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RESEARCH ARTICLE - ANTS

A New Species of the Ant Genus *Leptanilla* Emery, 1870 (Hymenoptera: Formicidae) from Sichuan Province, China

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Abstract

A new species of *Leptanilla* Emery, *L. sichuanensis* sp. nov., is described based on the worker caste from Sichuan, China. This new species is highly similar to *L. macauensis* Leong, Yamane & Guénard, sharing a conspicuous and strong central clypeal protuberance and clypeal lobes, along with a microspine-like subpetiolar process. The following characteristics of *L. sichuanensis* sp. nov. serve to distinguish it from the species: anteromedial circular disc of clypeal protuberance does not present a pair of triangular extensions on its medial margin, and instead has a complete curve; head and antennal scape longer in comparison (CI 67–70, SI 63–66); inferolateral margin of antennal toruli stretched angularly. An illustrated identification key for the Chinese *Leptanilla* based on the worker caste is provided.

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Introduction

The genus *Leptanilla* is a rare group of ants that inhabit subterranean habitats. The genus was first established by Emery (1870) from the type species *L. revelierii* and initially classified within the subfamily Dorylinae, which was subsequently separated into the subfamily Leptanillinae by Wheeler (1923). Phylogenetically, the genus is sister to the genus Yavnella Kugler (Griebenow, 2020), but the evolutionary relationship between its subfamily Leptanillinae and other ants remains controversial. Recent studies suggest that Leptanillinae may be the sister group of all ants (Cai, 2024). Typically, *Leptanilla* species have small colonies of only 100 to 200 workers and may exclusively feed on geophilomorph centipedes (Masuko, 1990). The genus comprises 61 valid species, none represented by fossil species (Bolton, 2024). These species are distributed across Asia, Australia, Africa, and Europe (AntWiki, 2024). Of these, the only species for which both the worker caste (Baroni Urbani, 1977) and the male caste (Ogata et al., 1995) are known is *L. japonica* Baroni Urbani, 1977. In contrast, the remaining species are taxonomically isolated, i.e., only males or only workers are known (some species are also known as the queen caste, but it is still isolated). Among the species of known workers, they are usually relatively easy to distinguish and identify, and the taxonomic keys have been continually updated (Morisita et al., 1989; Bharti & Kumar, 2012; Leong et al., 2018; Saroj et al., 2022; Griebenow, 2024; Qian et al., 2024). A recent revision of the subfamily Leptanillinae by Griebenow (2024) provides diagnoses for males and workers. He added a new Chinese species, *L. bethyloides*, based on the male caste, but the taxonomic communication of males and workers was still lacking.

In China, the first record of the genus and the first new species, *L. hunanensis*, were recorded and described by Tang et al. (1992). The second species, *L. taiwanensis,* was described by Ogata et al. (1995) from Taiwan and is based on worker and queen castes. Xu (2002) conducted a comprehensive

study of the subfamily Leptanillinae and provided a key for Chinese *Leptanilla* species, which described a new species, *L. yunnanensis*. Leong et al. (2018) described a species from Macao, *L. macauensis,* and updated the key for the Oriental and Sino-Japanese regions. Griebenow (2024) described a male-based species, *L. bethyloides*, and provided keys for each species group. Qian et al. (2024) described three new species, *L. beijingensis*, *L. dehongensis*, and *L. qinlingensis*, and provided a worker-based key to the world.

This article describes a new species, *L. sichuanensis* sp. nov., from Sichuan, China. An illustrated identification key for the Chinese *Leptanilla* based on the worker caste is provided.

Materials and methods

The examined specimens were collected from Dazhou City, Sichuan Province, China. The type specimens are deposited at Southwest Forestry University (SWFU), Kunming City, Yunnan Province, China.

All specimens were examined and identified using a Phenix XSP-02 microscope, and multi-focused montage photographs were taken using a telephoto camera of Samsung SM-N9860 (Fig 1, 2B). The montage photographs were processed and stacked using Adobe Photoshop and Helicon Focus software, with each stacked photo focused in a different position. Scanning electron microscope (SEM) photographs were taken using a FEI Quanta 450 field emission SEM at 12.5 kV (Fig 3A) and a JEOL JCM-6000 versatile benchtop SEM at 10 kV (Figs 2A, 3B). Specimens were measured using HAYEAR software with a Hayear HY-800B digital camera and a Hayear 0745 lens, with results being accurate to 0.001 mm.

Morphological descriptions of workers mainly follow the terminology of Hölldobler & Wilson (1990) and Bolton (1994). Measurements were standardized by Leong et al. (2018) and are described as follows, all measurements are in millimeters (mm):

HL Head length, the maximum length of head in full-face view, measured from midpoint of anterior clypeal margin to midpoint of line across the posteriormost points of head.

HW Head width measures the maximum width of head in full-face view.

SL Scape length and maximum length of scape were measured, excluding the basal neck and condyle.

PnW Pronotal width, maximum width of pronotum in dorsal view.

WL Weber's mesosomal length (= AL, alitrunk length), measured from the point between cervical shield and pronotum to posteroventral point of metapleuron.

PtL Petiolar length, measured the maximum length of petiole from dorsal view.

PtW Petiolar width, measured the maximum width of petiole from dorsal view.

PtH Petiolar height, measured the maximum height of petiole from dorsalmost point of node to ventralmost point of sternite in lateral view.

PpL Postpetiolar length, measures the maximum length of postpetiole from dorsal view (excluding helcium).

PpW Postpetiolar width, measure the maximum width of postpetiole from dorsal view.

PpH Postpetiolar height, measured the maximum height of postpetiole from dorsalmost point of node to ventralmost point of sternite in lateral view.

CI Cephalic index, HW/HL × 100.

SI Scape index, SL/HW × 100.

PI Petiolar index, PtW/PtL × 100.

PHI Petiolar height index, PtW/PtH × 100.

PPI Postpetiolar index, PpW/PpL × 100.

PPHI Postpetiolar height index, PpW/PpH × 100.

WI Waist index, PpW/PtW × 100.

Systematics

List of Chinese *Leptanilla* species

L. beijingensis Qian et al., 2024 [Type location: CHINA (Beijing). Palearctic]

L. bethyloides Griebenow, 2024 [Type location: CHINA (Hong Kong). Indomalaya]

L. dehongensis Qian et al., 2024 [Type location: CHINA (Yunnan). Indomalaya]

L. hunanensis Tang et al., 1992 [Type location: CHINA (Hunan). Indomalaya]

L. kunmingensis Xu & Zhang, 2002 [Type location: CHINA (Yunnan). Indomalaya]

L. macauensis Leong et al., 2018 [Type location: CHINA (Macau). Indomalaya]

L. qinlingensis Qian et al., 2024 [Type location: CHINA (Shaanxi). Palearctic]

L. sichuanensis sp. nov. [Type location: CHINA (Sichuan). Palearctic]

L. taiwanensis Ogata et al., 1995 [Type location: CHINA (Taiwan). Indomalaya]

L. yunnanensis Xu, 2002 [Type location: CHINA (Yunnan). Indomalaya]

Leptanilla sichuanensis sp. nov Zhong - Figs 1-3

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Type material. Holotype. **CHINA:** 1 worker (A23-1643), Sichuan Province, Dazhou City, Kaijiang County, Hanlin Village, Tianwan, 31°13'12''N, 107° 55'48''E, ca. 1000m alt., 30.VI.2023, Gui-Chuan Nie leg. (SWFU). Paratypes: 19 workers, same data as holotype.

Other material examined. CHINA: 4 workers and 1 queen (A22-1020), Sichuan Province, Dazhou City, Kaijiang County, Guanyinqiao Village, Zhengjiaba, 31°10'28''N, 107°56'47''E, ca. 500m alt., 8.VI.2022, Gui-Chuan Nie leg. (SWFU).

Measurements and descriptions. Holotype worker. HL 0.28, HW 0.19, SL 0.12, PnW 0.13, WL 0.35, PtL 0.09,

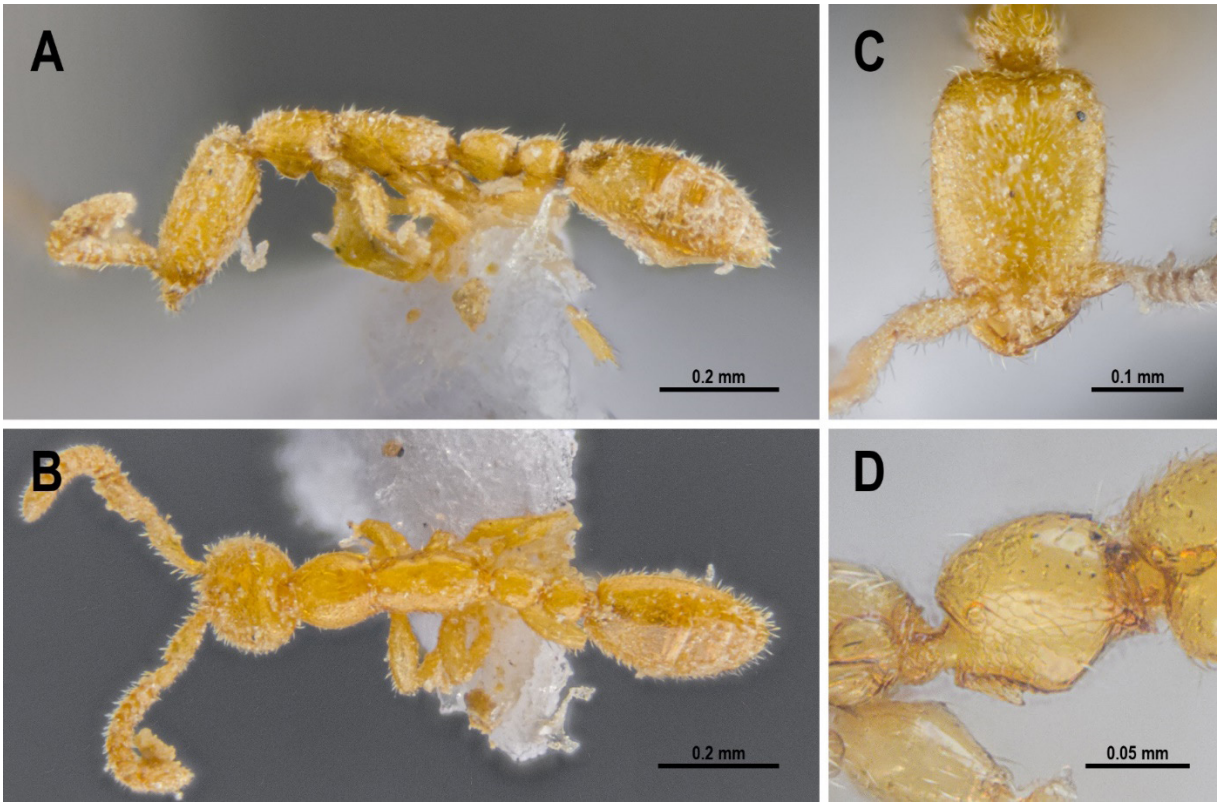

Fig 1. *Leptanilla sichuanensis* sp. nov., workers: A - holotype (A23-1643), body in lateral view; B - same, body in dorsal view; C - same, head in full-face view; D - paratype (damaged), petiole in lateral view.

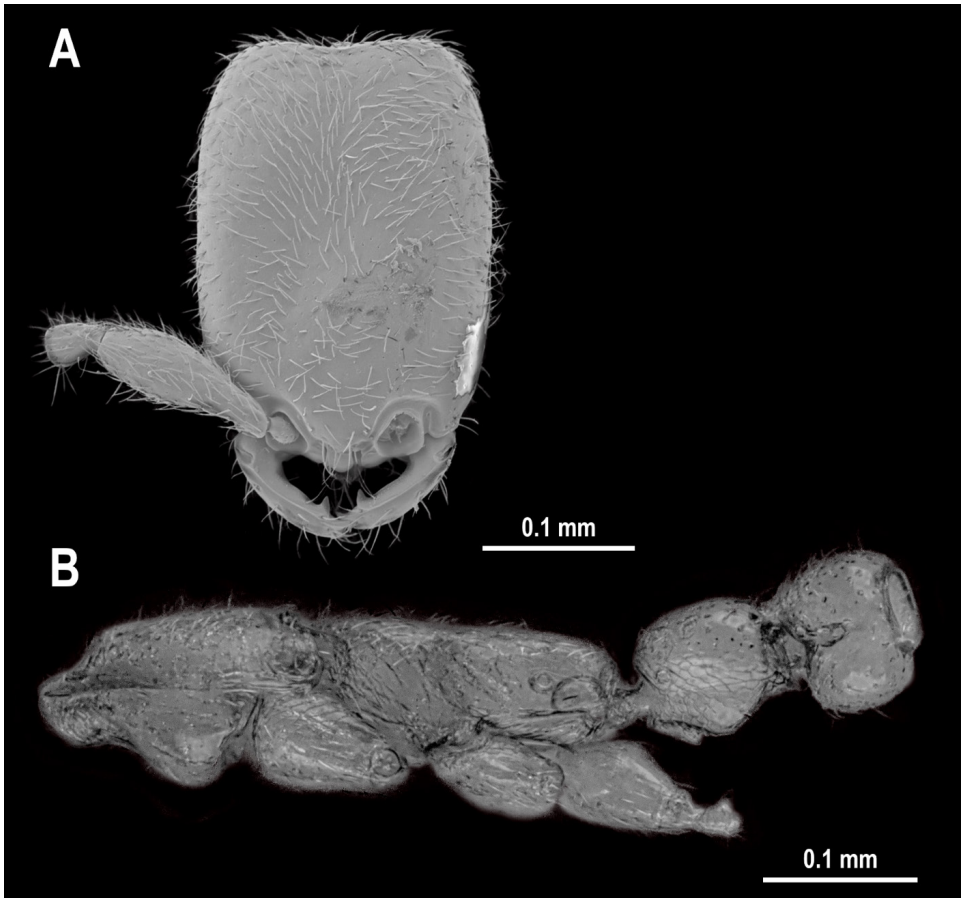

Fig 2. *Leptanilla sichuanensis* sp. nov. (worker): A - SEM of head in full view; B - body in lateral view.

PtW 0.07, PtH 0.09, PpL 0.07, PpW 0.08, PpH 0.10, CI 70, SI 63, PI 78, PHI 80, PPI 108, PPHI 81, WI 112. Paratype workers (n = 3). HL 0.27–0.28, HW 0.19, SL 0.12, PnW 0.12–0.14, WL 0.34, PtL 0.09, PtW 0.07, PtH 0.08–0.09, PpL 0.07–0.08, PpW 0.07–0.10, PpH 0.09–0.11, CI 67–70, SI 63–66, PI 73–78, PHI 74–82, PPI 104–119, PPHI 80–90, WI 110–136.

Workers. Head. Subrectangular in full-face view about 1.5 times as long as width, slightly convex laterally, posterior margin concave, central point of concavity forming an angle ca. 160° with cephalic occipital corners. Eyes absent. Clypeus confluent with frons; not clearly demarcated. Anterior margin of clypeus with trilobate prominences, central disc-shaped, most prominent, distinctly broader than base with rounded anterior margin and sides, surface without any appendages; lateral prominences derived from antennal toruli forward towards centrum, subtriangular, with a strong notch between central protuberance. Antennal toruli widened and placed quite anteriorly, ventral side distinctly elongated forward over upper side, both ventral sides prolonged outward, slightly lobular, conspicuous, and distinctive. Anterior tentorial pits placed posterosuperior to antennal toruli, rounded. Antennae 12-segmented; scape rather short, fusiform, middle widest, only touching the mid-length of head; funicular first segment (pedicel) triangular-conical, strongly converging basally; second segment goblet-shaped, strongly converging basally and slightly elongated; remaining segments extremely short, bucket-shaped, distinctly broader than long; but twelfth segment almost twice as long as wide. Mandible slender, surface with distinct transverse groove, masticatory margin tri-toothed and arranged in triplicate; basal tooth small but sharp (apical angle 40° – 45°), inwardly directed (dental posterior margin angle with mandible ca. 85°); anterior tooth broader and vertically directed (apical angle ca. 70°); apical tooth very sharp and massive (apical angle ca. 30°).

Mesosoma. In lateral view, flattened overall, dorsum flat but interrupted by conspicuous propodeal suture, metanotal groove fused and invisible; pronotum long and flattened, dorsum slightly convex; propleuron large, posterior portion distinctly protruding downward, as high as pronotum, ventral surface rounded; mesopleuron with slight cleavage groove with propodeum, but disappearing and fusing dorsally; propodeum narrow and slightly flattened, with a short declivity

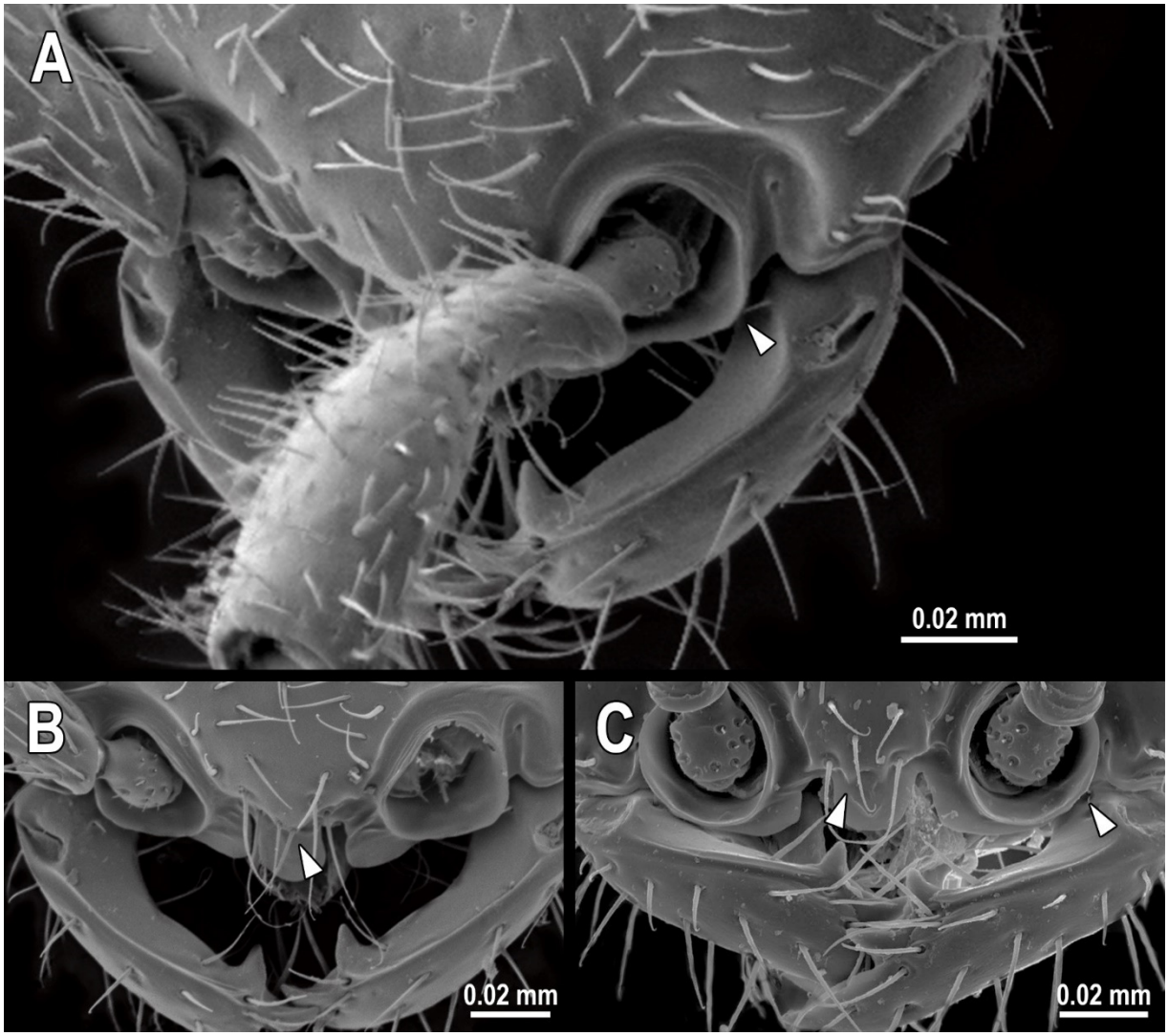

Fig 3. SEM photographs of *Leptanilla* workers: A, B - *L. sichuanensis* sp. nov.; C - *L. macauensis*, images from Leong et al. (2018).

and rounded transition to basal face; propodeal spiracle located behind center of propodeum; bulla of metapleural gland large and rounded, located posteroventral to propodeal spiracle. In dorsal view, pronotum subequal in length and width, rounded, and distinctly broader with posterior segments; cervical shield broad and trapezoidal; mesonotum and propodeum perfectly fused, without clear demarcation, but propodeum slightly broader with mesonotum.

Metasoma. In lateral view, petiole almost as high as postpetiole; in dorsal view, postpetiole slightly wider than petiole. Petiolar node in lateral view with strongly triangular concavity on anterior margin; posterior margin of dorsal portion steeply straight; dorsum rounded, middle highest, anterior margin lowest; petiolar spiracle large and close to anterior center; ventral portion triangular, with angular transition between posteroventral and anteroventral margins; subpetiolar process present, blade-shaped, and with a protruding dent or spine on posterior margin; in dorsal view, node subrectangular, anterior margin concave, lateral and posterior margins slightly convex; stalk and helcium significantly elongated. Postpetiole lateral view center divided horizontally and converged, dorsal and ventral portion equal in height; anterior margin concave, posterior margin flattened; postpetiolar spiracle small and close to anterior upper; in dorsal view, bead-shaped. Gaster ovate; first segment slightly longer than wide in dorsal view, narrowing forward, anterior margin broad and concave in center; remaining segments gradually narrowing.

Sculpture. Body simple overall, without complex sculptures, largely smooth, sparse, and minutely punctuate. Head and antennae superficially punctate, distinctly smooth between punctures; central prominence of clypeus and mandible smooth and shining; remaining protuberances of clypeus with several weak transverse striations; antennal toruli finely annulate. Mesosoma smooth overall, minutely punctate; neck portion of pronotum and propleuron strongly reticulated; lower margin of pronotum and propodeum superficially elongate-striate; mesopleuron and base of coxae slightly imbricate. Petiolar stalk strongly reticulate anteriorly, smooth posteriorly; petiole mid-ventral surface (including subpetiolar process) with weak reticulation; postpetiole overall smooth and superficially punctate.

Pilosity and coloration. Whole covered with pubescence, hairs of anterior margin of clypeus longer. Unicolored, yellowish throughout; gaster slightly darkened.

Male. Unknown.

Comparative diagnosis. The new species is extremely similar to *L. macauensis* Leong, Yamane & Guénard, sharing a conspicuous and strong central clypeal protuberance and clypeal lobes, with a microspine-like subpetiolar process (Fig 1D, 3). However, easily distinguishable from the following characteristics: anteromedial circular disc from clypeal margin without a pair of triangular extensions on surface, instead forming a complete curve (Fig 3B); inferolateral margin of antennal toruli stretched angularly (Fig 3A); head and antennal scape longer (CI 67–70, SI 63–66) (Fig 4).

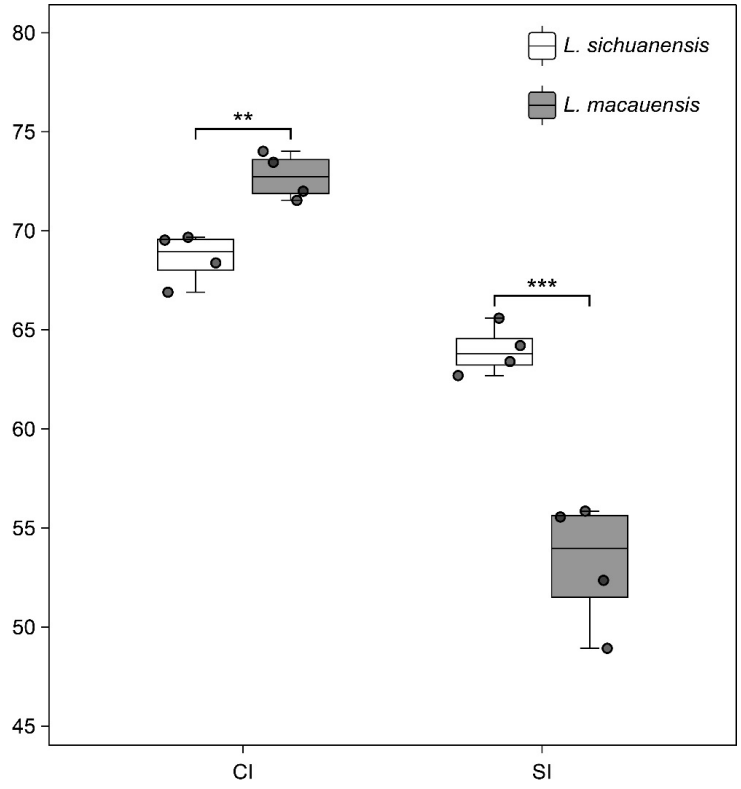

Fig 4. A comparison of cephalic index (CI) and scape index (SI) measurements for *Leptanilla sichuanensis* sp. nov. and *L. macauensis*. The data for *L. macauensis* were provided by Dr. Chi-Man Leong and visualised using ChiPlot. Significance levels for independent samples *t*-test are indicated by stars, with ** denoting $p<0.01$ and *** denoting $p < 0.001$.

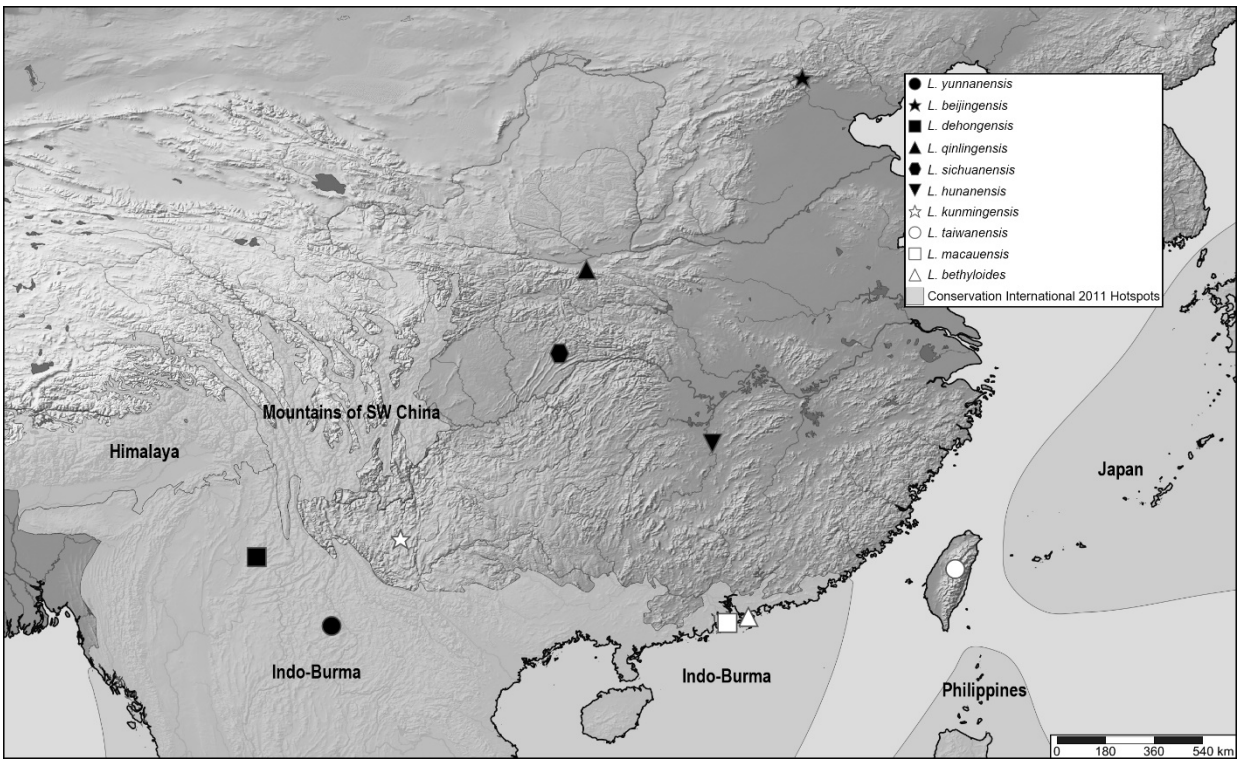

Fig 5. Geographical distributions of the Chinese *Leptanilla* species. Locality information was obtained from the original literature of each species and visualized with SimpleMappr.

Distribution. (Fig 5). Only known in Sichuan, China.
Biology. The species has been observed on several occasions to inhabit stones or mud in pine forests, as well as in shadier and wetter environments of mixed deciduous and bamboo forests.
Etymology. Specifically refers to Sichuan Province, where the type locality.

Taxonomic key to the Chinese *Leptanilla* species based on the worker caste (excluding *L. bethyloides* for which only males are known)

1 In profile, subpetiolar process of petiole with a short, backward-facing spine (Fig 6A).....2

– In profile, vertical margin of petiole rounded and without distinct subpetiolar process (Fig 6B).....3

2 Head and antennal scape not markedly elongated (CI 72–74, SI 49–56). Medial margin of disc protruding from anterior margin of clypeus with a pair of triangular extensions; antennal toruli rounded overall (Fig 7A).....***macauensis***

– Head and antennal scape elongated (CI 67–70, SI 63–66). Medial margin of disc protruding from anterior margin of clypeus without a pair of triangular extensions, instead forming a complete curve; inferolateral margin of antennal toruli stretched angularly (Fig 7B).....***sichuanensis* sp. nov.**

3 Clypeus elevated and elongated, distinctly beyond antennal toruli (Fig 8A).....4

– Clypeus not elongated, anterior margin level with antennal toruli or only slightly surpassed (Fig 8B).....5

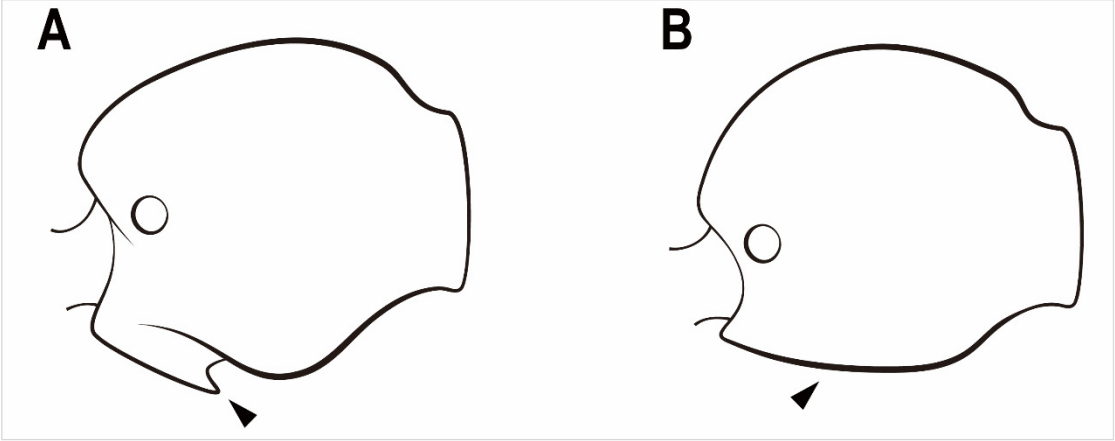

Fig 6. Lateral view of petiole of *Leptanilla sichuanensis* sp. nov. (left) and *L. kunmingensis* (right): A – subpetiolar process present; B – subpetiolar process absent.

4 Anterior margin of clypeus concave centrally, with a pair of projecting sides (Fig 9A).....***kunmingensis***

– Anterior margin of clypeus truncated (Fig 9B)....***dehongensis***

5 Anterior margin of clypeus complete, either flattened or convex (Fig 10A).....6

– Anterior margin of clypeus distinctly notched centrally (Fig 10B).....7

6 Head subrectangular, subequal width and length (Fig 11A) .....***yunnanensis***

– Head about 1.5 times as length as width (Fig 11B) ..... ***hunanensis***

7 Ventral portion of postpetiole slightly flattened, 0.5 times as height as node (Fig 12A).....***qinlingensis***

– Ventral portion of postpetiole strongly rounded, as height as node (Fig 12B).....8

8 Mandiblar teeth arranged trisectionally (Fig 13A). petiole elongated, 1.3 times as long as wide, longer than postpetiole (Fig 13C).....***beijingensis***

– Mandibular basal tooth slightly removed from preapical and apical teeth (Fig 13B). petiole as long as wide or only slightly elongated, shorter than postpetiole (Fig 13D).....***taiwanensis***

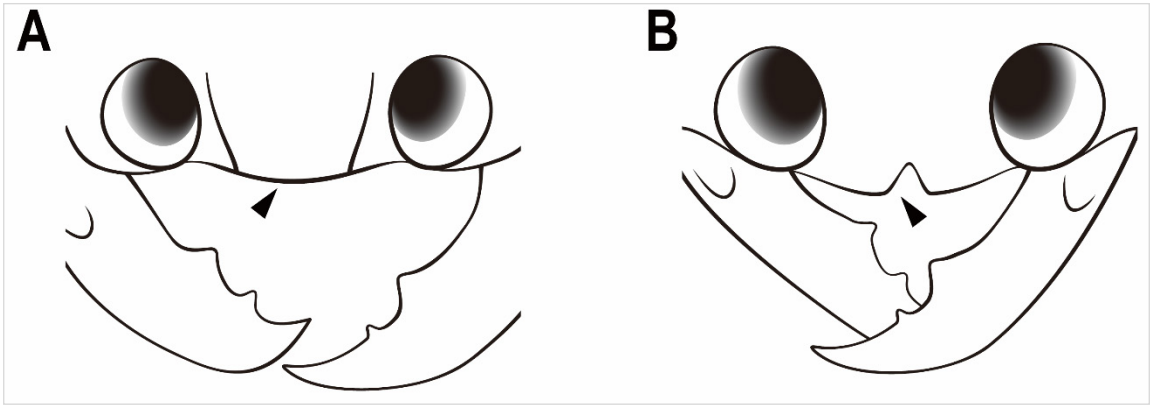

Fig 7. Frontal view of clypeus of *Leptanilla macauensis* (left) and *L. sichuanensis* sp. nov. (right): A – medial protrusion with a pair of triangular extensions, antennal toruli rounded overall. B – posterior margin of medial protrusion forming a complete curve, antennal toruli stretched angularly.

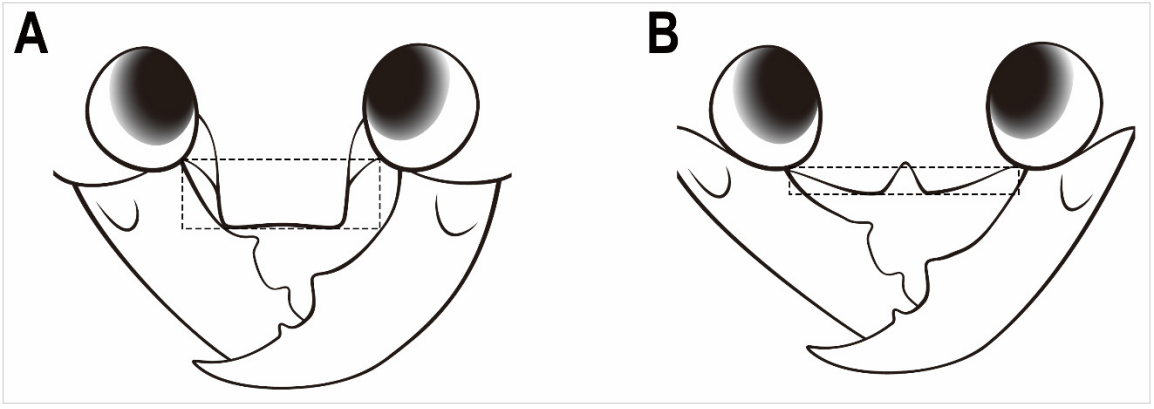

Fig 8. Frontal view of clypeus of *Leptanilla dehongensis* (left) and *L. qinlingensis* (right): A – elevated and elongated, distinctly beyond antennal toruli overall. B – not elongated, anterior margin only slightly surpassing antennal toruli.

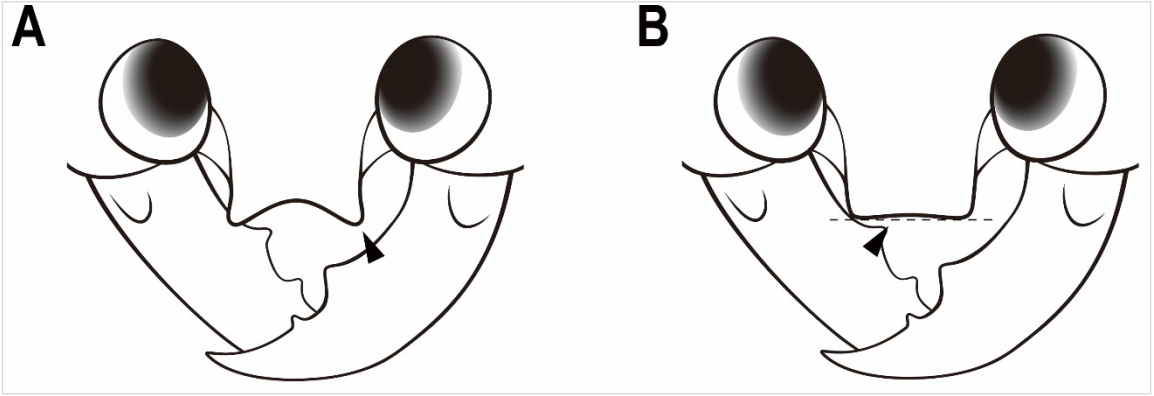

Fig 9. Frontal view of clypeus of *Leptanilla kunmingensis* (left) and *L. dehongensis* (right): A – anterior margin concave centrally, sides projecting. B – anterior margin truncated, sides level.

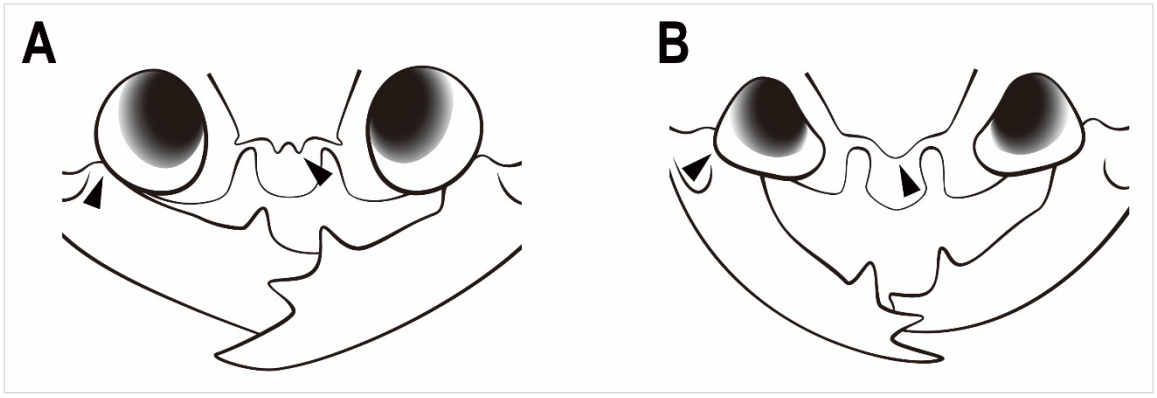

Fig 10. Frontal view of clypeus of *Leptanilla yunnanensis* (left) and *L. qinlingensis* (right): A –anterior margin complete. B – anterior margin notched centrally.

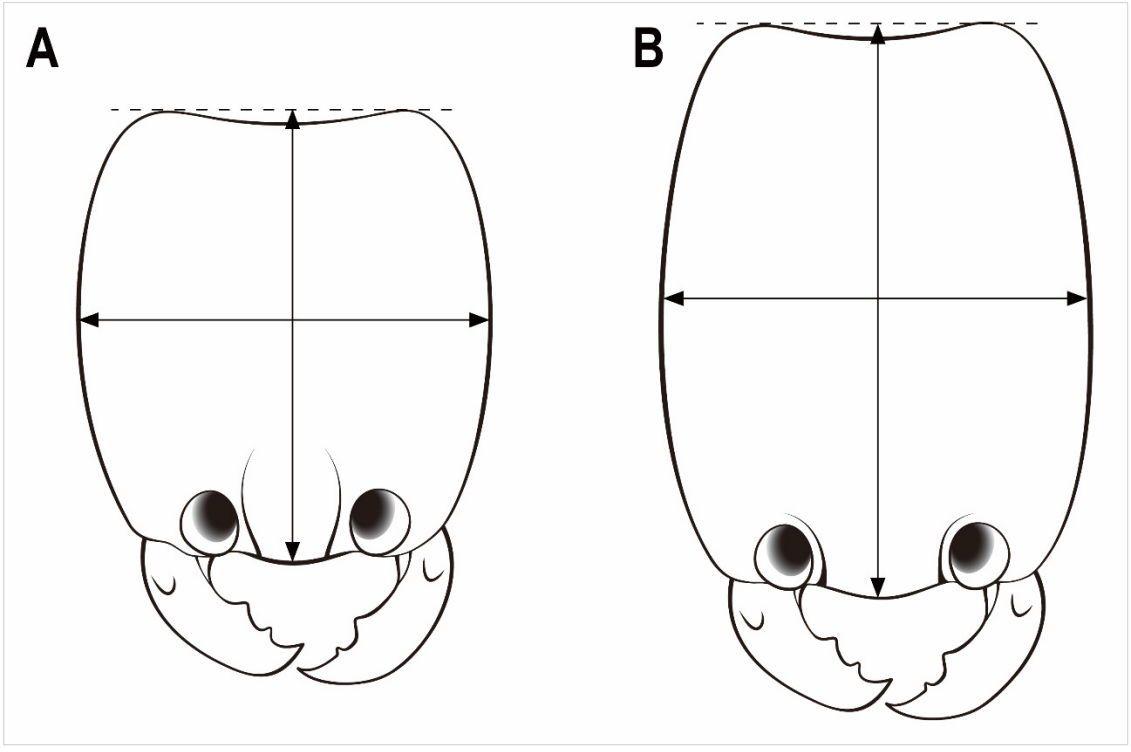

Fig 11. Full-face view of head of *Leptanilla yunnanensis* (left) and *L. hunanensis* (right): A – outline subrectangular overall. B – outline elongated, about 1.5 times as length as width.

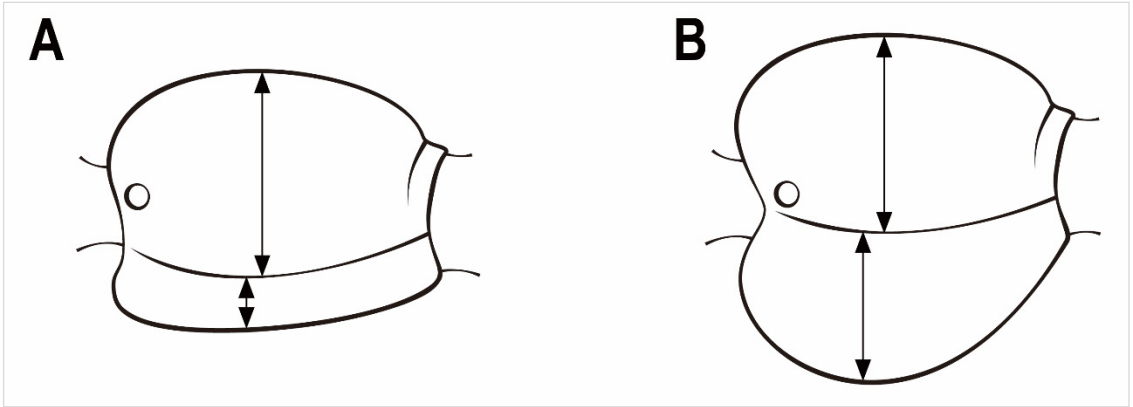

Fig 12. Lateral view of postpetiole of *Leptanilla qinlingensis* (left) and *L. beijingensis* (right): A – ventral portion flattened and short. B – ventral portion strongly rounded and tall.

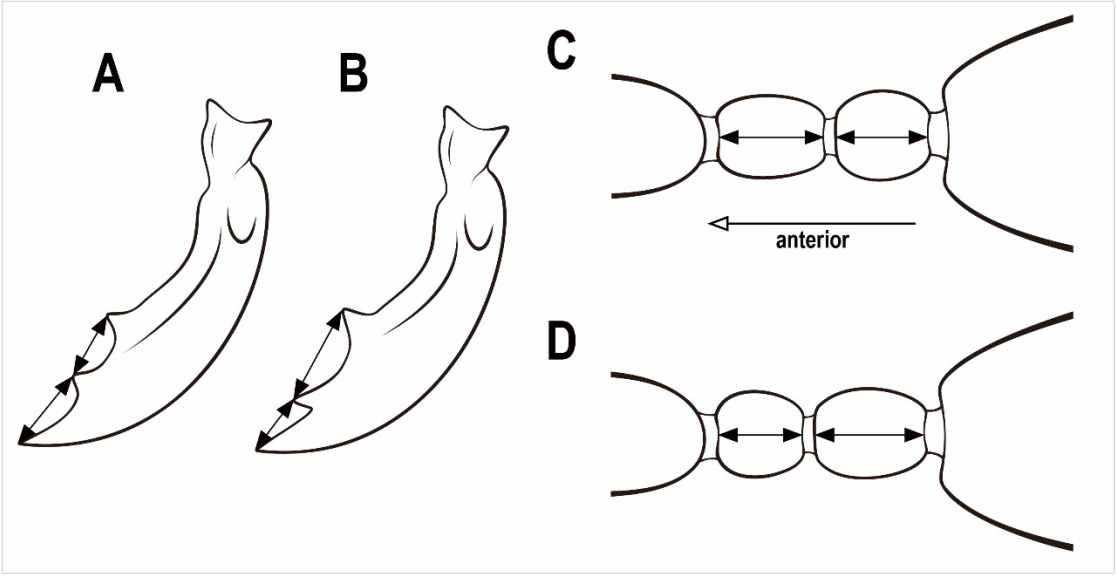

Fig 13. Frontal view of mandible of *Leptanilla beijingensis* (A and C) and *L. taiwanensis* (B and D): A – mandiblar teeth arranged trisectionally. B – mandibular basal tooth slightly removed from orther teeth. C – petiole longer than postpetiole. D – petiole shorter than postpetiole.

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