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Research article

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Three new species of pseudoscorpions (Arachnida: Pseudoscorpiones: Pseudotyrannochthoniidae) from caves in Yunnan and Guizhou Provinces, China

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Abstract. Three new species of pseudoscorpion, *Allochthonius lini* sp. nov. (Xiaoguoquan Cave) and *Selachochthonius yinae* sp. nov. (Xiao Cave) from Yunnan Province, *Allochthonius xuae* sp. nov. (Yelaoda Cave) from Guizhou Province, are described and illustrated. An identification key is provided for all known Chinese representatives of the family Pseudotyrannochthoniidae.

Keywords. Cave-inhabiting, identification key, pseudoscorpion, soil-dwelling, taxonomy.

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Introduction

Pseudotyrannochthoniidae Beier, 1932 is a small family containing six genera: *Afrochthonius* Beier, 1930 includes seven species (soil-dwelling) from Namibia, Sri Lanka and South Africa; *Allochthonius* Chamberlin, 1929 includes 30 species (two species of troglophiles, seven species of troglobite and 20 soil-dwelling species) from China, Japan, far eastern Russia (Primorsky-Krai) and South Korea, as well as a fossil species from Baltic amber in northern Europe; *Centrochthonius* Beier, 1931 includes five species (soil-dwelling) from high-altitude habitats in China, Kyrgyzstan and Nepal, and one fossil species from Bitterfeld amber in Germany; *Pseudotyrannochthonius* Beier, 1930 includes 18 species (six species of troglobite and 12 soil-dwelling species) from Australia, Japan, Korea, western USA and Chile; *Selachochthonius* Chamberlin, 1929 includes four species (three species of troglobite and one soil-dwelling species) from South Africa; and *Spelaeochthonius* Morikawa, 1954 includes nine species (troglobites) from Japan and South Korea (Schwarze *et al.* 2021; Harvey & Harms 2022; Prado *et al.* 2022; World Pseudoscorpiones Catalog 2022; You *et al.* 2022). The species in this family are all narrow-range endemics (Harms 2018; Harms *et al.* 2019). They generally have prominent chelicerae and trichobothria *ib* and *isb* situated distally near the base of the fixed finger of the pedipalpal hand so that the hand appears to be devoid of trichobothria (Harms & Harvey 2013). Two genera, *Allochthonius* (nine species) and *Centrochthonius* (two species), have been reported in China.

The pseudoscorpion genus *Allochthonius* was erected by Chamberlin for the Japanese type species *Chthonius opticus* Ellingsen, 1907 (by original designation). This genus is diagnosed by a carapace with 18–28 setae (except *Allochthonius brevitus* Hu & Zhang, 2012, 16 setae), coxal spines 'spray' or 'fan', spatulate spines on a common protuberance and a larger intercoxal tubercle (Harvey & Harms 2022; You *et al.* 2022).

The genus *Spelaeochthonius* was established by Morikawa for the Japan type species *Spelaeochthonius kubotai* Morikawa, 1954 (by original designation). This genus is diagnosed by a carapace with only 16 setae, eyes completely absent; chelicera hand generally with 5 setae, galea present as a very low mound; coxal spines on coxa I only and comprising 7–12 long and basally tripartite spines that are situated individually on anterior inner margin of coxa, never on a common protuberance, tips of spines plumose; intercoxal tubercle present and usually bisetose (Morikawa 1954; You *et al.* 2022).

During the identification of pseudoscorpion specimens collected on the Yunnan-Guizhou Plateau in the years 2017–2020, we found three new cave-inhabiting species of *Allochthonius* and *Spelaeochthonius*, which we describe in this article.

Material and methods

The specimens were preserved in 75% ethanol. They were cleared in lactic acid for 12–24 h at room temperature and, after the study, washed in distilled water and returned to alcohol. The specimens were examined with a Leica M205FA stereo microscope and an Olympus CX31 compound microscope. Photographs were taken using a Canon 6D Mark II camera fitted with Laowa 25 mm f/2.8 2.5–5X and 100 mm F2.8 2.0X Ultra Macro lenses. The final high depth of field (DoF) images were stacked from 30 to 80 single photos using Helicon Focus ver. 7.6.1., and CorelDRAW 2018 and SAI 2 software were used to draw the figures. The type specimens of the new species are deposited in the collection of the Museum of China West Normal University (MCWNU; Sichuan, China).

Pseudoscorpion terminology and measurements mostly follow Chamberlin (1931), with some minor modifications to the terminology of the trichobothria (Harvey 1992) and chelicera (Judson 2007).

Abbreviations for morphological terms used for the trichobothria

b = basal
eb = exterior basal
esb = exterior sub-basal
est = exterior sub-terminal
et = exterior terminal
ib = interior basal
isb = interior sub-basal
ist = interior sub-terminal
it = interior terminal
sb = sub-basal
st = sub-terminal
t = terminal

Results

Taxonomy

Class Arachnida Cuvier, 1812
Order Pseudoscorpiones de Geer, 1778
Suborder Heterosphyronida Chamberlin, 1929
Superfamily Chthonioidea Daday, 1889
Family Pseudotyrannochthoniidae Beier, 1932
Genus *Allochthonius* Chamberlin, 1929

Allochthonius lini sp. nov.
urn:lsid:zoobank.org:act:A63F930C-B176-411F-8254-6B843FF240F7
Figs 1, 4A–B

Diagnosis

Differs from the other members of the genus *Allochthonius* by the following combination of characters: cheliceral hand with 7 setae, fixed cheliceral finger with large basal and subapical tooth, rallum with 11 blades (each with fine barbules, the basal-most blade shorter than the others); and coxae I with 8 tridentate blades, each blade with a central spine terminally distinctly expanded as fan-shaped, all situated on a common tubercle. Pedipalpal femur (♂) 5.56–5.59 ×, (♀) 4.95–4.98 × as long as broad, length (♂) 0.89–0.92 mm, (♀) 0.99–1.01 mm; chela (♂) 4.78–4.81 ×, (♀) 4.44–4.50 × as long as broad, length (♂) 1.29–1.31 mm, (♀) 1.51–1.54 mm; ratio movable chelal finger/chelal hand (♂) 1.78–1.82 ×, (♀) 0.97–0.99 ×.

Etymology

The specific epithet was given in honour of Dr Yu-Chen Lin (College of Life Science, Sichuan University, China), not only due to the assistance provided during fieldwork, but also for his great contribution to the knowledge of arthropods, especially Mysmenidae.

Type material

Holotype

CHINA • ♂; Yunnan Province, Zhaotong City, Zhenxiong County, Wude Town, Xinzhai Village, Xiaoguoquan Cave; 25.586027° N, 104.762101° E; 1220 m a.s.l.; 9 Apr. 2017; Yun-Chun Li leg.; MCWNU (Ar-Ps-YN-0082).

Paratypes

CHINA • 9 ♂♂, 9 ♀♀; same collection data as for holotype; MCWNU (Ar-Ps-YN-0027) • 3 ♂♂, 3 ♀♀; same collection data as for preceding; 30 Aug. 2020; Yun-Chun Li, Yu-Chen Lin, Ya Li and Yun-Fei Shu leg.; MCWNU (Ar-Ps-YN-0019).

Description

Adult male

Colour. Chelicerae and pedipalps reddish brown, remaining parts brown; carapace, chelicerae and abdomen with dense round white spots.

Carapace (Fig. 1A). 0.81–0.85 × as long as broad, scarcely constricted posteriorly, with 4 well-developed eyes; epistome absent, space between median setae slightly recurved. Carapace surface with 4 lyrifissures, near anterior and posterior margins. With 26 setae arranged 10: 4: 6: 2: 4.

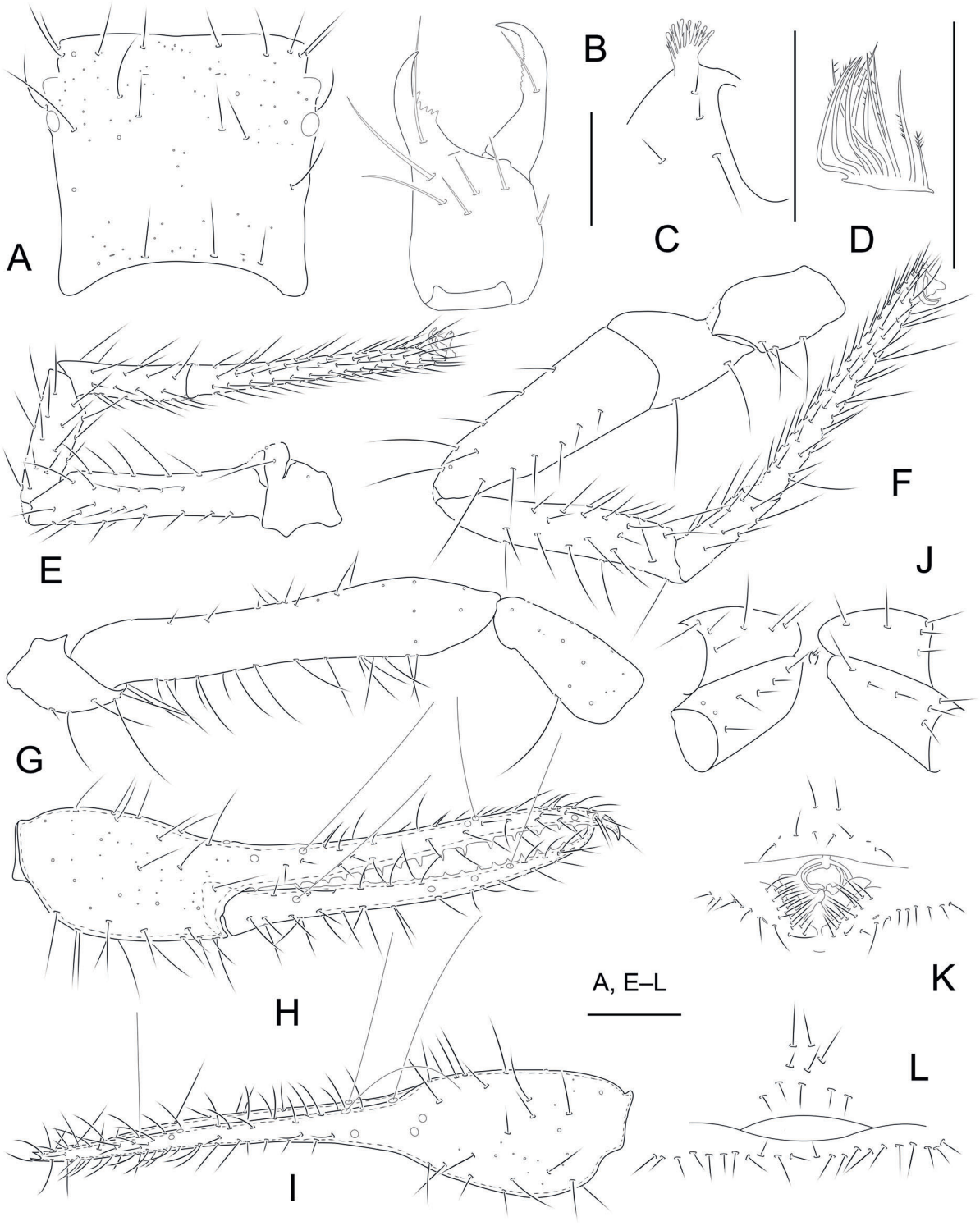

Fig. 1. *Allochthonius lini* sp. nov. **A–K**. ♂, holotype (MCWNU (Ar-Ps-YN-0082)). **L**. ♀, paratype (MCWNU (Ar-Ps-YN-0019)). **A**. Carapace. **B**. Right chelicera. **C**. Coxal spines. **D**. Rallum of left chelicera. **E**. Right leg I, lateral view. **F**. Right leg IV, lateral view. **G**. Right pedipalp (minus chela). **H**. Chela, retrolateral view. **I**. Chela, dorsal view. **J**. Intercoxal tubercle. **K**. Male genital area. **L**. Female genital area. Scale bars = 0.20 mm.

Chelicera. Relatively broad. Cuticle of hand gently granulate to squamate. Hand with 7 setae, all setae acuminate, movable finger with 1 seta in medial position, with 1 small lyrifissure in most dorsal row of setae on hand, galea absent. Fixed finger with 5 conspicuous teeth, including 1 large basal tooth and 1 subapical tooth; movable finger with 17–19 teeth (Fig. 1B). Serrula exterior with 21–24 lamellae; serrula interior with 16–18 lamellae. Rallum composed of 11 blades with fine barbules, basal-most 1 distinctly shorter than others (Fig. 1D).

Pedipalp (Fig. 1G–I). All setae acuminate. Trochanter 1.47–1.51 ×, femur 5.56–5.59 ×, patella 2.19–2.24 × as long as broad, femur 2.54–2.60 × as long as patella. Chela 4.78–4.81 × and hand 1.70–1.77 × as long as broad; movable chelal finger 1.78–1.82 × as long as hand. Fixed finger with 17 acute teeth, including 1 large basal tooth, almost close to junction; movable finger with 16 teeth, tubercle between 9 and 10. Fixed chelal finger with 8 trichobothria and movable finger with 4, *eb*, *esb*, *ib*, *isb*, and *ist* located basally of fixed finger and 2 special sensory hairs (*xs*) near fingertip; on movable finger, *st* subproximal and in medial position on finger, triplet *sb*, *b*, and *t* distomedial to distal, distance between *sb* and *b* sligthly longer than distance between *b* and *t*.

Abdomen. Tergal chaetotaxy (I–XII): 4: 6: 8: 9: 11: 12: 12: 13: 10: 6: 2: 0; sternal chaetotaxy (IV–XII): 18: 18: 16: 18: 16: 13: 7: 0: 2. Manducatory process with 2 setae. Pedipalpal coxa with 3 setae, coxa I 4, II 5, III 5–6, IV 6–7 setae; intercoxal tubercle present with 2 setae (Fig. 1J). Coxal blades only present on coxa I, with spray of 8 clavate blades (Fig. 1C). Anterior genital operculum with 8 setae and 2 lyrifissures; genital opening with 15 setae on the right side, and 12 on the left (Fig. 1K).

Legs (Fig. 1E–F). Leg I: trochanter 1.20–1.21 × as long as deep, femur 4.17–4.22 × as long as deep and 1.72–1.75 × as long as patella, patella 2.90–2.93 × as long as deep, tibia 3.63–3.65 × as long as deep, tarsus 9.33–9.40 × as long as deep. Leg IV: trochanter 1.56–1.58 × as long as deep, femur+patella 3.14–3.20 × as long as deep, femur shorter than patella, tibia 5.18–5.23 × as long as deep, metatarsus 3.25–3.29 × as long as deep, tarsus 9.67–9.70 × as long as deep. Metatarsus with 1 tactile seta (sub-basal, TS = 0.21), tarsus with 2 tactile setae (sub-basal, TS = 0.19; subterminal, TS = 0.17). Arolia shorter than claws, latter slender and smooth.

Adult female

Mostly the same as the holotype.

Carapace. 0.80–0.85 × as long as broad.

Pedipalp. Trochanter 1.20–1.24 × as long as broad, femur 4.95–4.98 × as long as broad, patella 2.00–2.07 × as long as broad, femur 2.48–2.51 × as long as patella. Chela 4.44–4.50 × as long as broad, hand 1.62–1.65 × as long as broad; movable finger 1.76–1.81 × as long as hand.

Abdomen. Tergal chaetotaxy (I–XII): 4: 6: 7: 11: 11: 11: 12: 14: 9: 6: 2: 0; sternal chaetotaxy (IV–XII): 18: 17: 16: 16: 14: 12: 8: 0: 2. Genital opening slit-like, anterior genital operculum with 10 setae, without lyrifissures (Fig. 1L).

Dimensions (length/width or, in the case of the legs, length/depth in mm). Males (females in parentheses). Body length 2.72–2.81 (2.81–2.93). Carapace 0.48–0.51/0.59–0.61 (0.53–0.58/0.66–0.70). Pedipalp: trochanter 0.25–0.26/0.17–0.18 (0.24–0.26/0.20–0.22), femur 0.89–0.92/0.16–0.19 (0.99–1.01/0.20–0.21), patella 0.35–0.37/0.16–0.18 (0.40–0.44/0.20–0.21), hand 0.46–0.48/0.27–0.28 (0.55–0.59/0.34–0.36), length of movable chelal finger 0.82–0.84 (0.97–0.99), chela 1.29–1.31/0.27–0.28 (1.51–1.54/0.34–0.36). Leg I: trochanter 0.18–0.19/0.15–0.17 (0.22–0.24/0.19–0.20), femur 0.50–0.54/0.12–0.13 (0.55–0.57/0.11–0.12), patella 0.29–0.31/0.10–0.11 (0.34–0.37/0.10–0.11), tibia 0.29–0.31/0.08–0.10 (0.32–0.34/0.08–0.09), tarsus 0.56–0.58/0.06–0.07 (0.62–0.65/0.07–0.08).

Leg IV: trochanter 0.25–0.28/0.16–0.18 (0.20–0.22/0.18–0.19), femur+patella 0.69–0.72/0.22–0.23 (0.78–0.82/0.24–0.26), tibia 0.57–0.59/0.11–0.12 (0.66–0.69/0.12–0.13), metatarsus 0.26–0.28/0.08–0.09 (0.29–0.31/0.10–0.11), tarsus 0.58–0.61/0.06–0.07 (0.67–0.69/0.07–0.08).

Distribution

China (Yunnan).

Habitat

The cave was 10–80 m high, 300 m long and 50–200 m wide. The new species were collected from under the wet and dimly lit gravel 10–50 m away from the cave entrance. In addition, some spiders and Carabidae were also collected in the area.

Allochthonius xuae sp. nov.
urn:lsid:zoobank.org:act:C70C86D8-8E61-4684-AEE2-DA6EBE7D5171
Figs 2, 4C–D

Diagnosis

Differs from the other members of the genus *Allochthonius* by the following combination of characters: cheliceral hand with 7 setae, fixed cheliceral finger with large subapical tooth, rallum with 11 blades (each with fine barbules, the basal-most blade shorter than the others); coxae I with 8 tridentate blades, each blade with a central spine terminally distinctly expanded as fan-shaped, all situated on a common tubercle. Pedipalpal femur (♂) 5.21 ×, (♀) 5.59–5.61 × as long as broad, length (♂) 0.99 mm, (♀) 1.23–1.24 mm; chela (♂) 4.81 ×, (♀) 4.20–4.24 × as long as broad, length (♂) 1.49 mm, (♀) 1.72–1.78 mm; ratio movable chelal finger/chelal hand (♂) 1.63 ×, (♀) 1.63–1.65 ×.

Etymology

The specific epithet was given in honour of Mrs Juan Xu, the wife of the author.

Type material

Holotype

CHINA • ♂; Guizhou Province, Dafang County, Wenge Town, Sanhe Village, Yelaoda Cave; 27°10.900′ N, 105°28.278′ E; 1438 m a.s.l.; 23 Apr. 2019; Yun-Chun Li leg.; MCWNU (Ar-Ps-GZ-0056).

Paratypes

CHINA • 5 ♀♀; same collection data as for holotype; MCWNU (Ar-Ps-GZ-0012).

Description

Adult male

Colours. Chelicerae and pedipalps reddish brown, remaining parts brown; carapace, chelicerae and abdomen with dense round white spots.

Carapace (Fig. 2A). 0.87 × as long as broad, scarcely constricted posteriorly, with 4 well-developed eyes; epistome absent, space between median setae slightly recurved. Carapace surface with 5 lyrifissures, near anterior and posterior margins. With 26 setae arranged 10: 4: 6: 2: 4.

Chelicera. Relatively broad. Cuticle of hand gently granulate to squamate. Hand with 7 setae and 3 lyrifissures, all setae acuminate, movable finger with 1 seta in medial position, galea absent. Fixed finger with 4 conspicuous teeth, including 1 large subapical tooth, distinctly larger than others; movable finger with 21–23 teeth (Fig. 2B). Serrula exterior with 23–24 lamellae; serrula interior with 19–20

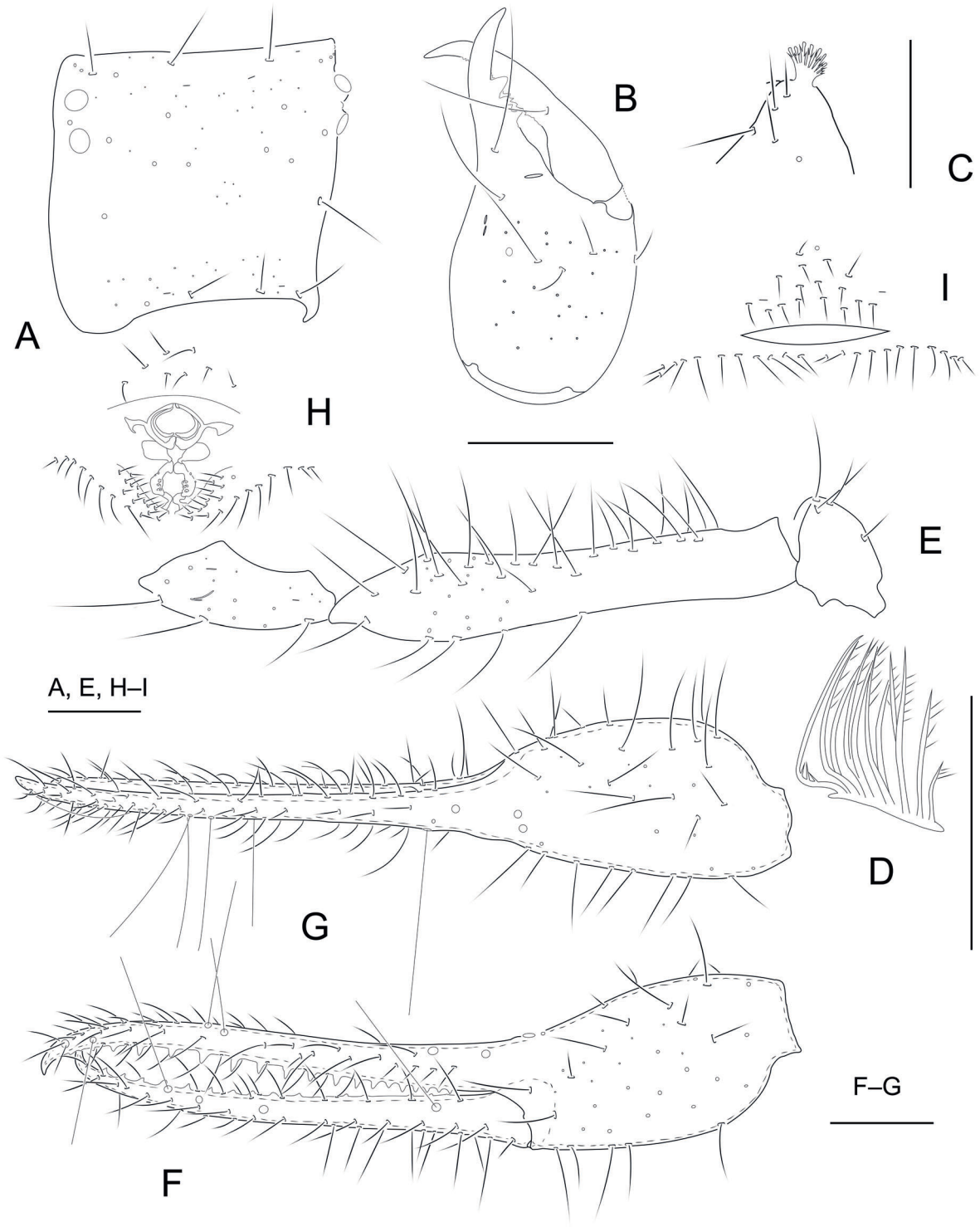

Fig. 2. *Allochthonius xuae* sp. nov. **A–H**. ♂, holotype (MCWNU (Ar-Ps-GZ-0056)). **I**. ♀, paratype (MCWNU (Ar-Ps-GZ-0012)). **A**. Carapace. **B**. Right chelicera. **C**. Coxal spines. **D**. Rallum of left chelicera. **E**. Left pedipalp (minus chela). **F**. Chela, retrolateral view. **G**. Chela, dorsal view. **H**. Male genital area. **I**. Female genital area. Scale bars = 0.20 mm.

lamellae. Rallum composed of 11 blades with fine barbules, the apical-most one with 3 small branches at bend and basal-most 1 distinctly shorter than others (Fig. 2D).

Pedipalp (Fig. 2E–G). All setae acuminate. Trochanter 1.47 ×, femur 5.21 ×, patella 2.47 × as long as broad, femur 2.36 × as long as patella. Chela 4.81 ×, hand 1.81 × as long as broad; movable chelal finger 1.63 × as long as hand. Fixed finger with 20 acute teeth, which middle ones larger than that in both ends; movable finger with 16 teeth, tubercle between 8 and 9. Fixed chelal finger with 8 trichobothria and movable finger with 4, *eb*, *esb*, *ib*, *isb*, and *ist* located basally of fixed finger and 2 special sensory hairs (*xs*) near the fingertip; on movable finger, *st* subproximal and in medial position on finger, triplet *sb*, *b*, and *t* distomedial to distal, distance between *sb* and *b* distinctly longer than distance between *b* and *t*.

Abdomen. Tergal chaetotaxy (I–XII): 4: 5: 7: 7: 8: 11: 11: 12: 10: 8: 2: 0; sternal chaetotaxy (IV–XII): 17: 16: 15: 16: 16: 12: 12: 0: 2. Manducatory process with 2 setae. Pedipalpal coxa with 3 setae, coxa I 5–6, II 5, III 7, IV 7 setae; intercoxal tubercle present with 2 setae. Coxal blades only present on coxa I, with spray of 8 clavate blades (Fig. 2C). Anterior genital operculum with 8 setae, without lyrifissures; genital opening with 14 setae on the right side, and 12 on the left (Fig. 2H).

Legs. Leg I: trochanter 1.16 × as long as deep, femur 5.09 × as long as deep and 1.60 × as long as patella, patella 3.50 × as long as deep, tibia 4.57 × as long as deep, tarsus 9.43 × as long as deep. Leg IV: trochanter 0.90 × as long as deep, femur + patella 3.28 × as long as deep, femur shorter than patella, tibia 4.86 × as long as deep, metatarsus 3.67 × as long as deep, tarsus 11.33 × as long as deep. Metatarsus with 1 tactile seta (sub-basal, TS = 0.28), tarsus with 2 tactile setae (sub-basal, TS = 0.29; subterminal, TS = 0.20). Arolia shorter than claws, latter slender and smooth.

Adult female

Mostly the same as the holotype.

Carapace. 0.83–0.87 × as long as broad.

Pedipalp. Trochanter 1.43–1.44 × as long as broad, femur 5.59–5.61 × as long as broad, patella 2.23–2.25 × as long as broad, femur 2.51–2.54 × as long as patella. Chela 4.20–4.24 × as long as broad, hand 1.59–1.62 × as long as broad; movable finger 1.63–1.65 × as long as hand.

Abdomen. Tergal chaetotaxy (I–XII): 4: 5: 7: 9: 11: 11: 10: 14: 11: 10: 2: 0; sternal chaetotaxy (IV–XII): 18: 18: 16: 15: 16: 14: 12: 0: 2. Genital opening slit-like, anterior genital operculum with 17 setae, with 2 lyrifissures (Fig. 2I).

Dimensions (length/width or, in the case of the legs, length/depth in mm). Male (females in parentheses): body length 2.92 (3.70–3.77). Carapace 0.52/0.60 (0.58–0.61/0.70–0.72). Pedipalp: trochanter 0.22/0.15 (0.30–0.32/0.21–0.23), femur 0.99/0.19 (1.23–1.24/0.22–0.23), patella 0.42/0.17 (0.49–0.51/0.22–0.23), hand 0.56/0.31 (0.65–0.67/0.41–0.44), length of movable chelal finger 0.91 (1.06–1.10), chela 1.49/0.31 (1.72–1.78/0.41–0.44). Leg I: trochanter 0.22/0.19 (0.20–0.22/0.16–0.18), femur 0.56/0.11 (0.64–0.67/0.13–0.14), patella 0.35/0.10 (0.41–0.44/0.12–0.13), tibia 0.32/0.07 (0.39–0.41/0.09–0.10), tarsus 0.66/0.07 (0.73–0.75/0.08–0.09). Leg IV: trochanter 0.19/0.21 (0.32–0.34/0.25–0.26), femur + patella 0.82/0.25 (0.91–0.95/0.31–0.33), tibia 0.68/0.14 (0.76–0.79/0.17–0.19), metatarsus 0.33/0.09 (0.37–0.39/0.11–0.12), tarsus 0.68/0.06 (0. 69–0.70/0.08–0.09).

Distribution

China (Guizhou).

Habitat

The cave was about 20–200 m high, the length was unknown, and the width was about 50–200 m. The new species were collected from under wet, dimly lit rubble about 100 m from the cave entrance. The surrounding herbs were abundant, and some spiders, millipedes and Carabidae were also collected.

Genus *Spelaeochthonius* Morikawa, 1954

Spelaeochthonius yinae sp. nov.
urn:lsid:zoobank.org:act:022ECCAC-A3CD-4BD4-876D-3167FD2CF413
Figs 3, 5A–B

Diagnosis

Differs from the other members of the genus *Spelaeochthonius* by the following combination of characters: carapace without eyes or eyespots, anterior margin with 6 setae, posterior margin with 2 setae (male 15 setae, female 16 setae); epistome present, composed of 6 teeth, heavily sclerotised; cheliceral hand with 5 lyrifissures, fixed cheliceral finger with large subapical tooth, rallum with 11 blades; and male coxae I with 7 coxal blades, female with 8 coxal blades, each terminally trifurcate blades; fixed chelal finger with 23 acute teeth, movable chelal finger with 14 teeth. Tergite I–II each with 2 setae. Pedipalpal femur (♂) 7.65 ×, (♀) 7.26 × as long as broad, length (♂) 1.30 mm, (♀) 1.38 mm; chela (♂) 5.93 ×, (♀) 6.30 × as long as broad, length (♂) 1.72 mm, (♀) 1.89 mm; ratio movable chelal finger/chelal hand (♂) 1.36 ×, (♀) 1.40 ×.

Etymology

The specific epithet was given in honour of Mrs Hao-Min Yin due to the assistance provided during fieldwork.

Type material

Holotype

CHINA • ♂; Yunnan Province, Zhaotong City, Doushaguan Town, Xiao Cave; 28°02.405′ N, 104°06.845′ E; 708 m a.s.l.; 11 Apr. 2017; Yun-Chun Li leg.; MCWNU (Ar-Ps-YN-0081).

Paratype

CHINA • 1 ♀; same collection data as for holotype; MCWNU (Ar-Ps-YN-0008).

Description

Adult male

Colours. Chelicerae, pedipalps, and legs reddish brown, remaining parts yellow brown.

Carapace (Fig. 3A–B). Subquadrate, 0.90 × as long as broad, without furrows; lateral margins constricted posteriorly, eyes absent but eye region bulging and convex in dorsal view; epistome present, composed of 6 teeth, heavily sclerotised. With 15 setae arranged 6: 2: 3: 2: 2.

Chelicera. Relatively broad. Cuticle of hand gently granulate to squamate. Hand with 6 setae and 5 lyrifissures, all setae acuminate, movable finger with 1 seta in medial position, galea present as a very low mound. Fixed finger with 1 medium-sized distal tooth and 11 progressively smaller proximal teeth; movable finger with 12 teeth (Fig. 3C). Serrula exterior with 22 lamellae; serrula interior with 18 lamellae. Rallum composed of 11 blades with fine barbules, basal-most 1 distinctly shorter than others (Fig. 3E).

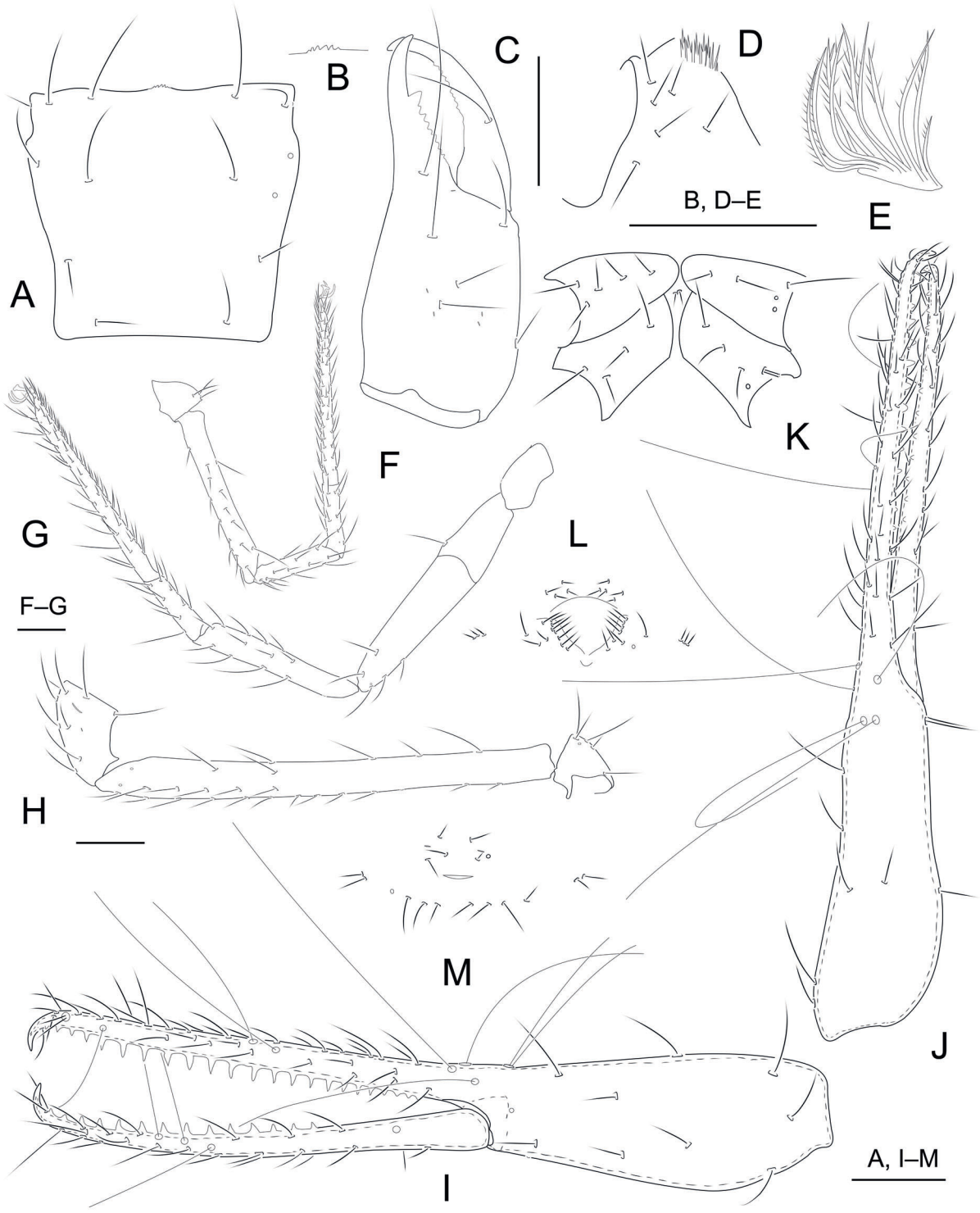

Fig. 3. *Spelaeochthonius yinae* sp. nov. **A–L**. ♂, holotype (MCWNU (Ar-Ps-YN-0081)). **M**. ♀, paratype (MCWNU (Ar-Ps-YN-0008)). **A**. Carapace. **B**. Epistome **C**. Right chelicera. **D**. Coxal spines. **E**. Rallum of left chelicera. **F**. Left leg I, lateral view. **G**. Left leg IV, lateral view. **H**. Left pedipalp (minus chela). **I**. Chela, retrolateral view. **J**. Chela, dorsal view. **K**. Intercoxal tubercle. **L**. Male genital area. **M**. Female genital area. Scale bars = 0.20 mm.

Pedipalp (Fig. 3H–J). All setae acuminate. Hand of chela narrowed at base of fingers. Trochanter 1.56 ×, femur 7.65 ×, patella 2.33 × as long as broad, femur 3.10 × as long as patella. Chela 5.93 ×, hand 2.48 × as long as broad; movable chelal finger 1.36 × as long as hand. Fixed finger with 23 acute teeth, with middle ones larger than that in both ends; movable finger with 14 teeth. Fixed chelal finger with 8 trichobothria and movable finger with 4, *eb*, *esb*, *ib*, *isb*, and *ist* located basally of the fixed finger, *it* and *est* distomedial and forming a pair, *it* slightly more distal than *est*; *et* subdistal and duplex *xs* distal; on movable finger, *st* subproximal and in medial position on finger, triplet *sb*, *b*, and *t* distomedial to distal, distance between *sb* and *b* almost equal to distance between *b* and *t*.

Abdomen. Tergal chaetotaxy (I–XII): 2: 2: 4: 4: 4: 6: 7: 7: 6: 6: 4: 0; sternal chaetotaxy (IV–XII): 13: 11: 10: 11: 10: 12: 10: 0: 2. Manducatory process with 2 setae. Pedipalpal coxa with 3 setae, coxa I 6, II 6,

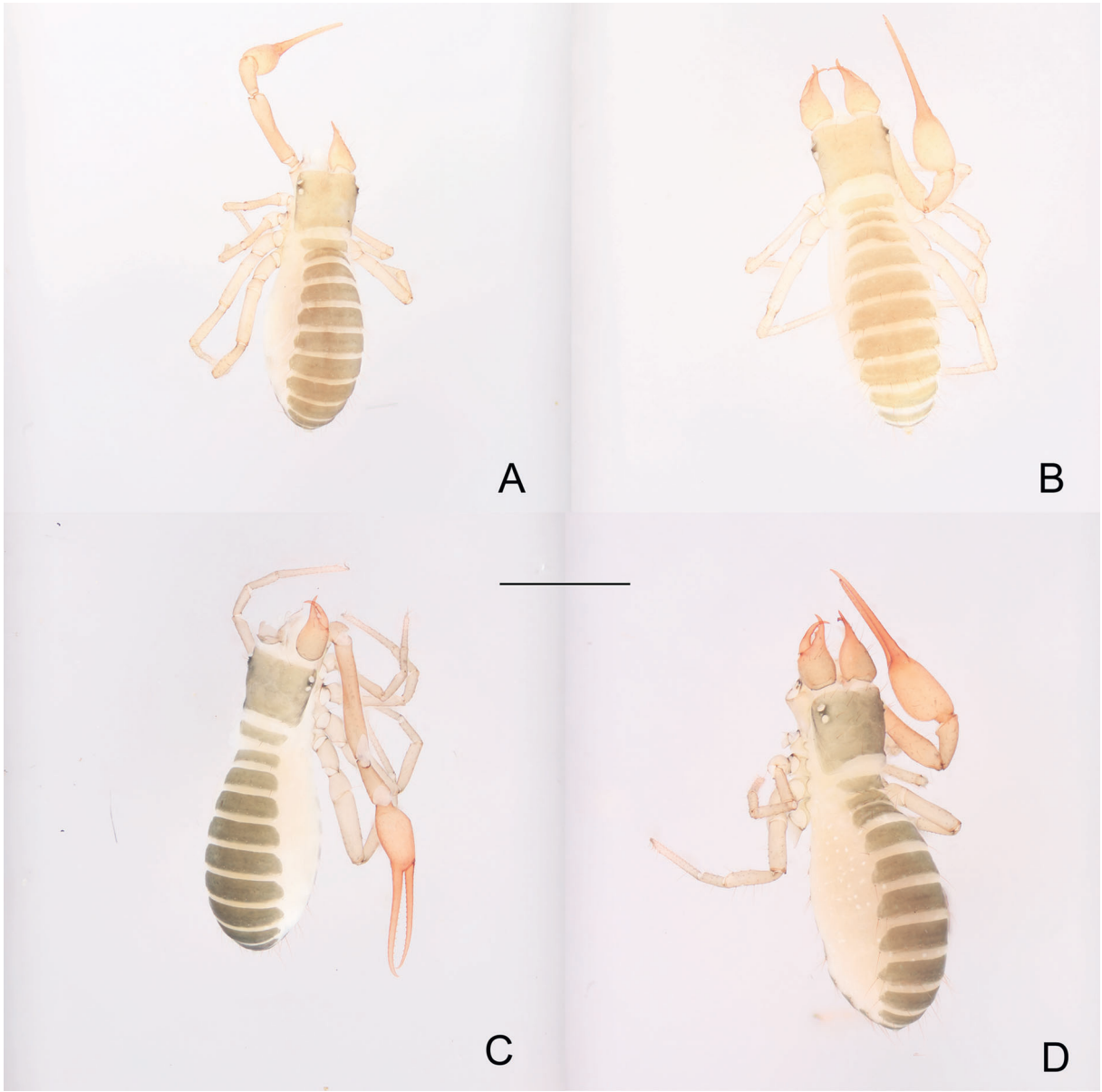

Fig. 4. A–B. *Allochthonius lini* sp. nov., dorsal views. **A**. ♂, holotype (MCWNU (Ar-Ps-YN-0082)). **B**. ♀, paratype (MCWNU (Ar-Ps-YN-0019)). **C–D**. *A. xuae* sp. nov., dorsal views. **C**. ♂, holotype (MCWNU (Ar-Ps-GZ-0056)). **D**. ♀, paratype (MCWNU (Ar-Ps-GZ-0012)). Scale bar = 1.00 mm.

III 5, IV 4–5 setae; intercoxal tubercle present with 2 setae. Coxae I with 7 coxal blades, each terminally trifurcate blades (Fig. 3D). Anterior genital operculum with 9 setae, without lyrifissures; genital opening with 8 setae on the right side and 7 on the left (Fig. 3L).

Legs (Fig. 3F–G). Leg I: trochanter 1.34 × as long as deep, femur 7.40 × as long as deep and 2.00 × as long as patella, patella 4.11 × as long as deep, tibia 4.57 × as long as deep, tarsus 13.00 × as long as deep. Leg IV: trochanter 1.56 × as long as deep, femur+patella 4.62 × as long as deep, femur shorter than patella, tibia 6.55 × as long as deep, metatarsus 3.78 × as long as deep, tarsus 15.00 × as long as deep. Metatarsus with 1 tactile seta (sub-basal, TS = 0.20), tarsus with 1 tactile seta (sub-basal, TS = 0.18). Subterminal tarsal setae not distally serrate, arolium slightly shorter than claws and not divided; all claws simple.

Adult female

Mostly the same as the holotype.

Carapace. 0.97 × as long as broad. With a total of 16 setae, including 6 on the anterior margin and 4 on the posterior margin.

Pedipalp. Trochanter 1.58 × as long as broad, femur 7.26 × as long as broad, patella 2.47 × as long as broad, femur 2.94 × as long as patella. Chela 6.30 × as long as broad, hand 2.5 × as long as broad; movable finger 1.40 × as long as hand.

Abdomen. Tergal chaetotaxy (I–XII): 2: 2: 4: 4: 4: 5: 6: 7: 5: 5: 2: 0; sternal chaetotaxy (IV–XII): 11: 11: 10: 10: 11: 11: 7: 0: 2. Coxae I with 8 coxal blades, each terminally trifurcate blades. Genital opening slit-like, anterior genital operculum with 6 setae, with 2 lyrifissures (Fig. 3M).

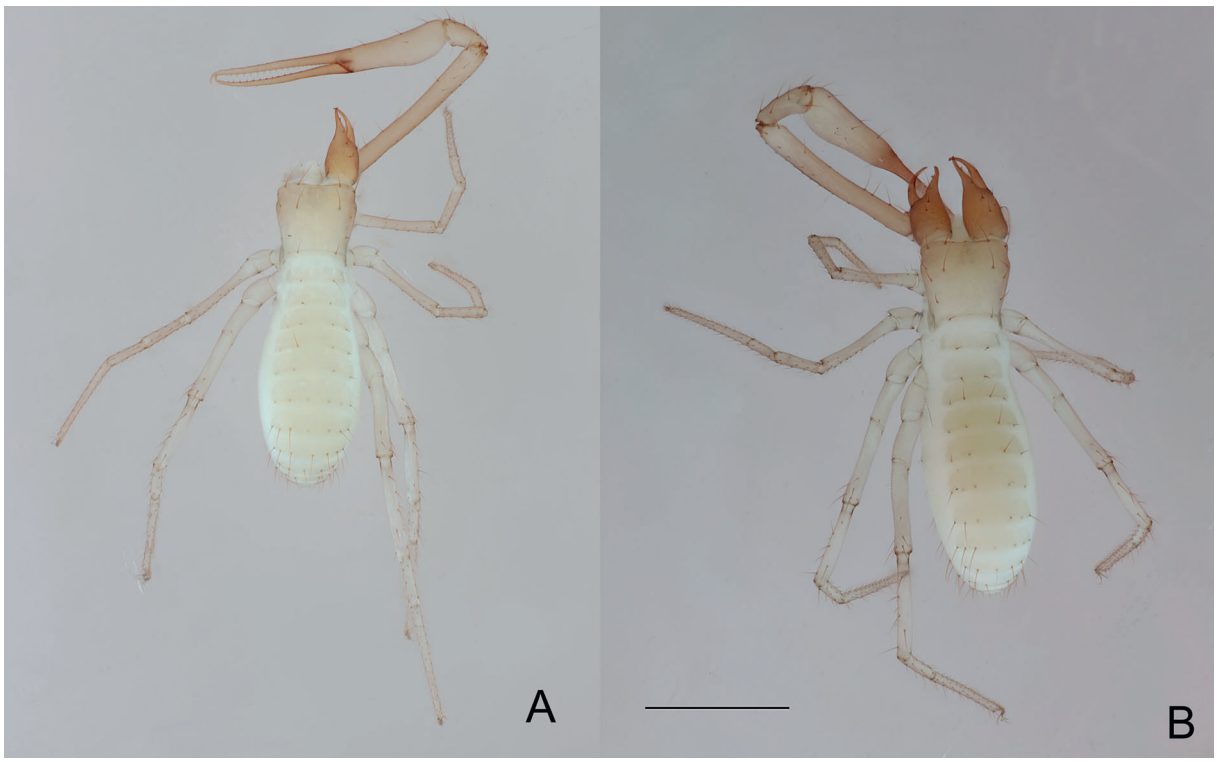

Fig. 5. *Spelaeochthonius yinae* sp. nov., dorsal views. **A**. ♂, holotype (MCWNU (Ar-Ps-YN-0081)). **B**. ♀, paratype (MCWNU (Ar-Ps-YN-0008)). Scale bar = 1.00 mm.

Dimensions (length/width or, in the case of the legs, length/depth in mm). Male (female in parentheses): body length 2.64 (3.06). Carapace 0.53/0.59 (0.61/0.63). Pedipalp: trochanter 0.28/0.18 (0.30/0.19), femur 1.30/0.17 (1.38/0.19), patella 0.42/0.18 (0.47/0.19), hand 0.72/0.29 (0.75/0.30), length of movable chelal finger 0.98 (1.05), chela 1.72/0.29 (1.89/0.30). Leg I: trochanter 0.22/0.16 (0.24/0.18), femur 0.74/0.10 (0.80/0.11), patella 0.37/0.09 (0.42/0.10), tibia 0.32/0.07 (0.35/0.08), tarsus 0.78/0.06 (0.82/0.07). Leg IV: trochanter 0.25/0.16 (0.32/0.17), femur+patella 0.97/0.21 (1.04/0.22), tibia 0.72/0.11 (0.78/0.12), metatarsus 0.34/0.09 (0.38/0.08), tarsus 0.90/0.06 (0.95/0.08).

Distribution

China (Yunnan).

Habitat

The cave was about 5–20 m high, 15–80 m wide, and its length was unknown. The new species were collected from under damp, shaded gravel about 80 m from the cave entrance. At the same time, some species of spiders, millipedes and neobisiid pseudoscorpions were also collected.

Identification key to the family of Pseudotyrannochthoniidae from China

1. Coxal spines on a common protuberance 2
– Coxal spines never on a common protuberance 12

2. Carapace with eyes 3
– Carapace without eyes or eyespots ..... ***Allochthonius brevitus*** Hu & Zhang, 2012

3. Carapace anterior margin with 8 setae 4
– Carapace anterior margin with 10 setae 7

4. Rallum with 11 pinnate blades 5
– Rallum only with 8 pinnate blades ..... ***Allochthonius sichuanensis*** (Schawaller, 1995)

5. Carapace without lyrifissures; movable chelicera finger most with 14 conspicuous teeth 6
– Carapace with 2 pairs of lyrifissures; movable chelicera finger with 20 conspicuous teeth ..... ***Allochthonius fanjingshan*** Gao, Zhang & Zhang, 2016

6. Fixed chelicera finger with 6 teeth; palpal femur 5.30–5.50 × as long as broad (length 1.05–1.22 mm) ..... ***Allochthonius fuscus*** Hu & Zhang, 2011
– Fixed chelicera finger with 5 teeth; palpal femur 6.10–7.20 × as long as broad (length 1.36–1.40 mm) ..... ***Allochthonius wui*** Hu & Zhang, 2011

7. Carapace anterior margin without protuberances 8
– Carapace anterior margin with 27 triangular protuberances ..... ***Allochthonius trigonus*** Hu & Zhang, 2011

8. Chelicera hand with 6 setae 9
– Chelicera hand with 7 setae 11

9. Rallum with 10 pinnate blades 10
– Rallum with 12 pinnate blades ..... ***Allochthonius liaoningensis*** Hu & Zhang, 2012

10. Fixed chelicera finger with 5–6 teeth; coxal spine with a spray of 4–5 clavate blades ..... ***Allochthonius jingyuanus*** Zhang & Zhang, 2014
– Fixed chelicera finger with 4 teeth; coxal spine with a spray of 7–8 clavate blades ..... ***Allochthonius exornatus*** Gao & Zhang, 2013

11. Fixed finger with 5 teeth; rallum; the apical-most one without small branches at the bend.....***Allochthonius lini*** sp. nov.
– Fixed finger with 4 teeth; rallum; the apical-most one with 3 small branches at the bend..... ***Allochthonius xuae*** sp. nov.

12. Carapace with eyes; coxal spine with a spray of 4–5 clavate blades..... 13
– Carapace without eyes or eyespots; coxal spine with a spray of 7–8 clavate blades .....
..... ***Spelaeochthonius yinae*** sp. nov.

13. Carapace with three pairs of lyrifissures; female chela length 1.21 mm .....
..... ***Centrochthonius cheni*** (Gao, Zhang & Zhang, 2016)
– Carapace without lyrifissures; female chela length 1.71 mm .....
.....***Centrochthonius kozlovi*** (Redikorzev, 1918)

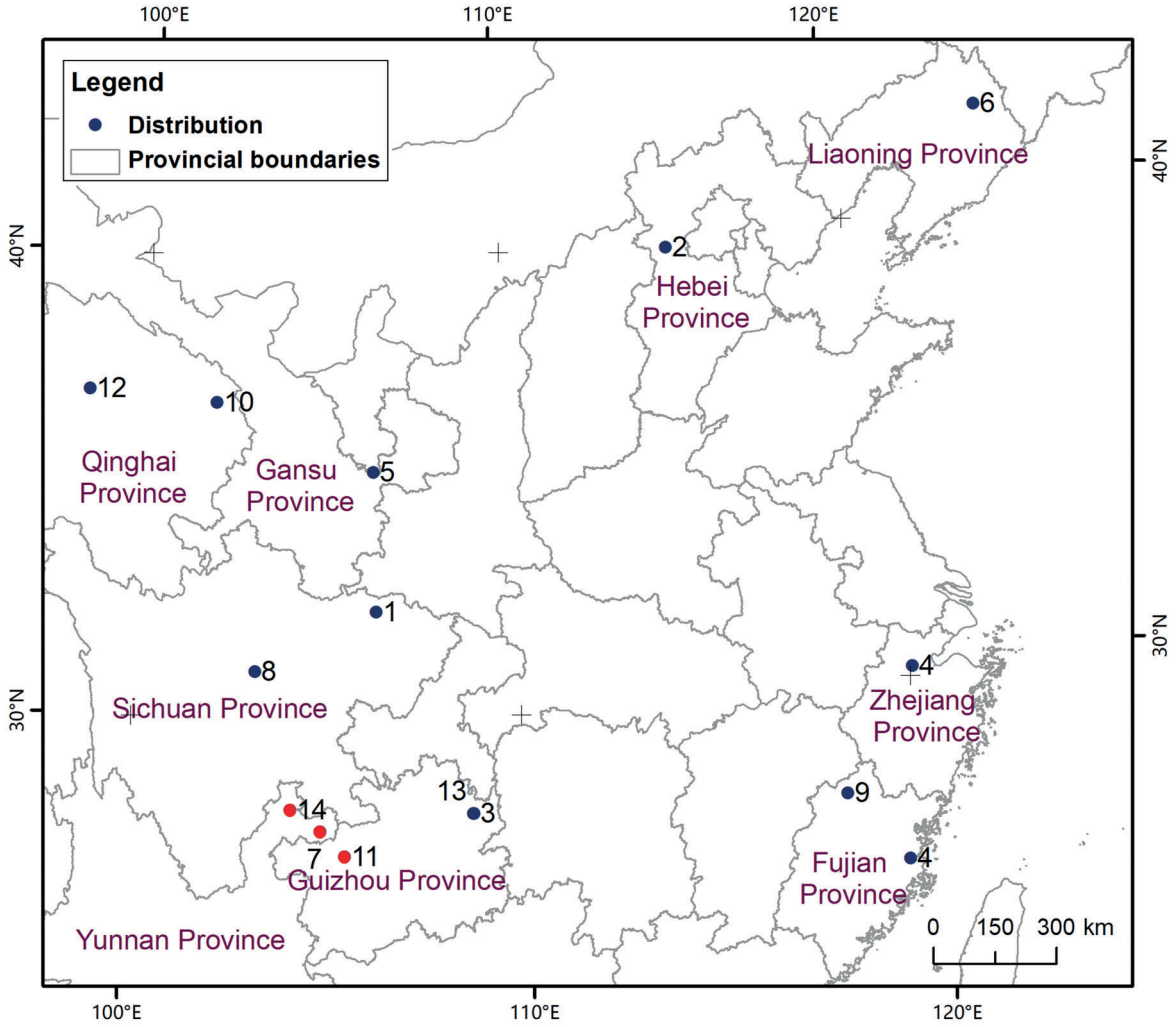

Fig. 6. The known distribution of Pseudotyrannochthoniidae from China. **1**. *Allochthonius brevitus* Hu & Zhang, 2012. **2**. *A. exornatus* Gao & Zhang, 2013. **3**. *A. fanjingshan* Gao, Zhang & Zhang, 2016. **4**. *A. fuscus* Hu & Zhang, 2011. **5**. *A. jingyuanus* Zhang & Zhang, 2014. **6**. *A. liaoningensis* Hu & Zhang, 2012. **7**. *A. lini* sp. nov. **8**. *A. sichuanensis* (Schawaller, 1995). **9**. *A. trigonus* Hu & Zhang, 2011. **10**. *A. wui* Hu & Zhang, 2011. **11**. *A. xuae* sp. nov. **12**. *Centrochthonius kozlovi* (Redikorzev, 1918). **13**. *C. cheni* (Gao, Zhang & Zhang, 2016). **14**. *S. yinae* sp. nov.

Discussion

There are 14 known species of this family in China, including 3 new species (Fig. 6). The genus *Allochthonius* is present in China, with all currently known species being soil-dwelling (Hu & Zhang 2011, 2012; Gao & Zhang 2013; Zhang & Zhang 2014; Gao *et al.* 2016). Only one species (*A. brevitus* Hu & Zhang, 2012), from Liupan Mountain in Ningxia, completely lacked eyes, while the others all had four more developed eyes. The two new species collected inside the cave still have well-developed eyes and are troglophiles. Regrettably, due to the excessive focus on the inside of the cave, the collection of species in the leaf litter under the bushes outside of the cave was neglected, making it unclear whether the species were also distributed in the litter outside the cave. As revealed by Harms (2018) and Harms *et al.* (2019) using molecular techniques and established niche models, species in this family shrink towards places with high rainfall. In recent years, the climate in the areas where the species were collected has changed greatly, and droughts have occurred frequently. Whether this is the reason for the collection of these species inside the cave needs to be further confirmed.

Spelaeochthonius yinae sp. nov. is the first record of this genus in China. All known species are troglobites, and the eyes have been completely degraded. In addition to the species in China, there are nine other species in this genus: *S. cheonsooi* You, Yoo, Harvey & Harms, 2022 described from 'Sinryeong Cave' (South Korea), *S. dentifer* (Morikawa, 1970) described from 'Yong'yeon-gul Cave' (South Korea), *S. seungsookae* You, Yoo, Harvey & Harms, 2022 described from 'Hogye Cave' (South Korea), *S. akiyoshiensis* Morikawa, 1956 described from 'Tanuki-ana Cave' (Japan), *S. dorogawaensis* Morikawa, 1956 described from 'Menfudô-no-iwaya Cave' (Japan), *S. kobayashii* Morikawa, 1956 described from 'Samé-no-kômori-ana Cave' (Japan), *S. kishidai* (Morikawa, 1960) described from 'Kurasawa-do Cave' (Japan), *S. undecimclavatus* Morikawa, 1956 described from 'Kwannoniwa-no-ana Cave' (Japan), *S. kubotai* (Morikawa, 1954) described from 'Kwannoniwa-no-ana Cave' (Japan) (Morikawa 1954; You *et al.* 2022). However, compared with the above, the biggest difference is that the tergite II of the new species has only two setae, while all other known species have four. In addition to the above-mentioned characteristics, the biggest difference between the new species and other species is that the near-middle of the new species' chelal hand is curved inward in an arc shape, and the chelal hand is relatively slender. Therefore, the new species can be easily distinguished from known species. The known species are all from Japan and Korea, and the discovery in China suggests that the genus may have a larger distribution area, which remains to be investigated.

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