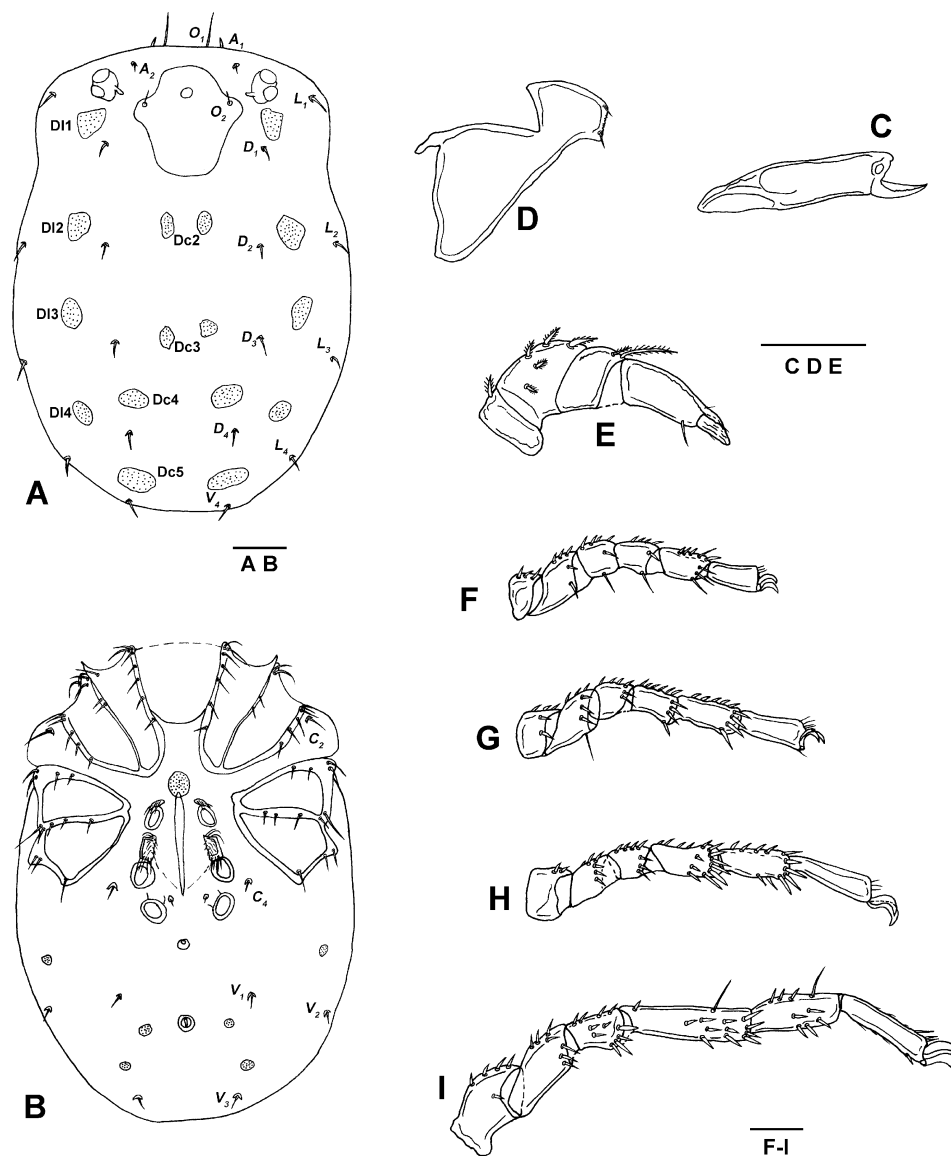


FIGURE 7. *Deuterothyas luzhangensis* Zhong & Guo **sp. nov.**, female (YN-HY-2023072602), A = dorsal view; B = ventral view; C = chelicera; D = gnathosoma ; E = palp; F = leg I; G = leg II; H = leg III; I = leg IV. Scale bars = 100 μ m.

***Deuterothyas baiyuensis* Zhong & Guo **sp. nov.** (Figs. 8–10)**

Habitat. Slow-moving stream with organic detritus and leaves.

Material examined. Holotype: adult female, Chaqingsongduo National Natural Reserve, Baiyu County, Sichuan Province, P. R. China (31.0088°N, 99.2471°E; 3523 m a.s.l.), collected by Bo-Yan Li, 30-VIII-2020. Slide No. SC-HY-2020083001.

Etymology. The species is named after Baiyu County, where the holotype was collected.

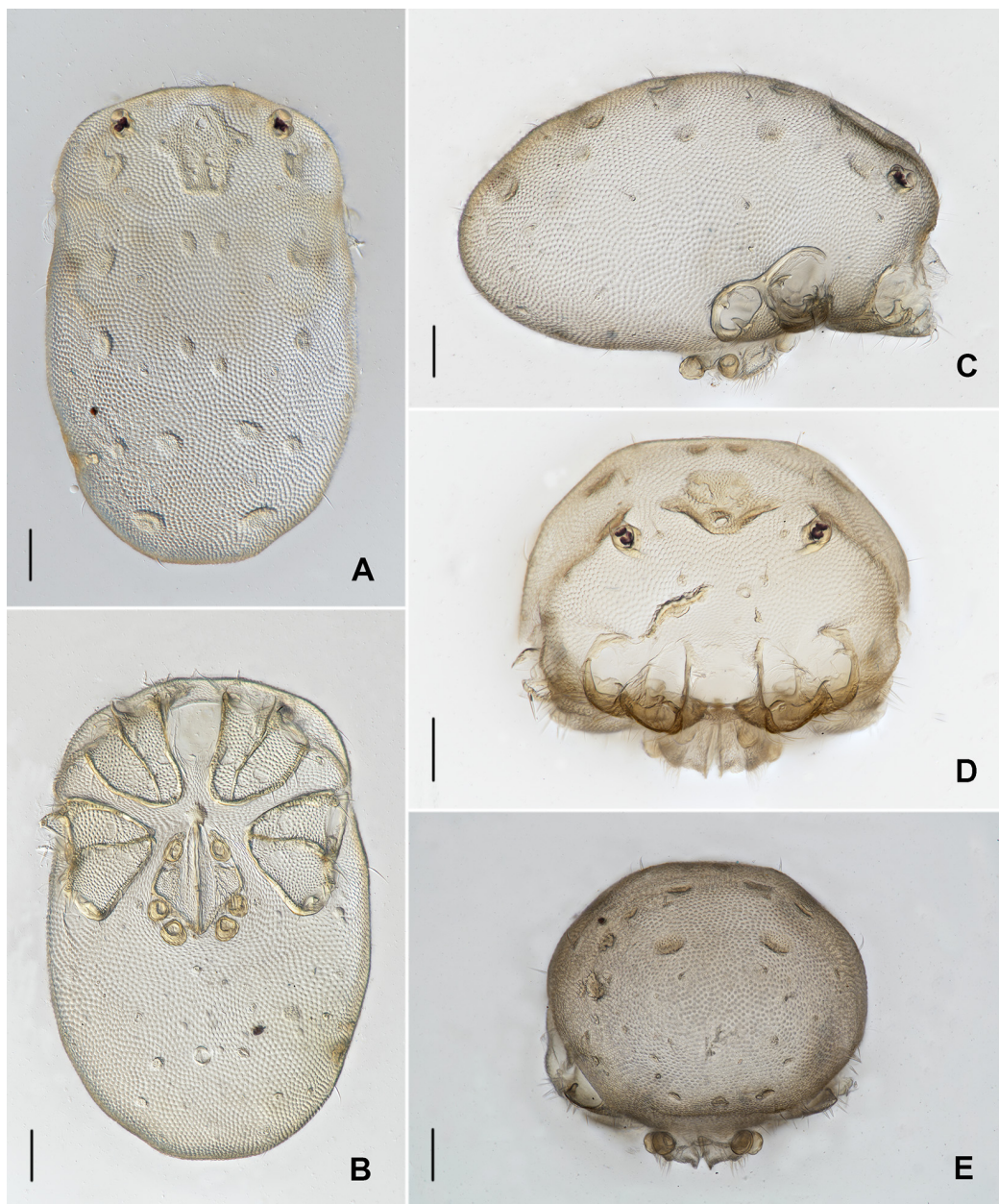


FIGURE 8. *Deuterothyas baiyuensis* Zhong & Guo **sp. nov.**, female (SC-HY-2020083001), A = dorsal view; B = ventral view; C = lateral view; D = anteromedial view; E = posteromedial view. Scale bars = 100 μ m.

Description. *Female* (n=1). Integument papillate, idiosoma long elliptical, length 961, width 602 (Fig. 8A–E). A_1 smooth. A well-developed median eye present and surrounded by median eye plate, which is formed by the fusion of pre- and post- frontalia and Dc1 including O_2 . O_1 located anterior idiosoma margin. Median eye plate length 183, width 163, polygonal in shape (longer than wide). The dorsalia small and irregularly oval in shape. Dc2–5 all free (Fig. 10A). Coxae in four groups. Length of ACG 218, PCG 240 (Fig. 10B). Genital field (including pregenital sclerite) 277 in length, 196 in width. Pregenital sclerite rhomboid in shape. Three pairs of genital acetabula, arranged

more or less in a line on each side, with six pairs of setae on the small sclerites anterior to Ac-1; the large median sclerites between Ac-1 and Ac-2 with a fringe of setae along medial margin, larger than Ac-2, and connected with the small sclerites anterior to Ac-1 by narrow chitin strips; Ac-3 lying free in the integument. Between Ac-3 a pair of tiny sclerites each with three setae (Fig. 9A). Gonopore relatively long. Ib-Ap 519. Ib-Gf 58. Dorsal side of P-I with one pinnate seta, P-II with three setae, and P-III with one long seta. P-IV with a dorsodistal projection, and one hair-like anteroventral seta and one long hair-like anterodorsal seta, P-V with two small setae (Figs. 9D, 10E). Dorsal length of palp segments: P-I, 27; P-II, 14; P-III, 43; P-IV, 119 (including distal projection); P-V, 38. Gnathosoma 178 in length (Figs. 9B, 10D). Chelicera length 219, chela serrated (Figs. 9C, 10C). Legs with many peg-like setae and without swimming setae (Fig. 10F–I). Dorsal lengths of segments of leg I–IV: I-L-1, 65; I-L-2, 72; I-L-3, 59; I-L-4, 86; I-L-5, 99; I-L-6, 98 (Fig. 9E); II-L-1, 67; II-L-2, 89; II-L-3, 74; II-L-4, 93; II-L-5, 120; II-L-6, 111; III-L-1, 64; III-L-2, 143; III-L-3, 62; III-L-4, 111; III-L-5, 144; III-L-6, 150; IV-L-1, 172; IV-L-2, 92; IV-L-3, 115; IV-L-4, 219; IV-L-5, 161; IV-L-6, 160 (Fig. 9F).

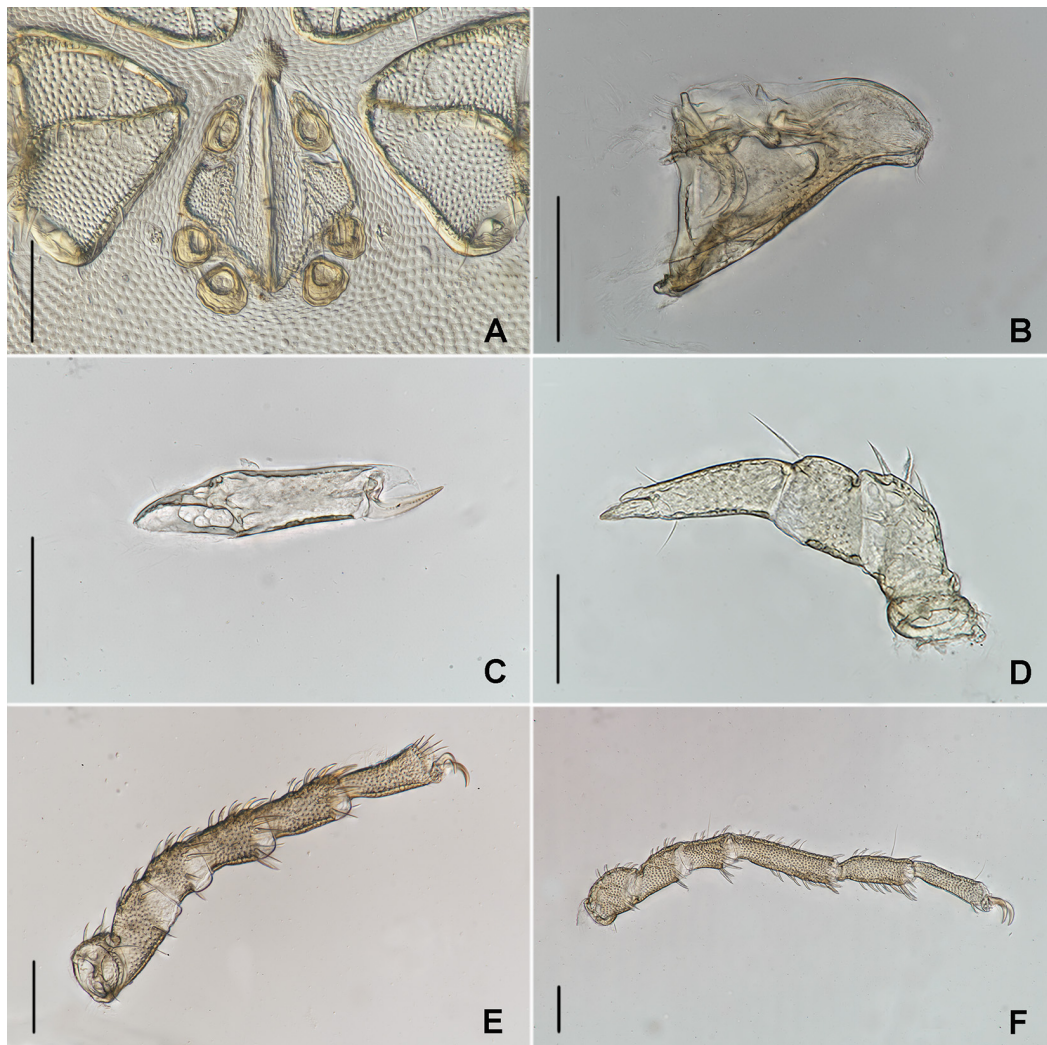


FIGURE 9. *Deuterothyas baiyuensis* Zhong & Guo **sp. nov.**, female (SC-HY-2020083001), A = genital field; B = gnathosoma; C = chelicera; D = palp; E = leg I; F = leg IV. Scale bars = 100 μ m.

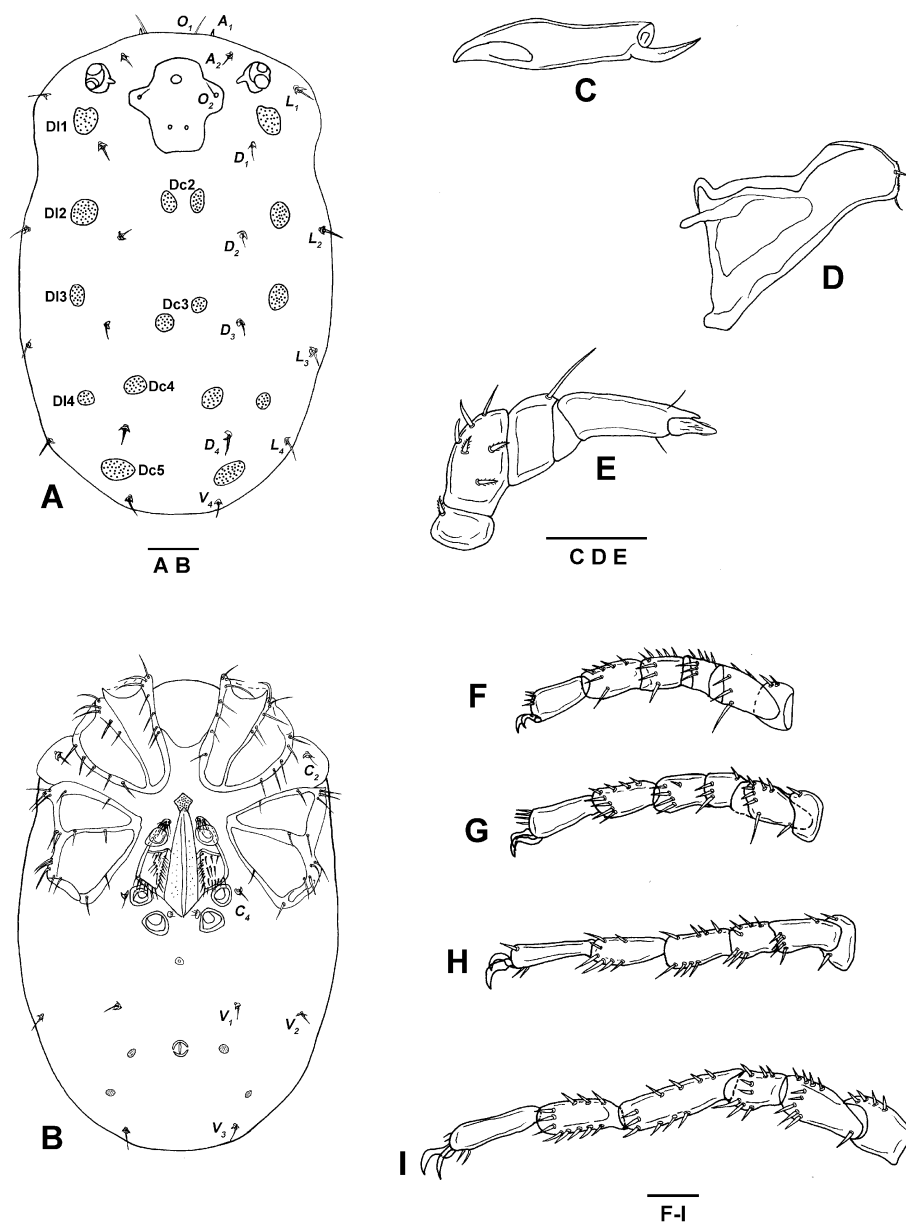


FIGURE 10. *Deuterothyas baiyuensis* Zhong & Guo **sp. nov.**, female (SC-HY-2020083001), A = dorsal view; B = ventral view; C = chelicera; D = gnathosoma; E = palp; F = leg I; G = leg II; H = leg III; I = leg IV. Scale bars = 100 μ m.

Male. Not collected.

Remarks. This new species is close to *D. variabilis* Lundblad, 1941 and *D. luzhangensis* Zhong & Guo **sp. nov.**. However, the new species can be easily separated by the following characteristics. In this new species, the dorsalia are small and irregularly oval in shape, Dc2–5 all free, anterior to Ac-1 a pair of sclerites each with six setae, medially of Ac-3 a pair of tiny sclerites each with three setae. In *D. variabilis*, the dorsalia are large, with a tendency for Dc3 and the enlarged Dc5 to fuse

medially, anterior to Ac-1 a pair of sclerites each with 2–4 setae, medially of Ac-3 a pair of tiny sclerites each with two setae (Smit 2020).

In this new species, idiosoma long elliptical, body with a slightly hard texture compared to *D. luzhangensis* Zhong & Guo **sp. nov.**; pregenital sclerite pentagonal in shape; the median sclerites between Ac-1 and Ac-2 with a fringe of setae along medial margin, larger than Ac-2, and connected with the small sclerites anterior to Ac-1 by narrow chitin strips; anterior to Ac-1 a pair of sclerites each with six setae; medially of Ac-3 a pair of tiny sclerites each with three setae; one long hair-like anterodorsal seta on P-IV. In *D. luzhangensis* Zhong & Guo **sp. nov.**, idiosoma short elliptical, integument very soft; pregenital sclerite rounded; the median sclerites between Ac-1 and Ac-2 with a fringe of setae along medial margin, smaller than Ac-2, not connected with the small sclerites anterior to Ac-1; anterior to Ac-1 a pair of sclerites each with four setae; medially of Ac-3 a pair of tiny sclerites each with one seta; one short hair-like anterodorsal seta on P-IV.

Funding

This research was supported by the National Natural Science Foundation of China (32260125) and the Guizhou Provincial Science and Technology Projects (Qiankehe Pingtai Rencai-GCC [2022] 029-1).

Author contributions

Hao Zhong identified the specimens, measured the data, finished the illustrations, wrote the manuscript, and took images by optical microscope. Harry Smit advised on the species delimitation. Yang Chen grouped images into plates by Adobe Photoshop CS2022®. Xin-Yao Gu, Jian-Jun Guo and Dao-Chao Jin supported the whole research.

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Submitted: 11 Apr. 2025; accepted by Almir Rogério Pepato: 7 Jul. 2025; published: 15 Sept. 2025