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# New records of the subgenus *Soarella* Koenike, 1907 from China (Acari, Hydrachnidia, Unionicolidae, *Neumania*), with the description of five new species

Zhu-Hui Ding <sup>a,b</sup>, Tian-Ci Yi <sup>a</sup>, Jian-Jun Guo <sup>a</sup>, Dao-Chao Jin <sup>a</sup>

<sup>a</sup> Institute of Entomology, Guizhou Provincial Key Laboratory for Agricultural Pest Management of the Mountainous Region, Guizhou University, Guiyang, P. R. China.

<sup>b</sup> Key Laboratory of Characteristic and Efficient Agricultural Plant Protection Informatization in Central Guizhou, College of Agriculture, Anshun University, Anshun, P. R. China.

## Original research

### ABSTRACT

Five new species of the subgenus *Soarella* are described from P. R. China, i.e. *Neumania nodophora* sp. nov., *Neumania paranodophora* sp. nov., *Neumania curosa* sp. nov., *Neumania parahirsuta* sp. nov. and *Neumania acanthophora* sp. nov. Detailed structures are illustrated through observation with an optical microscope, and new identifying features of *Soarella* are discussed.

**Keywords** *Soarella*; new species; new records; taxonomy

**Zoobank** <http://zoobank.org/69AB24E7-743E-4739-8C95-5EA86E7C3112>

## Introduction

Research on Unionicolidae in China began at the beginning of the 20th century with a series of publications by Marshall (1919, 1921, 1928), which were collected by Gee from Suzhou city, Jiangsu Province. Jin (1997) published a comprehensive study on the water mites of the Chinese fauna. Thus far, 46 species have been reported from China, including 22 species from the genus *Neumania*. This paper focuses on the water mites of the newly recorded subgenus *Soarella* Koenike, 1907, found in standing water in China. Despite the long history of studying water mites in China, knowledge of the Unionicolidae fauna in this country remains limited. Therefore, the aim of this study is to enhance the knowledge of Unionicolidae in China.

## Material and methods


The specimens were prepared for study using the methods of Jin (1997) and Gu *et al.* (2018). All holotypes and paratypes will be deposited in the Institute of Entomology, Guizhou University, Guiyang, P. R. China (GUGC) (Zhang 2018). The method and terms used follow Ding *et al.* (2019), ratios are calculated follow Valdecasas (2022). The following abbreviations are used: asl= above sea level,  $A_1$  = preantennal glandularia,  $A_2$  = postantennal glandularia, ACG = anterior coxal group (Cx-I + Cx-II), Cx-I-IV = coxae I-IV,  $D_1$ - $D_4$  = dorsoglandularia 1-4,  $C_1$ - $C_4$  = coxoglandularia 1-4, H = altitude, I-L-1-6 = first-sixth segment of the first leg,  $L_1$ - $L_4$  = lateroglandularia 1-4, L = length, LA = length between anterior end of Cx-I and posterior end of posterior apodeme of ACG, LP = length between anterior margin of Cx-III and posterior end of posterior apodeme of Cx-IV,  $O_1$  = preocularia,  $O_2$  = postocularia, P-1-P-5 = first-fifth

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Corresponding author

Dao-Chao Jin : [dcjin@gzu.edu.cn](mailto:dcjin@gzu.edu.cn)

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segment of palp, PCG = posterior coxal group (Cx-III + Cx-IV),  $V_1 - V_4$  = ventroglandularia 1–4, W = width. All measurements are given in  $\mu\text{m}$ , measurements of palp and leg segments are of the dorsal margins. Numbers are given as male/female/deutonymph or adult/deutonymph.

## Taxonomy

**Class Arachnida Lamarck, 1801**

**Order Trombidiformes Reuter, 1909**

**Suborder Prostigmata Kramer, 1877**

**Family Unionicolidae Oudemans, 1909**

**Subfamily Pionatacinae K. Viets, 1916**

**Genus *Neumania* Lebert, 1879**

**Subgenus *Soarella* Koenike, 1907**

**Diagnosis** — Integument smooth, usually with fine setae; all glandularia with varying degrees of enlargement, somewhat tubercular protrusions, without dorsal and ventral shields; excretory pore surrounded by a well-sclerotized tubercle-protrusion, sometimes it shrinks. Posterior extension of Cx-IV and C-4~ never fused, the genital field tends towards the ventral terminal. Males with a genital, but females with a pair of genital plates. Palp typically five-segmented, rarely P4 and P5 fused (Smit 2020), P-4 usually exhibits two closely positioned ventral setae, which also in proximity to the ventrodistal peg-like seta, and with P-5 without serrate seta. Legs without sexual dimorphism.

**Habitat** — Standing waters, slow flowing water, streams, interstitial.

**Distribution** — Palaearctic region; Oriental region; Afrotropical region.

**Remarks** — The classification status of this subgenus is a subject of controversy due to significant variations in the extent of protrusion of glandular hair tubercles. However, if the protrusion is not significant, i.e., *Neumania verrucosa* (Koenike, 1895), *Neumania angulate* (Sokolow, 1931), *Neumania tokyoensis* Imamura, 1959, and *Neumania morimotoi* Imamura, 1961, are all classified within the named subgenus (Gerecke *et al.* 2016; Imamura 1953, 1959, 1961). These species exhibit distinct characteristics, besides tubercular protrusions, the dorsal setae on P-3 shows varying degrees of deformation, clearly distinguishing them from the subgenus *Neumania*. Therefore, they should be classified within the subgenus *Soarella*.

***Neumania (Soarella) nodophora* sp. nov.**

Zoobank: 1F612678-BA8C-4EF0-A509-9EF346E48E9F

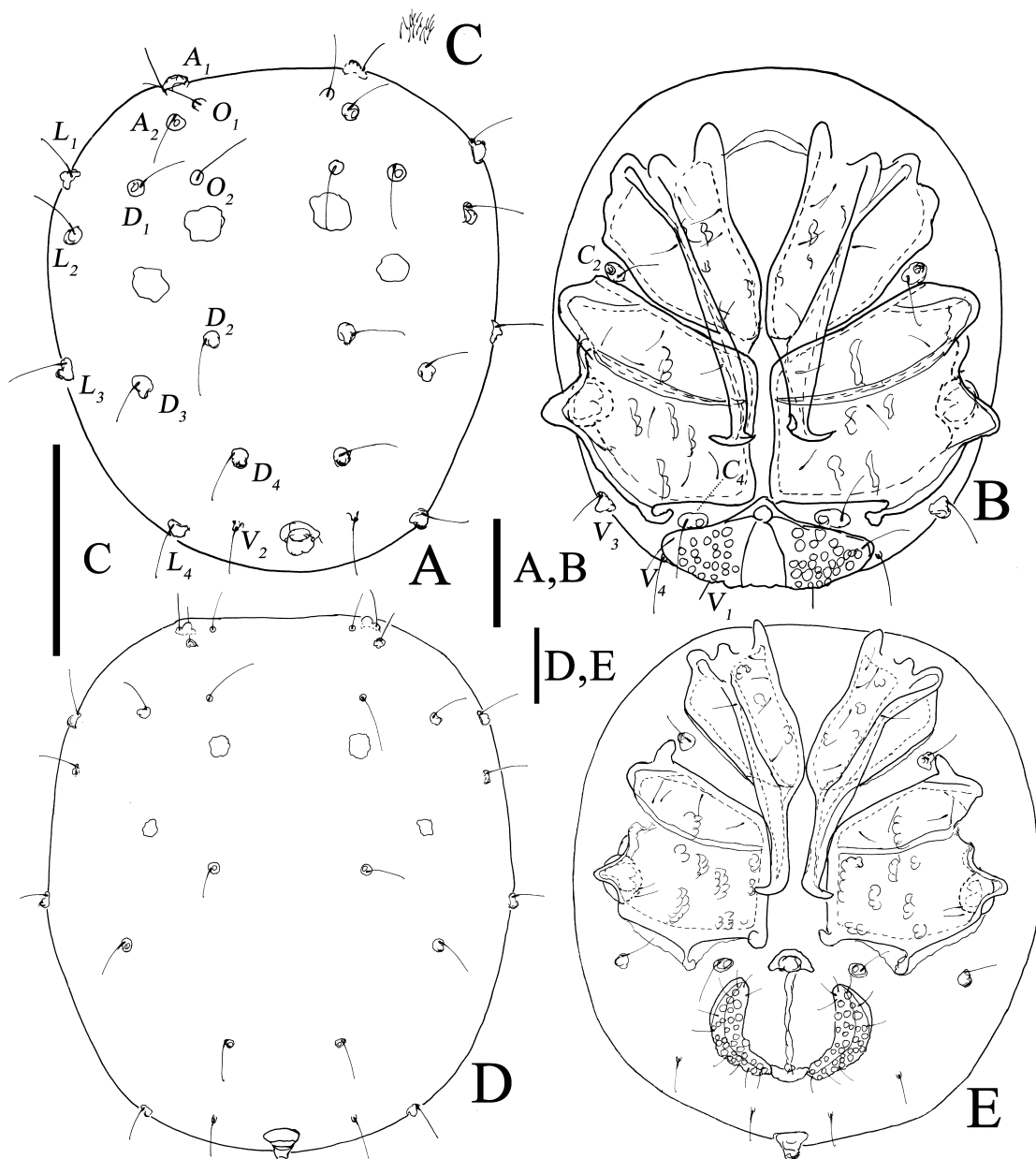
(Figures 1–3)

**Diagnosis** — Idiosoma with weak sclerotization, dorsum with two pairs of small dorsalia. Except for  $O_1$ ,  $O_2$ ,  $V_2$ ,  $V_1$ - and  $V_4$ ~, the remaining glandularia on tubercles. Excretory pore with developed spindle-shaped tubercle. P-3 with two dorsal setae, P-4 with a distal peg like seta, two subterminal fine setae. Suture line between Cx-III/IV complete, genital field with 34–36 pairs of acetabula.

**Etymology** — The specific name is from Latin word: “*nod-*» means node, “*-phora*» means attachment. The name of this new species is derived from the tubercular glandular it possesses.

**Material examined** — Holotype: ♂; Fenghuang Mountain, Jidong County, Heilongjiang Province, China; 44°58'17"N, 131°14'03"E, 427 m a.s.l.; 24 Jul. 2019; Min Ao and Haitao Li leg.; GUGC. Paratypes: 2 ♂♂, 2 ♀♀; the same data as the holotype; GUGC.

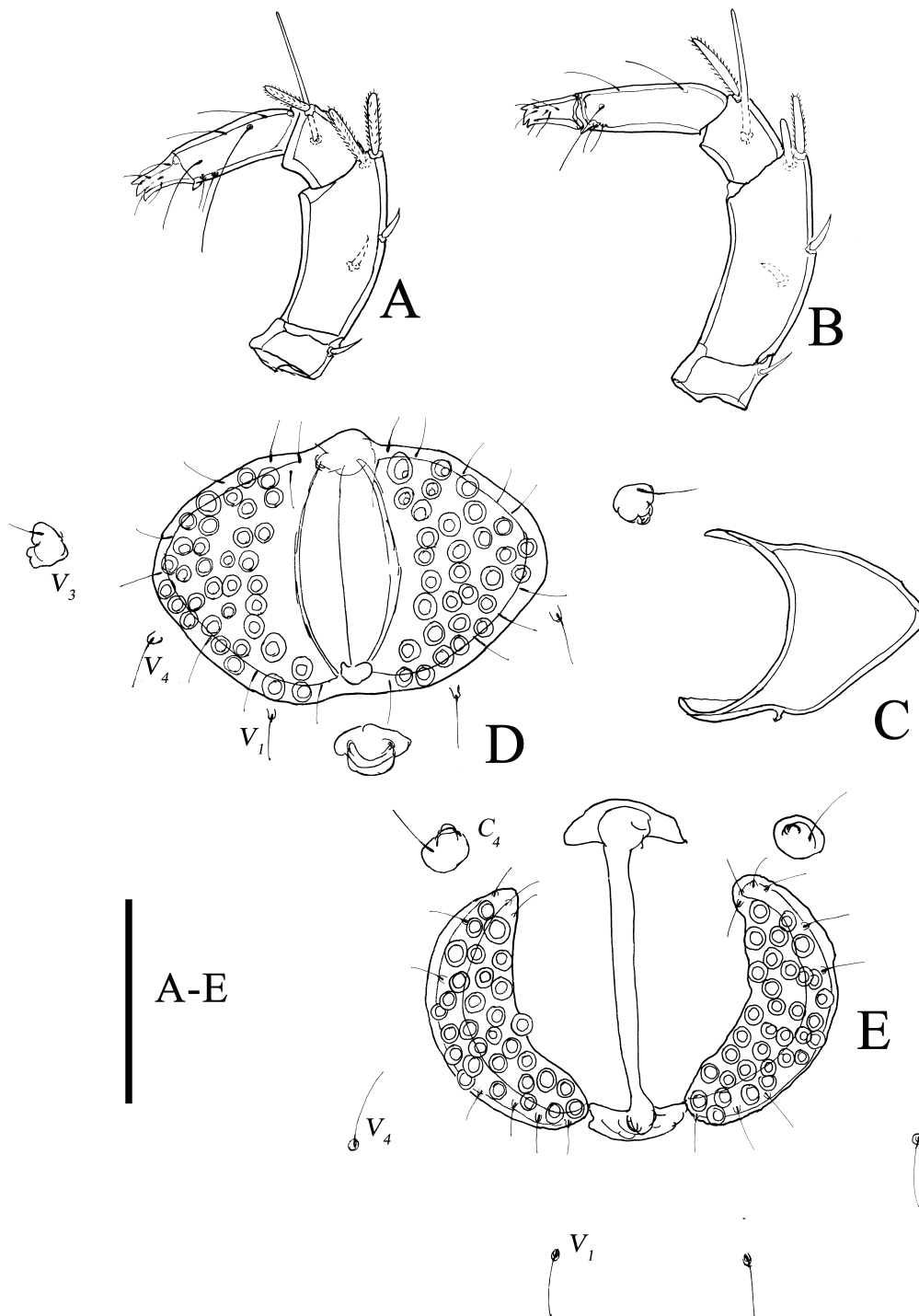
**Description** — Male: Idiosoma with weak sclerotization, covered with fine papillae (Figure 1C), dorsum with two pairs of approximate oval dorsalia,  $V_2$  lacks glandular sclerites and flush with the excretory pore, featuring a well-developed spindle-shaped nodule (Figure 1A). Coxal



**Figure 1** *Neumania (Soarella) nodophora* sp. nov. (Male A–C, Female D, E): A, D. Idiosoma, dorsal view; C. Mesh pattern of Idiosoma; B, E. Idiosoma, ventral view; Scale bars = 100  $\mu$ m.

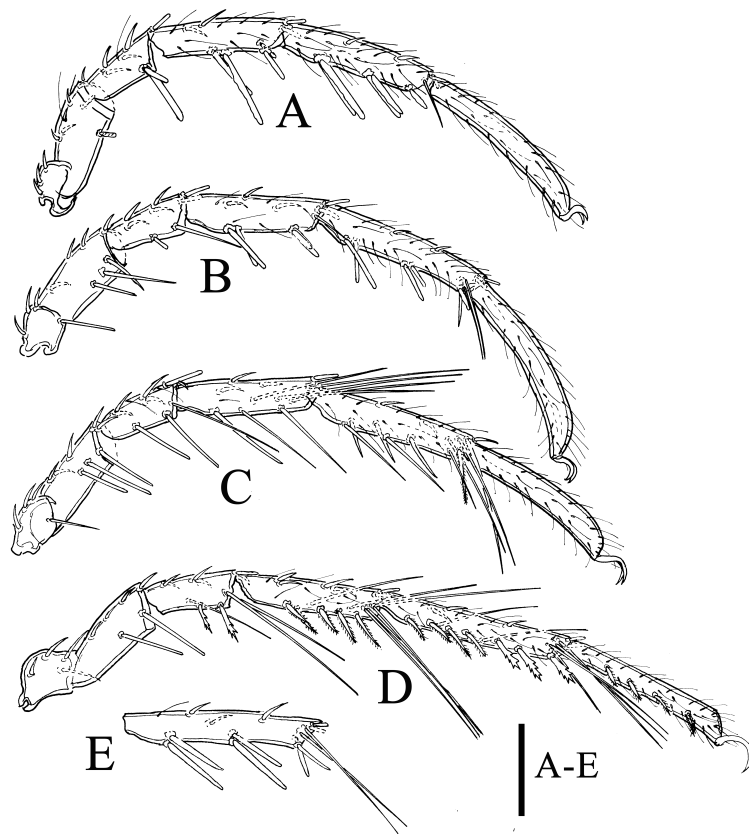
plates in four groups, surface lightly reticulated, interspace between Cx-II and Cx-III narrow, suture line between Cx-III/IV complete, posterior apodemes of ACG extending to one-third of Cx-IV, posterior projection of Cx-IV somewhat hook-shaped (Figure 1B). Cx-IV with many wavy muscle scars and Cx-III with few (Figure 1B). Genital field terminally located, each with 34–36 acetabula, the arrangement of the outermost acetabula suckers within a layer of folds, forming an inner ring. The edge of the genital plates lined with nine pairs of fine setae (Figure 2D).

Palp typically five-segmented. P-1 stubby, distally with one dorsal seta; P-2 with two dorsomedial setae and two distolateral blunt barbed setae; P-3 with a mediolateral long



**Figure 2** *Neumania (Soarella) nodophora* sp. nov. (Male B–D; Female A, E): A, B. Palp; C. Gnathosoma; D, E. Genital Field; Scale bars = 100  $\mu$ m.

seta and a dorsodistal blunt barbed seta; P-4 with two closed ventral setae situated on little tubercles and one peg-like setae inserting on its base, with a distolateral long fine seta and a proximodorsal long fine seta; P-5 claws distinctly trigeminal (Figure 2A). Ventral apodeme of gnathosoma slightly longer than dorsal apodeme, a toe-like projection located at the base



**Figure 3** *Neumania (Soarella) nodophora* sp. nov. (Male A–D; Female E): A. I-L-1–6; B. II-L-1–6; C. III-L-1–6; D. IV-L-1–6; E. II-L-5; Scale bars = 100 \*µm.

of the ventral apodeme of the gnathosoma (Figure 2C). Chelicera with a well-developed claw. II-L-5 ventrodistally with two short swimming setae; IV-L-3, -4, -5 distally with one, five, three swimming setae, respectively; IV-L-6 ventrally with four serrate setae (Figures 3A–D).

**Measurements** — Male (n = 2): Idiosoma L 488–529, W 454–498 (L/W ratio 0.98–1.17); genital field L 109–127, W 185–204 (L/W ratio 0.53–0.69). LA 318–321; LP 202–207; medial distance between Cx-IV 10–19. Chelicera L 139–144. Ejaculatory complex L 86–139. Lengths of the palp segments (P-1–5): 25–28, 94–101, 33–38, 65–66, 26–28. Lengths of I-L-1–6: 57–60, 85–108, 108–111, 153–160, 175–185, 214–221. Lengths of II-L-1–6: 59–61, 91–111, 99–107, 128–181, 188–201, 205–227. Lengths of III-L-1–6: 58–67, 86–105, 98–100, 149–161, 184–200, 70–94. Lengths of IV-L-1–6: 70–94, 72–106, 110–112, 153–169, 208–221, 182–199.

Female: Similar to the male. The proportion of the dorsalia small obviously (Figure 1D). Interspace between Cx-II and Cx-III wide, the mid-edge spacing of Cx-IV wide, posterior apodemes of ACG extending to the middle of Cx-III (Figure 1E), and genital palates separated, each with 31–36 acetabula, the posterior edge of the genital plates makes contact with the postgenital sclerite, and the plate possesses nine genital setae (Figure 2E).

**Measurements** — Female (n = 2): Idiosoma L 726–822, W 651–725 (L/W ratio 1.00–1.26); genital field L 127–136, W 67–76 (L/W ratio 1.67–2.02); gonopore L 169–171. LA 382–384; LP 230–233; medial distance between Cx-IV 78–80. Gnathosoma L 108–110. Chelicera L 157–159. Lengths of the palp segments (P-1–5): 31–33, 109–121, 40–51, 73–80, 31–36. Lengths of I-L-1–6: 72–77, 109–121, 123–133, 177–179, 199–205, 211–214. Lengths of II-

L-1–6: 73–79, 114–123, 112–116, 181–196, 220–250, 229–231. Lengths of III-L-1–6: 76–80, 110–132, 109–121, 170–181, 223–230, 202–209. Lengths of IV-L-1–6: 109–116, 123–135, 137–145, 217–228, 274–279, 232–240.

**Remarks** — This species exhibits similarities with *Neumania (Soarella) tuberculata* Cook, 1966 from Liberia. However, there are notable differences between this species and the new species, which include: (1) Suture line between Cx-III/IV incomplete (complete in the new species). (2) Dorsum with three pairs of dorsalia (two pairs of dorsalia in the new species). (3) Glandularia are obviously enlarged (while slightly enlarged in the new species).

This species also exhibits similarities to *Neumania (Soarella) angulata* Sokolow, 1931 (Imamura 1953), and differs from the new species in the following aspects: posterior apodemes of ACG is straight (while bend inward in the new species); acetabula fewer than 30 pairs (while have more than 30 pairs in the new species); IV-L-6 of female have two serrate setae (with four in the new species).

**Distribution** — China (Heilongjiang Province), pond.

### ***Neumania (Soarella) paranodophora* sp. nov.**

Zoobank: [8169E83E-64E3-4D73-BC25-034323C903F4](https://doi.org/10.24349/3dju-a1w1)

(Figures 4–6)

**Diagnosis** — Idiosoma with weak sclerotization, dorsum with two pairs of small dorsalia. Except for  $O_1$ ,  $O_2$ ,  $V_2$ ,  $V_{1-}$  and  $v_{4-}$ , the remaining glandularia exhibit tubercular characteristics. Excretory pore with developed spindle-shaped nodule. P-3 with two blunt barbed setae, P-4 with a distal peg-like seta, two subterminal fine setae. Suture line between Cx-III/IV slightly incomplete, male genital field with 47–50 pairs of acetabula.

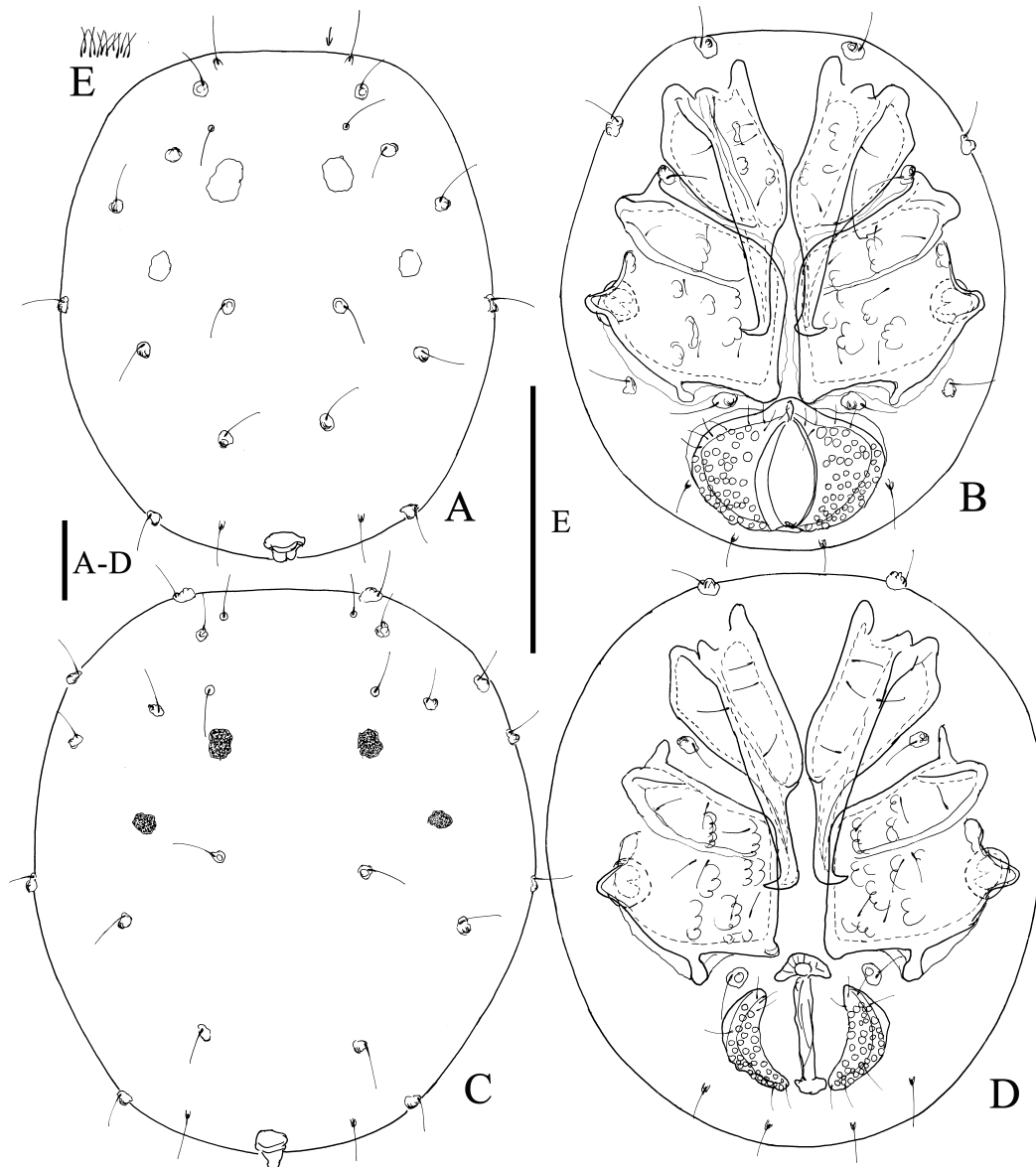
**Etymology** — The specific name is from Latin word: “*para-*» means similar, the name of this new species is derived from its similarity to *N. nodophora* sp. nov.

**Material examined** — Holotype: ♂; Songhua River, Harbin city, Heilongjiang Province, China; 45°41'19"N, 126°21'18"E, 127 m a.s.l.; 26 Jul. 2019; Min Ao and Haitao Li leg.; GUGC. Paratypes: 1 ♀; the same data as the holotype; GUGC.

**Description** — Male: Idiosoma with weak sclerotization, covered with fine papillae (Figure 4E), dorsum with two pairs of approximate oval dorsalia,  $V_{2-}$  without glandular sclerites, excretory pore located in the terminal position of the dorsum, with well-developed spindle-shaped nodule (Figure 4A). Coxal plates in four groups, surface lightly reticulated, interspace between Cx-II and Cx-III narrow, suture line between Cx-III/IV slightly incomplete, posterior apodemes of ACG extending to one-third of Cx-IV, posterior projection of Cx-IV bending medially and tending to be straight. Cx-IV with many wavy muscle scars and Cx-III with few (Figure 4B). Genital field located subterminally (Figure 4B), each with 47–50 acetabula, with prominent sclerotized margins surrounding it, with a layer of folds interspersed near the outer edge, forming an inner circle. The edge of the genital plates lined with 10 pairs of fine genital setae (Figure 5E).

Palp five-segmented. P-1 stocky, distally with one dorsal seta; P-2 with two dorsomedial setae and two distolateral blunt serrated setae; P-3 with two blunt barbed setae, the mediolateral one longer than the dorsodistal one; P-4 with two closed ventral setae situated on small tubercles, along with one peg-like seta inserted at its base, with a distolateral long fine seta; the claws of P-5 distinctly trifurcated (Figure 5A). Ventral apodeme of gnathosoma slightly shorter than dorsal apodeme, a toe-like projection located at the base of the ventral apodeme of the gnathosoma (Figure 5C). Chelicera with a well-developed claw (Figure 5D). II-L-5 ventrodistally with two short swimming setae (Figure 6B); IV-L-3, -4, -5 distally with one, five, three swimming setae, respectively; IV-L-6 ventrally with three serrate setae (Figure 6D).

**Measurements** — Male (n = 1): Idiosoma L 680, W 587 (L/W ratio 1.16); genital plates 167, W 253 (L/W ratio 0.66). LA 360; LP 236; medial distance between Cx-IV 26. Gnathosoma L 89. Chelicera L 117. Ejaculatory complex L: 138. Lengths of the palp segments (P-1–5): 28, 103, 33, 69, 30. Lengths of I-L-1–6: 59, 103, 102, 166, 179, 215. Lengths of II-L-1–6: 72, 124,



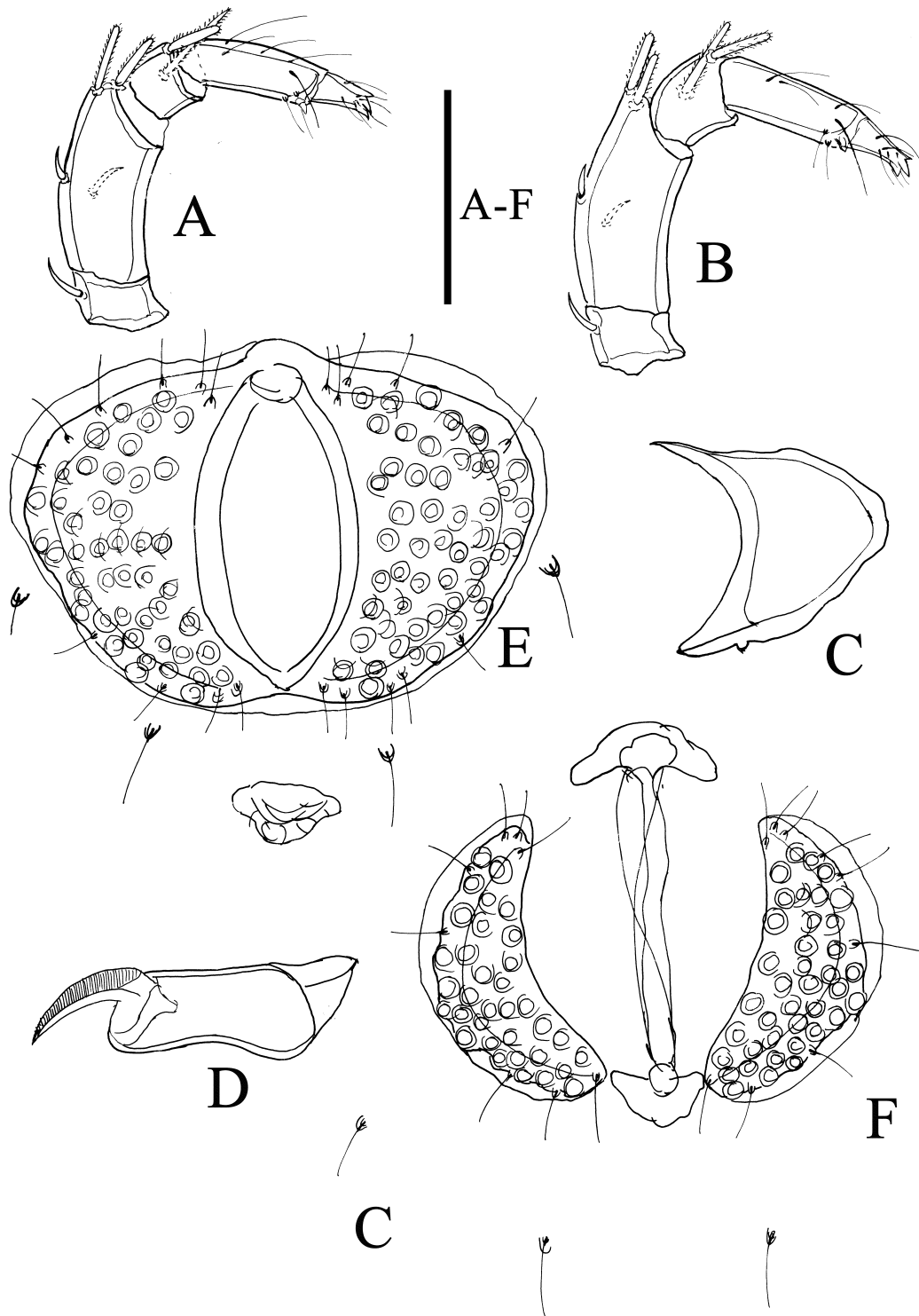
**Figure 4** *Neumania (Soarella) paranodophora* sp. nov. (Male A, B, E, Female C, D): A, C. Idiosoma, dorsal view; B, D. Idiosoma, ventral view; E. Mesh pattern of Idiosoma; Scale bars = 100  $\mu$ m.

102, 174, 203, 224. Lengths of III-L-1–6: 69, 111, 97, 185, 221, 226. Lengths of IV-L-1–6: 100, 119, 126, 213, 252, 227.

Female: Similar to the male. Interspace between Cx-II and Cx-III wide, the mid-edge spacing of Cx-IV wide, the proportion of the dorsalia small obviously (Figure 4D). Genital plates separated, each with 35–40 acetabula, the posterior edge of the genital palates makes contact with the postgenital sclerite, and the plate possesses nine genital setae (Figure 5F), IV-L-6 ventrally with three serrate setae (Figure 6E).

**Measurements** — Female (n = 1): Idiosoma L 754, W 675 (L/W ratio 1.12); genital plates 132, W 73 (L/W ratio 1.81); gonopore L 177. LA 371; LP 243; medial distance between Cx-IV 71. Gnathosoma L 93. Chelicera L 131. Lengths of the palp segments (P-1–5): 27, 110, 38, 70, 34. Lengths of I-L-1–6: 76, 110, 118, 170, 187, 203. Lengths of II-L-1–6: 76, 214, 114, 174, 211, 224. Lengths of III-L-1–6: 77, 114, 110, 178, 222, 204. Lengths of IV-L-1–6: 87, 127,

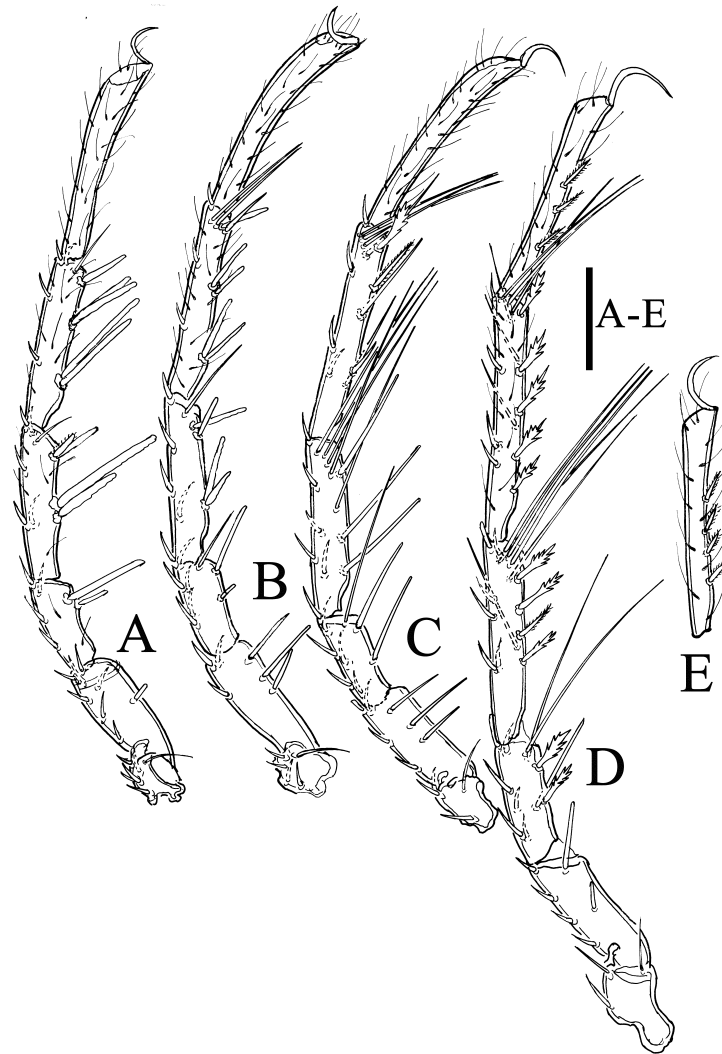




**Figure 5** *Neumania (Soarella) paranodophora* sp. nov. (Female A, F; Male B–E): A, B. Palp; C. Gnathosoma; D. Chelicera; E, F. Genital Field; Scale bars = 100  $\mu$ m.

139, 214, 263, 226.

**Remarks** — This species is similar to *Neumania (Soarella) nodophora* sp. nov. However, the two species can be distinguished by the following characteristics: (1) Suture line between



**Figure 6** *Neumania (Soarella) paranodophora* sp. nov. (Male A–D; Female E): A. I-L-1–6; B. II-L-1–6; C. III-L-1–6; D. IV-L-1–6; E. IV-L-6; Scale bars = 100  $\mu$ m.

Cx-III/IV complete in *N. nodophora* sp. nov. (incomplete in the new species). (2) Male acetabula have 24–36 pairs in *N. nodophora* sp. nov., the number is significantly less compared to the new species (while have 47–50 pairs in the new species).

**Distribution** — China (Heilongjiang Province), pond.

***Neumania (Soarella) parahirsuta* sp. nov.**

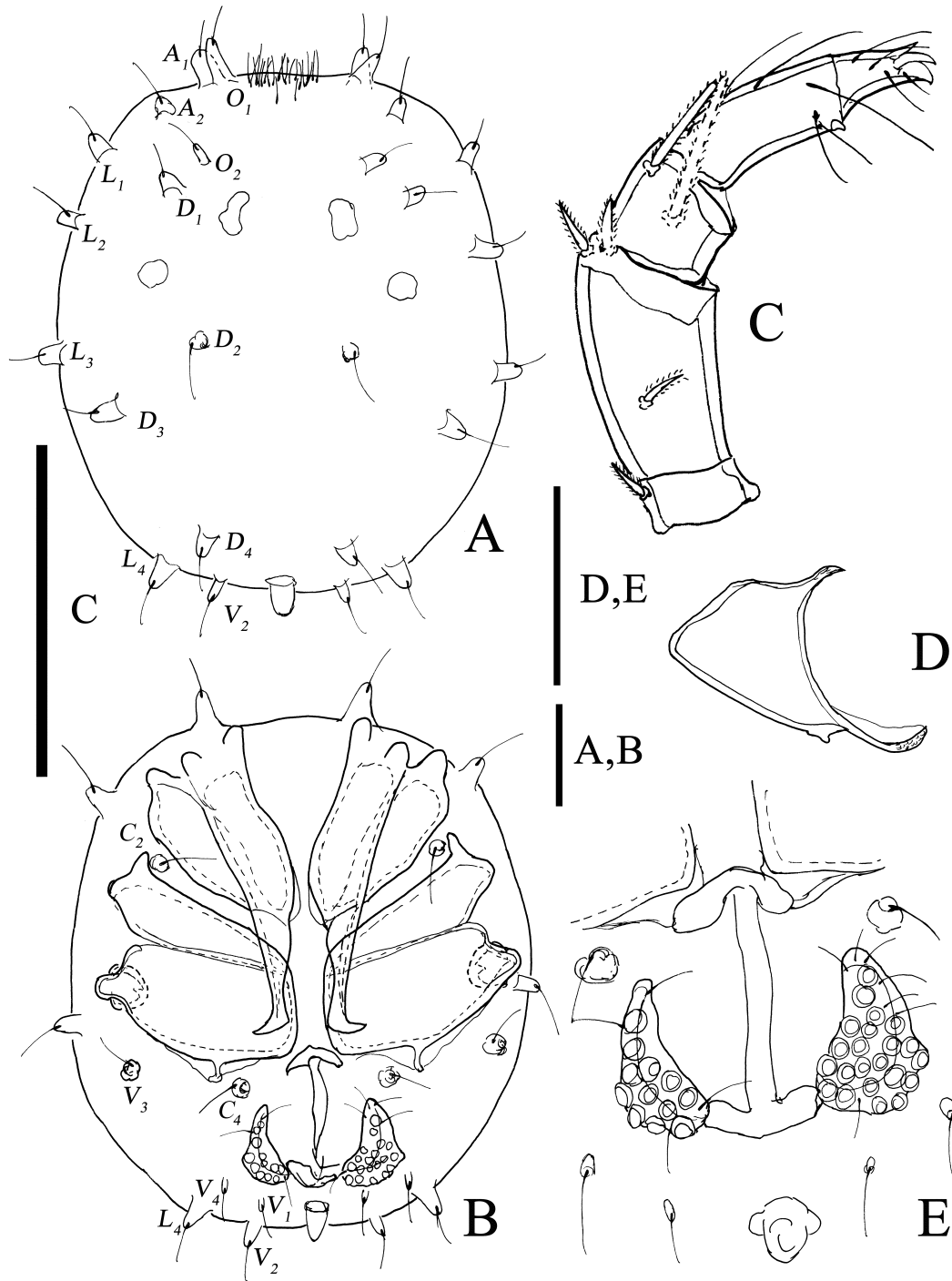
Zoobank: [4D3AF9FD-E483-4A8F-89F4-B5B7A9492E0E](https://zoobank.org/4D3AF9FD-E483-4A8F-89F4-B5B7A9492E0E)

(Figures 7–8)

**Diagnosis** — Idiosoma with weak sclerotization, densely with fine setae, dorsum with two pairs of small dorsalia. All glandularia with well-developed finger-like tubercles. Excretory pore on a spindle-shaped tubercle. P-3 with two blunt barbed setae, P-4 with a distal peg-like seta. Suture line between Cx-III/IV complete, female genital field with 12–22 pairs of acetabula.

**Etymology** — The specific name is from Latin word: “para-» means similar, the name of this new species is derived from its similarity to *N. hirsute* Wiles, 1999.

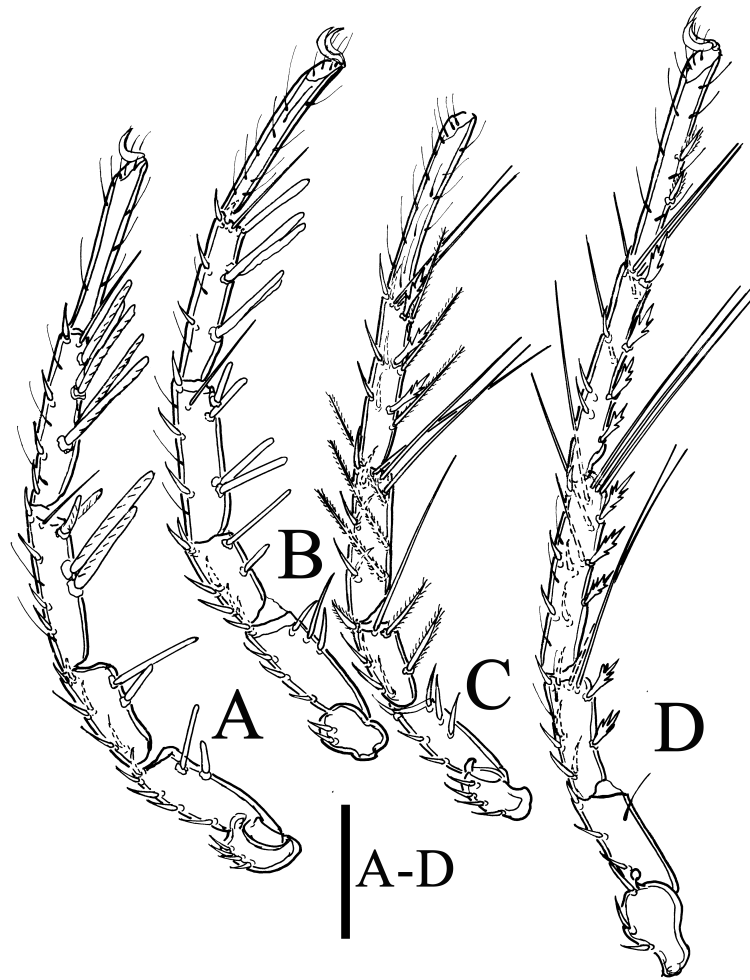
**Material examined** — Holotype: ♀; Diaoluo Mountain National Nature Reserve, Hainan



**Figure 7** *Neumania (Soarella) parahirsuta* sp. nov. (Female A–E): A. Idiosoma, dorsal view; B. Idiosoma, ventral view; C. Palp; D. Gnathosoma; E. Genital Field; Scale bars = 100  $\mu$ m.

Province, China; 18°43'17.76"N, 109°52'21.36" E, 906 m a.s.l.; 16 Jan. 2018; Zhuhui Ding leg.; GUGC.

**Description** — Female: Idiosoma with weak sclerotization, covered with fine setae, dorsum with two pairs of dorsalia, excretory pore terminally located, with a well-developed spindle-shaped tubercle (Figure 7A). Coxal plates in four groups, surface lightly reticulated,



**Figure 8** *Neumania (Soarella) parahirsuta* sp. nov. (Female A–D): A. I-L-1–6; B. II-L-1–6; C. III-L-1–6; D. IV-L-1–6; Scale bars = 100  $\mu$ m.

interspace between Cx-II and Cx-III narrow, suture line between Cx-III/IV complete, posterior apodemes of ACG extending to two-thirds of Cx-IV, posterior projection of Cx-IV hook-like. The mid-edge spacing of Cx-IV wide (Figure 7B). Genital field located subterminally, each with 12–22 acetabula, the pregenital sclerite connected to the middle edge of Cx-IV's end through a secondary-sclerotized structure, and the posterior edge of the genital plates contact the postgenital sclerite, and the plate contains 4–7 genital setae (Figure 7E).

Palp typically five-segmented. P-1 distally with one dorsal seta; P-2 with one dorsomedial seta and two distolateral barbed setae; P-3 with two blunt barbed setae, the mediolateral one longer than the dorsodistal one; P-4 with two closed ventral setae situated on little tubercles, along with one peg-like seta inserted at its small base, with a distolateral long fine seta; the claws of P-5 distinctly trifurcated (Figure 7C). Ventral apodeme of gnathosoma much longer than dorsal apodeme, a projection located at the base of the ventral apodeme of the gnathosoma (Figure 7D). Chelicera with a well-developed claw. II-L-4, 5 ventrodistally with one short swimming setae, respectively (Figure 8B); III-L-3, -4, -5 distally with one, three, three swimming setae, respectively (Figure 8C); IV-L-3, -4, -5 distally with two, three, three swimming setae, respectively; IV-L-6 ventrally with two serrate setae (Figure 8D).

**Measurements** — Female (n = 1): Idiosoma L 543, W 467 (L/W ratio 1.16); genital plates 82, W 44 (L/W ratio 1.86); gonopore L 141. LA 325; LP 171; medial distance between Cx-IV

33. Gnathosoma L 87. Lengths of the palp segments (P-1–5): 18, 75, 30, 56, 31. Lengths of I-L-1–6: 58, 86, 92, 131, 139, 142. Lengths of II-L-1–6: 52, 91, 81, 130, 141, 143, 4. Lengths of III-L-1–6: 54, 78, 66, 122, 143, 149. Lengths of IV-L-1–6: 69, 81, 95, 156, 180, 174.

Male: Unknown.

**Remarks** — This species is similar to *Neumania hirsuta* Wiles, 1999 (Wiles 1999). While Wiles did not assign this species to a particular subgenus, the significant presence of finger-like protuberance of glandularia provide evidence for its classification within the subgenus *Soarella*. And the two species can be distinguished by the following characteristics: (1) dorsum with a pair of dorsalia in *N. hirsuta* (while have two pairs in the new species). (2) I-leg-5 with a characteristic distal seta in *N. hirsuta* (while without in the new species). (3) The excretory pore with small tubercle in *N. hirsuta* (while large in the new species).

**Distribution** — China (Hainan Province), pond.

### ***Neumania (Soarella) curosa* sp. nov.**

Zoobank: [4C9A5E65-3DE1-4B79-8F1E-6A2E524EDC27](https://zoobank.org/4C9A5E65-3DE1-4B79-8F1E-6A2E524EDC27)

(Figures 9–10)

**Diagnosis** — Idiosoma with weak sclerotization, densely with fine setae, dorsum with two pairs of small dorsalia. All glandularia exhibit varying degrees of protrusion. Excretory pore positioned at subterminal dorsum, and accompanied by developed spindle-like nodule, and aligned with  $L_4$ . P-3 with two blunt barbed setae. Suture line between Cx-III/IV complete, female genital field with 21–28 pairs of acetabula. The postgenital sclerite in conjunction with the posterior edge of the genital plate.

**Etymology** — The specific name is from Latin word: “curo” means coalesce, the name of this new species is derived from the fusion of the postgenital sclerite and the genital plate.

**Material examined** — Holotype: ♀; Xinmin New Village, Wuzhishan City, Hainan Province, China; 18°52'17.47"N, 109°39'15.89"E, 908 m a.s.l.; 17 Jan. 2018; Zhuhui Ding leg.; GUGC.

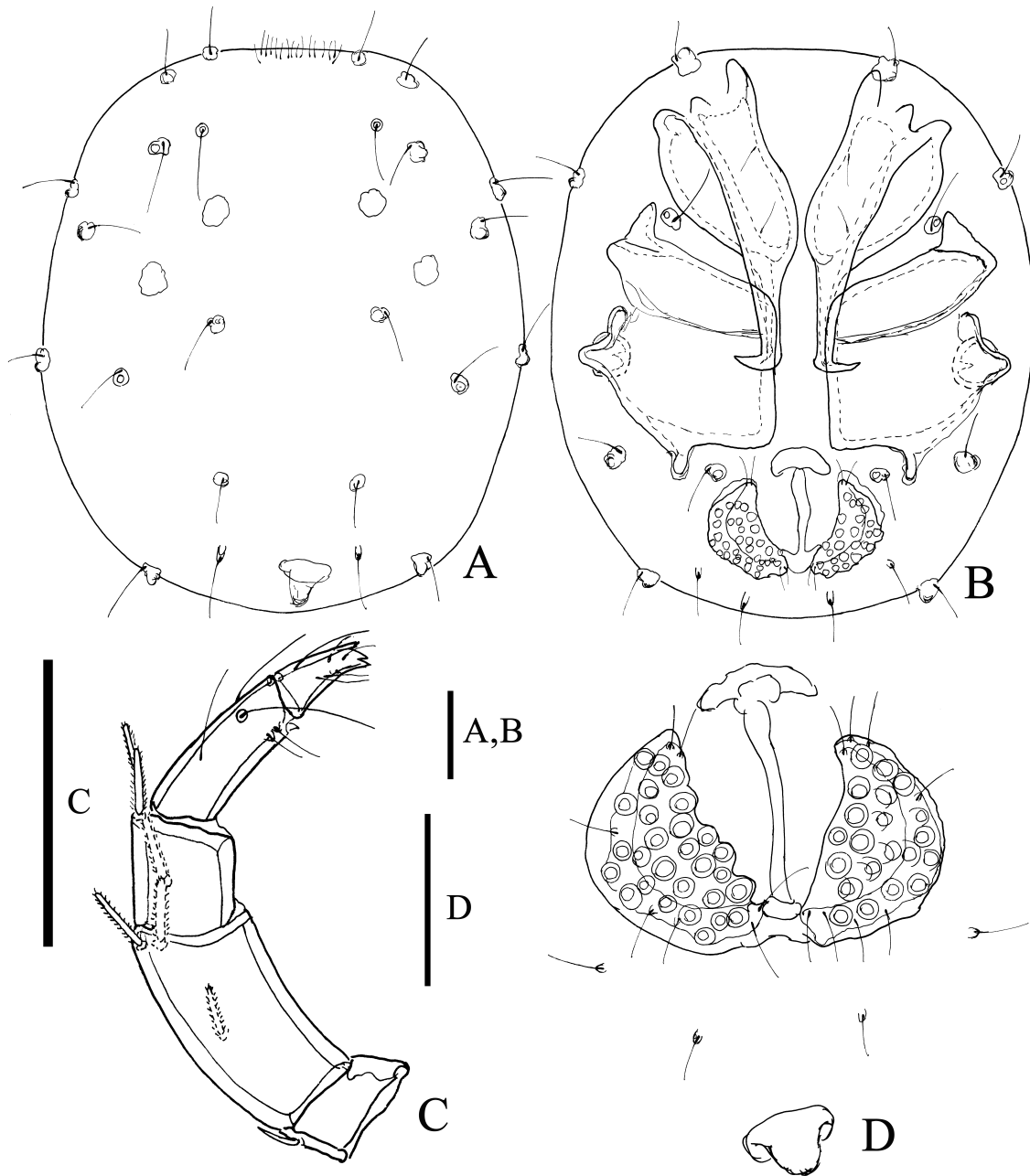
**Description** — Female: Idiosoma with weak sclerotization, covered with fine setae, dorsum with two pairs of dorsalia, excretory pore subterminal located, on a well-developed spindle-like tubercle (Figure 9a). Coxal plates in four groups, surface lightly reticulated, interspace between Cx-II and Cx-III wide, suture line between Cx-III/IV complete, posterior apodemes of ACG extending to one-third of Cx-IV, posterior projection of Cx-IV straight. The mid-edge spacing of Cx-IV wide (Figure 9B). Genital plates subterminally located, with clearly defined secondary sclerotized margins, each with 21–28 acetabula, and the posterior edge of the genital plates fused with the postgenital sclerite, and the plate contains 7–8 genital setae (Figure 9D).

Palp five-segmented. P-1 distally with one dorsal seta; P-2 with one dorsomedial seta and two distolateral barbed setae; P-3 with two blunt barbed setae, the mediolateral one much longer than the dorsodistal one; P-4 with two closed ventral setae situated on little tubercles, along with one peg-like seta inserted at its small base, with a distolateral long fine seta; the claws of P-5 indistinctly trifurcated (Figure 9C). I-L-4, 5 ventrodistally with one short, one long swimming seta, respectively (Figure 10A); II-L-4, 5 ventrodistally with one, two swimming setae, respectively (Figure 10B); III-L-3, -4, -5 distally with one, four, three swimming setae, respectively (Figure 10C); IV-L-3, -4, -5 distally with two, five, three swimming setae, respectively; IV-L-6 ventrally with two serrate setae (Figure 10D).

**Measurements** — Female (n = 1): Idiosoma L 688, W 586 (L/W ratio 1.17); genital plates 126, W 64 (L/W ratio 1.97); gonopore L 150. LA 353; LP 241; medial distance between Cx-IV 50. Gnathosoma L 96. Lengths of P-1–5: 26, 88, 38, 61, 32. Lengths of I-L-1–6: 54, 106, 107, 164, 172, 190. Lengths of II-L-1–6: 66, 114, 104, 164, 179, 194. Lengths of III-L-1–6: 67, 101, 95, 157, 186, 174. Lengths of IV-L-1–6: 100, 112, 122, 194, 221, 201.

Male: Unknown.

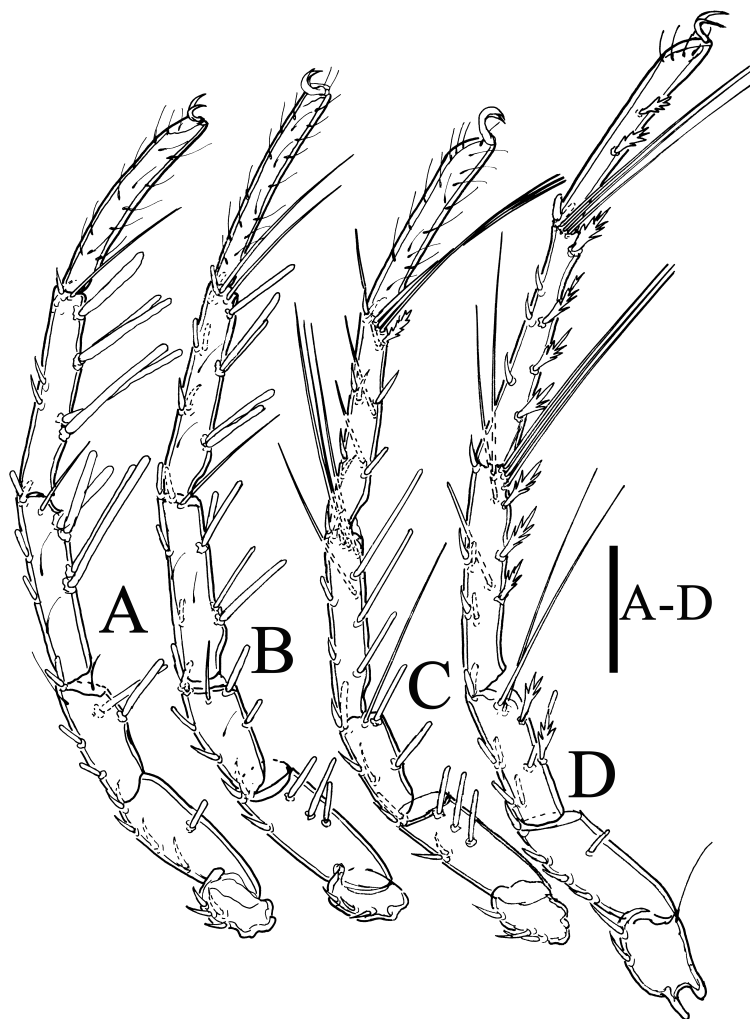
**Remarks** — This species shares similarities with *Neumania (Soarella) angulata*, Sokolow, 1931 in terms of: (1) the length of the posterior apodemes of ACG, (2) the general shape of



**Figure 9** *Neumania (Soarella) curosa* sp. nov. (Female A–D): A. Idiosoma, dorsal view; B. Idiosoma, ventral view; C. Palp; D. Genital Field; Scale bars = 100  $\mu$ m.

the palps. However, the new species differs from *N. angulata* in: (1) The excretory pore of *N. angulata* is positioned at the ventral end, whereas the excretory pore opening of the new species is located near the dorsal end. (2) In *N. angulata*, P-2 bears four setae, whereas the new species has only three. (3) The female IV-L-3–5 of *N. angulata* possesses 2, 6, 4 swimming setae, respectively, whereas the new species has 2, 5, 3 swimming setae in the same leg segments. (4) The anterior dorsalia in *N. angulata* is situated medially to  $D_1$ , while in the new species, it is positioned below  $D_1$ .

**Distribution** — China (Hainan Province), pond.



**Figure 10** *Neumania (Soarella) curosa* sp. nov. (Female A–D): A. I–L–1–6; B. II–L–1–6; C. III–L–1–6; D. IV–L–1–6; Scale bars = 100  $\mu$ m.

***Neumania (Soarella) acanthophora* sp. nov.**

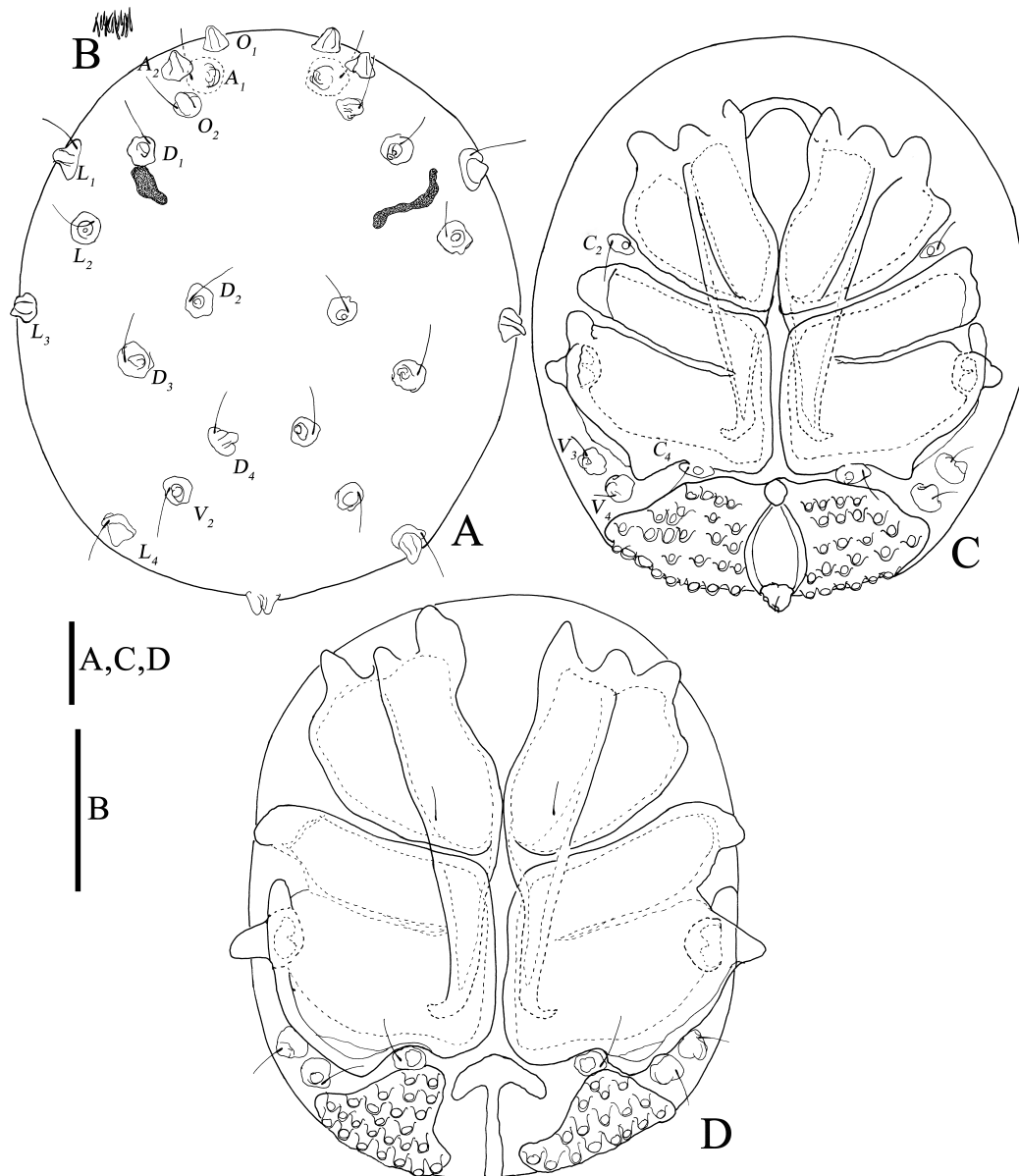
Zoobank: [1265A7F0-BBDD-4A98-8A22-AE475959D3CE](https://zoobank.org/1265A7F0-BBDD-4A98-8A22-AE475959D3CE)

(Figures 11–15)

**Diagnosis** — Idiosoma with weak sclerotization, dorsum with one pair of irregularly shaped dorsalia. All glandularia on well-developed tubercles. Excretory pore on a well-developed spindle-shaped tubercle. P-3 with two long setae, P-4 with two developed tubercles, each bearing one seta, and one ventrodiscal peg-like seta on protuberant base. Suture line between Cx-III/IV incomplete, male genital field with 47–50 pairs of acetabula, female with 39–49 pairs.

**Etymology** — The specific name is from Latin word: “*acanth-*» means thorns, “*-phora*» means attachment, The name of this new species is derived from its spinous tubercle on its dorsum.

**Material examined** — Holotype: ♂; Tongbiguan Township, Yingjiang County, Yunnan Province, China; 24°35'38.10"N, 97°43'24.29"E, 1300 m a.s.l.; 21 Jul. 2002; Jianjun Guo leg.; GUGC. Paratypes: 1 ♀; the same data as the holotype; GUGC. 2 ♀♀, 2 deutonymphs; Longxin Township, Longling County, Yunnan Province, China; 24°32'49.91"N, 98°49'15.67" E, 1700

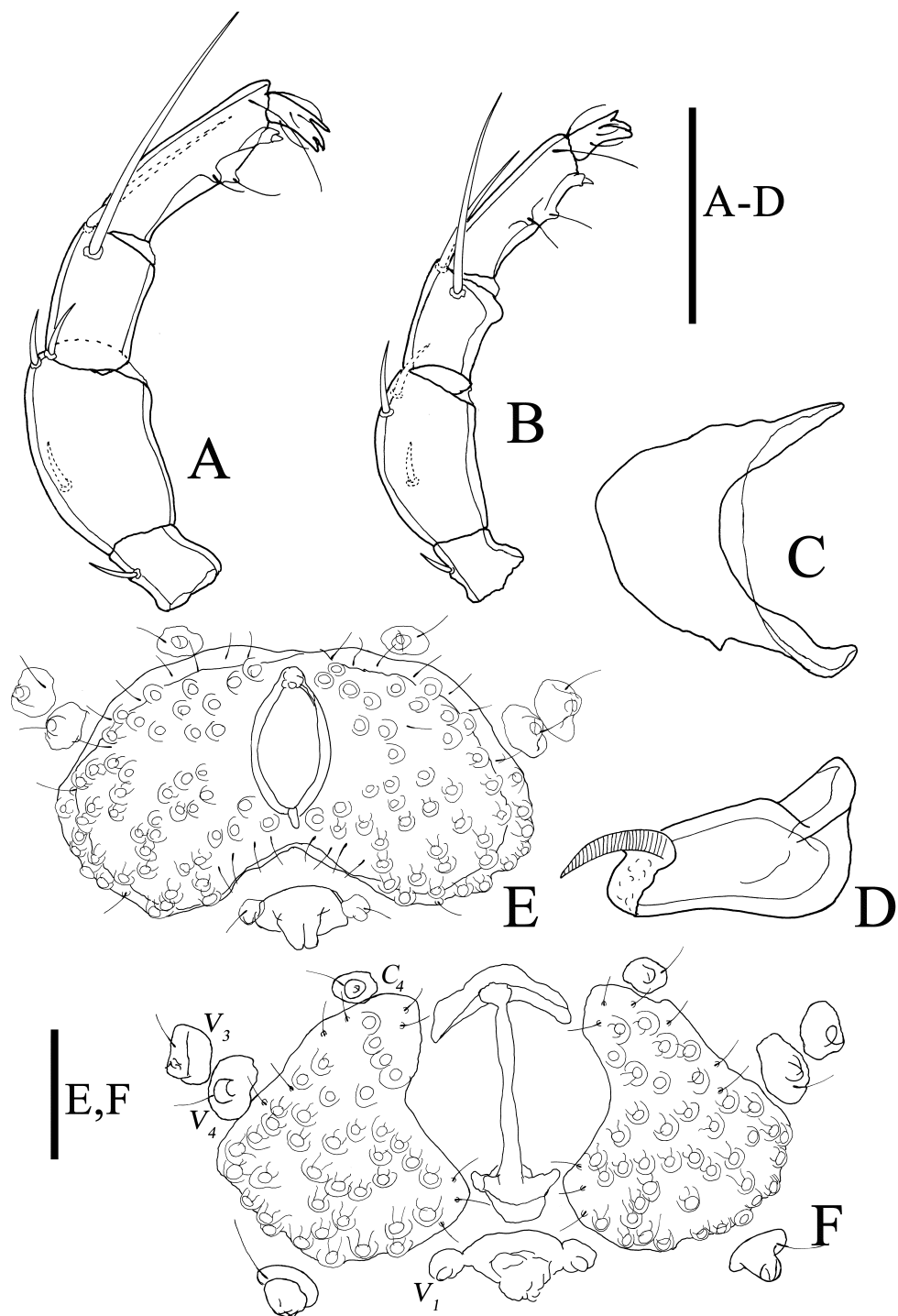


**Figure 11** *Neumania (Soarella) acanthophora* sp. nov. (Male A–C; Female D): A. Idiosoma, dorsal view; B. Mesh pattern of Idiosoma; C, D. Idiosoma, ventral view; Scale bars = 100  $\mu$ m.

m a.s.l.; 21 Jul. 2002; Jianjun Guo leg.; GUGC.

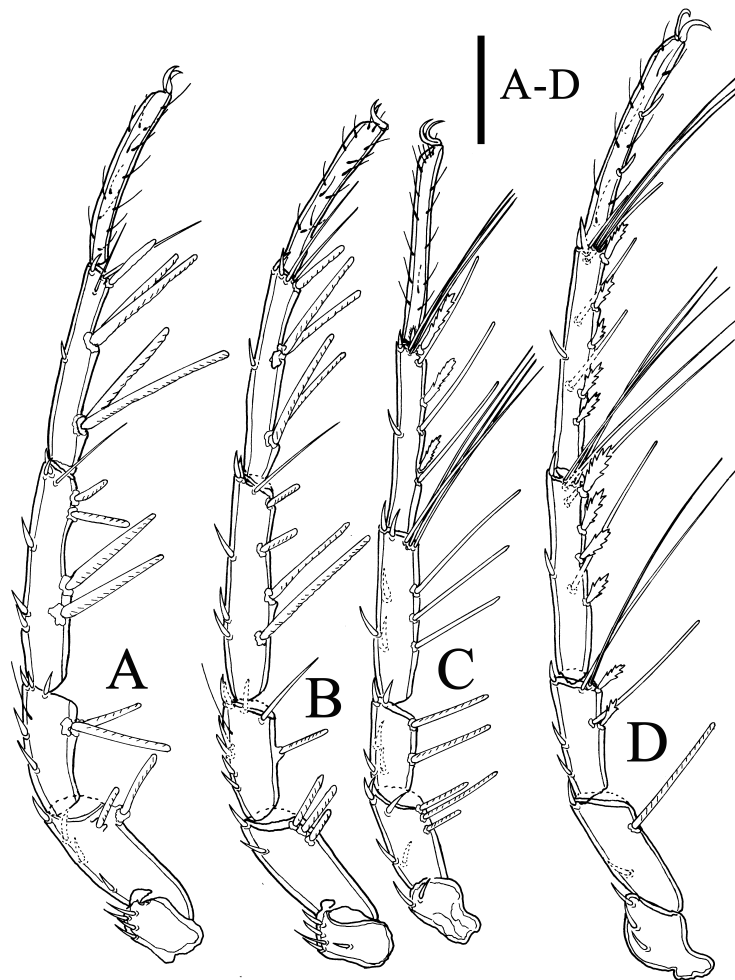
**Description** — Male: Idiosoma with weak sclerotization, covered with fine setae (Figure 11B), dorsum with two pairs of irregular banded dorsalia, all glandularia on well-developed tubercles, excretory pore located in the terminal position, on a well-developed spindle-shaped tubercle (Figure 12A), and fused with  $V_1$  (Figure 12E). Coxal plates in four groups, surface lightly reticulated, interspace between Cx-II and Cx-III narrow, suture line between Cx-III/IV incomplete, posterior apodemes of ACG extending to two-thirds of Cx-IV, posterior projection of Cx-IV forming a short extension (Figure 12C). Genital plates wider than long, each with 47–57 acetabula. The edge of the genital plates lined with 10 pairs of 12–14 genital setae.  $V_4$  situated in close proximity to  $V_3$  and positioned on the anterior side of the genital plates. Additionally,  $C_4$  is connected to both Cx-IV and the genital palates (Figure 12E).





**Figure 12** *Neumania (Soarella) acanthophora* sp. nov. (Male B–E; Female A, F): A, B. Palp; C. Gnathosoma; D. Chelicera; E, F. Genital Field; Scale bars = 100  $\mu$ m.

Palp five-segmented. P-1 slender, mediodorsal with one seta; P-2 with two dorsomedial setae and one distolateral seta; P-3 with two long setae; P-4 with two developed ventral projections, each bearing one seta, and one ventrodiscal peg-like seta on a tubercle; the claws of P-5 distinctly trifurcated (Figure 12A). Ventral apodeme of gnathosoma slightly as long as dorsal apodeme, a little projection located at the base of the ventral apodeme of the gnathosoma



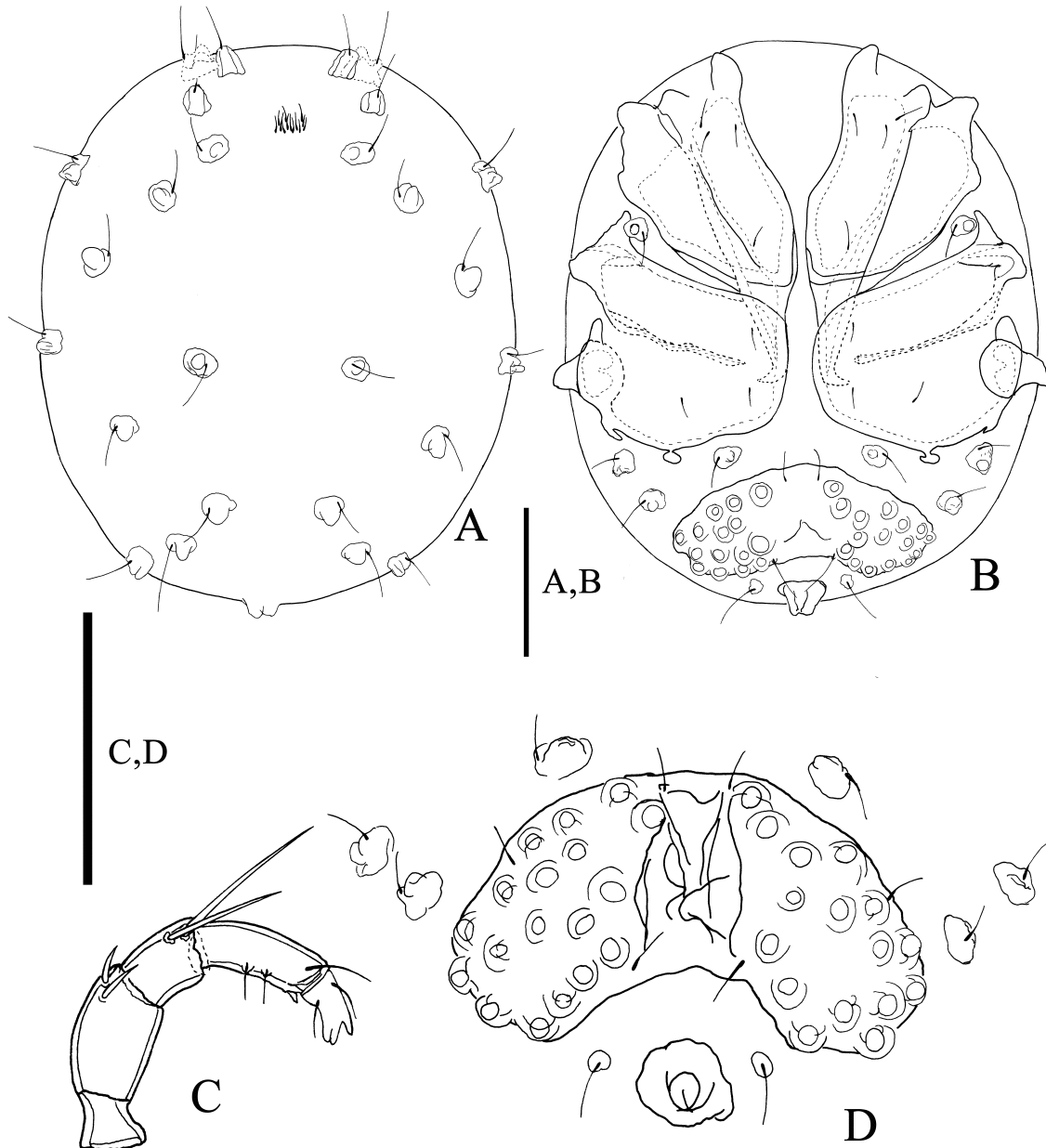
**Figure 13** *Neumania (Soarella) acanthophora* sp. nov. (Male A–D): A. I-L-1–6; B. II-L-1–6; C. III-L-1–6; D. IV-L-1–6; Scale bars = 100  $\mu$ m.

(Figure 12C). Chelicera with a well-developed claw (Figure 12D). I-L-4, -5 ventrodistally with one, one short swimming setae, respectively (Figure 13A); II-L-4, -5 ventrodistally with one, two short swimming setae, respectively (Figure 13B); III-L-3, -4, -5 distally with one, four, three swimming setae, respectively (Figure 13C); IV-L-3, -4, -5 distally with two, five, three swimming setae, respectively; IV-L-6 ventrally with two blunt setae (Figure 13D).

**Measurements** — Male ( $n = 3$ ): Idiosoma L 706–726, W 627–646 (L/W ratio 1.09–1.15); genital field L 173–177, W 392–397 (L/W ratio 0.44–0.45). LA 422–429; LP 236–239; medial distance between Cx-IV 9–11. Chelicera L 132–139. Gnathosoma L 102–114. Ejaculatory complex L 168–185. Lengths of the palp segments (P-1–5): 30–34, 81–85, 52–56, 75–80, 27–31. Lengths of I-L-1–6: 75–77, 118–125, 129–133, 214–227, 202–207, 163–175. Lengths of II-L-1–6: 69–71, 112–120, 121–127, 202–215, 206–221, 175–178. Lengths of III-L-1–6: 72–77, 91–94, 92–96, 165–169, 184–195, 177–184. Lengths of IV-L-1–6: 76–94, 94–110, 124–131, 193–209, 212–228, 201–215.

Female: Similar to the male. Interspace between Cx-II and Cx-III narrow, the mid-edge spacing of Cx-IV narrow (Figure 11D). Genital palates separated, each with 39–49 acetabula, and the plate possesses nine genital setae (Figure 12F).

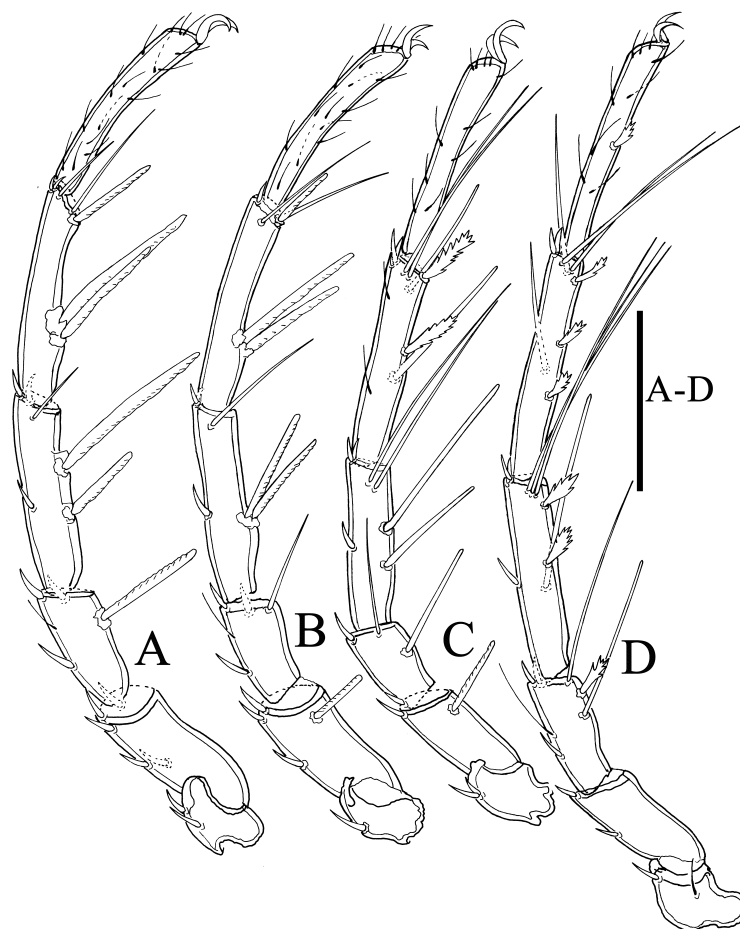
**Measurements** — Female ( $n = 3$ ): Idiosoma L 742–856, W 626–768 (L/W ratio 1.19–1.37); genital field L 142–177, W 127–145 (L/W ratio 0.98–1.39); gonopore L 155–203. LA 432–



**Figure 14** *Neumania (Soarella) acanthophora* sp. nov. (Deutonymphs A–D): A. Idiosoma, dorsal view; B. Idiosoma, ventral view; C. Palp; D. Genital Field; Scale bars = 100  $\mu$ m.

516; LP 249–312; medial distance between Cx-IV 11–20. Chelicera L 154–160. Gnathosoma L 121–124. Lengths of the palp segments (P-1–5): 34–38, 87–101, 57–65, 96–99, 34–43. Lengths of I-L-1–6: 83–92, 125–143, 133–163, 235–274, 220–231, 173–190. Lengths of II-L-1–6: 80–86, 101–141, 104–150, 182–263, 207–250, 191–196. Lengths of III-L-1–6: 78–91, 100–111, 95–114, 185–198, 200–220, 193–209. Lengths of IV-L-1–6: 97–102, 113–128, 139–153, 218–237, 242–260, 218–242.

Deutonymph: The deutonymph mites share similarities with adult overall, with the following distinctions: posterior apodemes of ACG extending to one-third of Cx-IV (Figure



**Figure 15** *Neumania (Soarella) acanthophora* sp. nov. (Deutonymphs A–D): A. I-L-1–6; B. II-L-1–6; C. III-L-1–6; D. IV-L-1–6; Scale bars = 100  $\mu$ m.

14B). Excretory pore away from  $V_1$  (Figure 14D). P-1 without seta, P-2 with two dorsal setae (Figure 14C). III-L-3, -4, -5 distally with one, one, two swimming setae, respectively (Figure 15C); IV-L-3, -4, -5 distally with one, three, two swimming setae, respectively (Figure 15D).

**Measurements** — Deutonymph (n = 2): Idiosoma L 379–497, W 324–435 (L/W ratio 0.87–1.53); genital field L 76–100, W 169–184 (L/W ratio 0.41–0.59). LA 217–226; LP 121–126; medial distance between Cx-IV 19–46. Chelicera L 93–98. Gnathosoma L 60–74. Lengths of the palp segments (P-1–5): 20–21, 49–50, 32–34, 52–54, 25–28. Lengths of I-L-1–6: 46–50, 65–67, 74–76, 124–126, 124–126, 119–124. Lengths of II-L-1–6: 46–49, 64–69, 70–72, 115–116, 126–135, 119–121. Lengths of III-L-1–6: 45–46, 54–56, 54–60, 95–97, 117–118, 122–124. Lengths of IV-L-1–6: 53–60, 61–64, 73–75, 118–119, 135–141, 136–137.

**Remarks** — The structure of the female genital plates and the palp in the new species exhibit similarities to those found in the subgenus *Ecpolopsis* Piersig. However, unlike the glandularia on the dorsum of this species, the latter subgenus has large glandularia plates, and the genital plates do not display fused and enlarged glandularia. Therefore, it is assigned to the subgenus *Soarella*. It is speculated that this species represents an intermediate form between the subgenus *Ecpolopsis* and the subgenus *Soarella*, allowing for clear differentiation from other members of the subgenus *Soarella*.

**Distribution** — China (Yunnan Province), standing waters.

## Discussion

The demarcation between the subgenus *Soarella* and other subgenera of *Neumania* is not clearly defined. For example, the assignment of *Neumania verrucosa*, which exhibits glandular sclerites but not as distinctly as in *Neumania papillosa*, to either *Soarella* or the nominate subgenus remains somewhat arbitrary (Gerecke *et al.* 2016). From our point of view, *Soarella* can be further distinguished based on recent findings regarding its palp structure. Generally, P-4 usually displays two adjacent ventral setae positioned on small tubercles, accompanied by a single peg-like seta inserted at its base. Cook (1974) advocated for retaining the subgenus *Soarella* for practical purposes. In order to achieve a more profound comprehension of the classification status pertaining to this subgenus, it becomes imperative to engage in an exploration of molecular taxonomy. Nevertheless, our current endeavors are hindered by the insufficiency of accessible material, particularly those originating from foreign localities. As we progress to the subsequent phase, our anticipation centers around forging collaborative partnerships with fellow scholars, with the overarching goal of meticulously accumulating the requisite molecular data.

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## ORCID

Zhu-Hui Ding  <https://orcid.org/0009-0006-2732-1535>

Tian-Ci Yi  <https://orcid.org/0000-0002-9953-3709>

Jian-Jun Guo  <https://orcid.org/0000-0002-0523-6704>

Dao-Chao Jin  <https://orcid.org/0000-0003-2727-5621>

## References

- Cook D.R. 1974. Water mite genera and subgenera. Michigan: Memoirs of the American Entomological Institute, 21. pp. 1-860.
- Ding Z.-H., Guo J.-J., Jin D.-C., Yi T.-C. 2019. Three new species of the subgenus *Unionicola* Haldeman, 1842 (Acari, Hydrachnidia, Unionicolidae) from Guizhou, China. *Zootaxa*, 4658(1): 141-154. <https://doi.org/10.11646/zootaxa.4658.1.6>
- Imamura T. 1953. Water-mites from Gifu prefecture. *Journal of The Faculty of Science Hokkaido University Series VI Zoology*, 11(3): 411-471.
- Imamura T. 1959. Water mites (Hydrachnellae) of subterranean waters in Kanto district, Japan. *Acarologia*, 1(4): 426-451.
- Imamura T. 1961. Water-mites (Hydrachnellae): mainly in subterranean waters, from the Ryu-KyuIslands. *Acarologia*, 3(1): 48-59.
- Gerecke R., Gledhill T., Pešić V., Smit H. 2016. Chelicerata: Acari III. In: Gerecke, R. (Eds). *Süßwasserfauna von Mitteleuropa*, 7/2-3. Heidelberg: Springer-Verlag Berlin. p. 1-429. <https://doi.org/10.1007/978-3-8274-2689-5>
- Gu X.-Y., Jin D.-C., Yi T.-C., Guo, J.-J. 2018. Chinese water mites of the genus *Torrenticola* Piersig, 1896 (Acari, Hydrachnidia, Torrenticolidae), with descriptions of two new species and a new record from Foding Mountain. *Systematic & Applied Acarology*, 23(10): 1972-1985. <https://doi.org/10.11158/saa.23.10.9>
- Jin D.C. 1997. Hydrachnellae-Morphology, systematics. A primary study of Chinese fauna. Guiyang: Guizhou Science and Technology Publishing House. pp. 1-356. (in Chinese with abstract of taxonomy in English)
- Marshall R. 1919. New species of water mites of the genus *Arrhenurus*. *Transactions of the American Microscopical Society*, 38: 275-281. <https://doi.org/10.2307/3221847>
- Marshall R. 1921. New species and collections of *Arrhenuri*: 1921. *Transactions of the American Microscopical Society*, 40: 168-176. <https://doi.org/10.2307/3221970>
- Marshall R. 1928. Water mites from China. *Transactions of the Wisconsin Academy of Sciences, Arts, and Letters*, 23: 603-608.

- Pešić V. 2001. New records of water mites (Acari: Hydrachnidia) from running waters from Montenegro and FYR Macedonia (SE Europe). *Acta Entomologica Serbica*, 6(1-2): 131-138.
- Smit H. 2020. Water mites of the world, with keys to the families, subfamilies, genera and subgenera (Acari: Hydrachnidia). Leiden: Monografieën van de Nederlandse Entomologische Vereniging. pp.1-774.
- Valdecasas A.-G. 2022. A cautionary note on linear measurements and their ratios in taxonomy. *Taxonomy*, 3(1): 1-9. <https://doi.org/10.3390/taxonomy3010001>
- Wiles P.-R. 1999. The water mites (Acari: Hydrachnidia) of Borneo and additional new species from Thailand and Sulawesi. *The Raffles Bulletin of Zoology*, 47(2): 409-439.
- Zhang Z.-Q. 2018. Repositories for mite and tick specimens: acronyms and their nomenclature. *Systematic & Applied Acarology*, 23(12): 2432-2446. <https://doi.org/10.11158/saa.23.12.12>