

A New Bicolor Species of the Ant Genus *Temnothorax* Mayr, 1861 (Hymenoptera: Formicidae) from Yunnan, China

Ye-Ming WEI¹ Tian-Qi WU² Ying ZHONG^{3*} Yu-Yuan HUANG⁴
Gui-Chuan NIE⁵

¹University of Arizona, Tucson, Arizona 85721, UNITED STATES OF AMERICA

²Beijing University Affiliated Middle School, Shenzhen, Guangdong 518116, P. R. CHINA

³GCTB-NSU Joint Institute of Technology, Guangzhou College of Technology and Business, Foshan, Guangdong 528100, P. R. CHINA

⁴Wuchuan No.1 Middle School, Wuchuan, Zhanjiang, Guangdong 524500, P. R. CHINA

⁵Puan Middle School, Kaijiang, Dazhou, Sichuan 636251, P. R. CHINA

e-mails: ¹weiy422@sina.com, ²113203231@qq.com, ³zhongying2005@gmail.com
⁴3284127759@qq.com, ⁵443358420@qq.com

ORCID IDs: ¹0009-0005-6618-3959, ²0009-0005-6672-3847, ³0000-0002-6289-4455
⁴0009-0005-3406-4875

*Corresponding author

ABSTRACT

In this paper, we described a new species, *T. gui* sp. nov. Wei, Wu, Zhong, & Huang, 2024, of the genus *Temnothorax* Mayr, 1861 from China. The new species is closely related to *T. leyeensis* Zhou, Huang, Yu, & Liu, 2010, but can be distinguished by the following characters: (1) Head with sculpture is simpler and lustrous, with relatively sparse and fine reticulated sculpture throughout. (2) Promesonotum in dorsal view only irregularly reticulate not interspersed with fine reticulation centrally. (3) Gaster smooth and shiny, without coarse sculpture anteriorly. (4) Colour of mesosoma reddish, instead of orange.

Keywords: Acorn ants, New Species, Taxonomy, China, *Temnothorax*.

Wei, Y., Wu, T., Zhong, Z., Huang, Y., & Nie, G. (2024). A new bicolor species of the ant genus *Temnothorax* Mayr, 1861 (Hymenoptera: Formicidae) from Yunnan, China. *Journal of the Entomological Research Society*, 26(3), 419-428.

Received: June 27, 2024

Accepted: November 14, 2024

INTRODUCTION

The genus *Temnothorax* contains 500 valid species and 33 valid subspecies worldwide (Bolton, 2024), and was established by Mayr (1861) based on the type species, *Myrmica recedens* Nylander, 1856 (= *T. recedens*). The size of their colonies is generally small, with a mature colony often having only around 200 workers and one queen (Beckers, Goss, Deneubourg, & Pasteelset, 1989). These ants frequently use small cavities as their nesting places, such as cracks in rocks, crevices in rocks, hollow nut shells, dead twigs, or directly in the soil. (Prebus, 2017). The species of the genus are widely distributed throughout the northern hemisphere of the world, including Asia, Africa, Europe, North America, and South America (Antmaps, 2024). They are typically found in the mesic forests of the Northern Hemisphere at mid-to-high elevations and are commonly referred to as 'acorn ants' or 'rock ants' due to their behavior of nesting in nuts and cracks in rocks (Prebus, 2017, Prebus, 2021). The ecological role of *Temnothorax* ants is generally decomposer. There is no evidence that any of them are aggressive or active predators (Snelling, Borowiec, & Prebus, 2014).

The morphological characters of *Temnothorax* and the genus *Leptothorax* are closely related, thus *Temnothorax* was considered a junior synonym or subgenus of *Leptothorax* in several earlier revisions (e.g. Donisthorpe, 1943; Ogata, 1991; Bolton, 1994; Bolton, 1995) until Bolton (2003) reconsidered *Temnothorax* as a valid genus and merged 8 genera into *Temnothorax*. Subsequently, Eguchi, Bui, & Yamane (2011) provided a key to Vietnamese genera, including the genus *Temnothorax*, and Ward, Brady, Fisher, & Schultz (2015) proposed seven other junior synonyms for *Temnothorax* in a phylogenetic and evolutionary study of myrmicine ants.

In China, 62 species have been recorded (Qian & Xu, 2024). The first two species of *Temnothorax* were recorded as *Leptothorax* by Wu & Wang (1995). Subsequently, Wang (1998) reported *Temnothorax fultonii* (= *L. fultonii*) from Hubei Province. Zhou (2001) reported *Temnothorax spinosior* (= *L. spinosior*) from Guangxi Province. Chang & He (2001) described three new *Temnothorax* species as species of *Leptothorax* from northwestern China. Huang, Chen, & Zhou, (2004) described a new species *Temnothorax hengshanensis* (= *L. hengshanensis*) from Hunan Province. Huang & Zhou (2006) reported 6 new recorded species of *Temnothorax*. Terayama (2009) described 6 new species of *Temnothorax* from the Taiwan region. These studies cumulatively reported 19 species. Zhou et al. (2010) reported 8 new species and 3 newly recorded species, and systematically summarized the ant species of this genus in China, with a key to Chinese *Temnothorax* species. Later, Hamer, Lee, & Guénard (2023) described two new species from Hong Kong and adapted the key of Zhou et al. (2010). More recently, Qian & Xu (2024) described twenty-eight species and re-compiled a preliminary key for Chinese *Temnothorax*.

In this study, we describe a new species of *Temnothorax*, *T. gui* sp. nov., from Yunnan, China, and update the key of Qian & Xu (2024). Additionally, given the marked changes in body size observed in the type material, we analyzed the head, mesosoma, and waist of this new species for allometry.

MATERIAL AND METHODS

The specimens in this study were obtained from Lijiang City, Yunnan Province, China, and collected manually. The specimens were placed on white triangular paper with red labels to indicate the holotype and yellow labels to indicate the paratypes.

The observation and identification of the type material were conducted using a Phenix XSP-02 light microscope on white soft rubber. Photographs of the holotype (Fig. 1) were taken using a Nikon D3000 digital camera attached to a Phenix Plan 4x microscope objective under the illumination of a Panasonic HH-LT0623 removable lamp and were processed by taking multiple photographs at different focal lengths for stacking. Image stacking and adjustment were performed using Helicon Focus 8 and Adobe Photoshop 2021 software. Measurements were performed with an HY-800B digital camera connected to a 0745 lens in HAYEAR software, after angular adjustment using the pinned insect manipulator (IMp) proposed by Dupont, Price, & Blagoderov (2015).

To investigate the presence of allometry in type material with significant body size differences, four groups of measurements (HL-HW, HW-WL, DPW-PPW, and PW-PPW) were selected for fitting an allometric equation ($y = ax^b$; Huxley, 1924) using Past 4.15 software (Hammer, Harper, & Ryan, 2001), and the goodness-of-fit (R^2) was calculated. In the allometric equation, y is the dependent variable, x is the independent variable, a is a constant, and b is the allometric coefficient.

The standard measurements and indices mainly refer to the definitions of Qian & Xu (2024). All measurements are expressed in millimeters (mm) and are supplemented by the indices PI, PHI, PPI, PPHI, and WI as follows:

TL. Total Length: measured the fully stretched and extended position from the mandibular apex to the posterior margin of first gastral tergite. Understandable as the sum of mandibular length + HL + ML + PL + PPL + first gastral tergite length.

HL. Head Length: straight line length of head in perfect full-face view, measured from the midpoint of the anterior margin of clypeus to the midpoint of the posterior margin of head. If the clypeus is depressed, the measurement is taken from the midpoint of the transverse line at the most prominent point on the outer sides of the depression.

HW. Head Width: maximum width of head in full-face view, excluding the eyes.

SL. Scape Length: diagonal length of antennal scape, excluding the basal constriction or neck.

ED. Eye Diameter: maximum diameter of eye.

PW. Pronotal Width: maximum width of pronotum measured in dorsal view.

WL. Weber's length or Alitrunk Length: measure the diagonal length of the mesosoma in lateral view from the junction of the pronotum with the cervical shield to the posterior base of the metapleuron.

PL. Petiole Length: length of petiole measured in lateral view from the anterior articulation to the posterior articulation of petiole.

PH. Petiole Height: height of petiole measured in lateral view from the ventral margin to the dorsalmost point of the node, excluding the subpetiolar process.

DPW. Dorsal Petiole Width: maximum width of petiole in dorsal view.

PPL. Postpetiolar Length: maximum length of postpetiole from dorsal view, excluding helcium.

PPH. Postpetiolar Height: maximum height of postpetiole from the dorsalmost point of node to ventralmost point of sternite measured in lateral view.

PPW. Postpetiolar Width: maximum width of postpetiole from dorsal view.

CI. Cephalic Index: $HW/HL \times 100$.

SI. Scape Index: $SL/HW \times 100$.

PI. Petiolar Index: $DPW/PL \times 100$.

PHI. Petiolar Height Index: $DPW/PH \times 100$.

PPI. Postpetiolar Index: $PPW/PPL \times 100$.

PPHI. Postpetiolar Height Index: $PPW/PPH \times 100$.

WI. Waist Index: $PPW/DPW \times 100$.

The type specimens of the new species are deposited at the Museum of Biology, Sun Yat-sen University (SYSBM), Guangzhou, China.

RESULTS

Temnothorax gui sp. nov. (Fig. 1)

Type Material: **Holotype.** Worker, **China**, Yunnan Province, Lijiang City, Yongsheng County, Shanglama Village, 26°54'16"N, 100°28'25"E, 2180 m alt., V-2023, Yu-Hua GU leg, En-425083 (SYSBM). **Paratypes.** 4 workers, with the same data as holotype, En-425084, En-425085, En-425086, En-425087 (SYSBM).

Measurements: Holotype worker: TL 4.3, HL 1.09, HW 0.98, SL 0.78, ED 0.20, PW 0.70, WL 1.27, PL 0.43, PH 0.35, DPW 0.25, PPL 0.29, PPH 0.33, PPW 0.34, CI 90, SI 79, PI 59, PHI 73, PPI 117, PPHI 102, WI 132.

Description: Head: Subrectangular in frontal view, slightly longer than wide; posterior margin nearly straight or slightly convex. The eyes slightly convex and appear almost at the midline of head. Frontal width moderate, lateral margins straight, contracted inwards from posterior to anterior; frontal lobes prominent and triangular, not covering antennal sockets. Antennal sockets exerted, and antennal scrobes extended to the anterior eyes level. Antennae 12-segmented; scape thickened from base to apex, apex not exceeding the posterior margin of head; segments of funiculus trapezoidal; last three segments forming a club. Anterior margin of clypeus rounded but concave middle. Mandibles triangular, masticatory margin with five teeth.

Mesosoma: in dorsal view lateral sides of pronotum convex but irregular slightly, broader than mesonotum and propodeum; pro-mesonotal suture and metanotal groove indistinct; propodeal spines blunt, moderately long, slightly outward; propodeal lobes inconspicuous. In lateral view, mesosomal dorsum forming a smooth curve; dorsum of pronotum slightly convex; mesonotum fused with mesopleuron; metanotal groove absent; dorsal margin of mesonotum and propodeum continuous and straight; propodeal spines blunt, directed outward; posterior lateral lobe of propodeum obscure, blunt, and directed posteriorly.

Waist: in dorsal view petiolar node subovate, postpetiole subrounded. In lateral view petiolar dorsum rounded, slightly higher than postpetiole; subpetiolar process spinelike, protruding downwards; postpetiole subrounded. Gaster oblong-ovate.

A New Bicolor Species of the Ant Genus Temnothorax

Sculpture: head punctured and longitudinally striated; vertex mixed with strongly striated and slightly reticulated; frons densely longitudinally striated; antennal scrobes with circular sculpture; clypeus smooth, with sparser longitudinal sculpture. Mesosoma shiny, with irregular sculptures; in lateral view pronotum horizontally rugose, in dorsal view irregular; inferior part of mesopleuron horizontally; propodeum irregular rugose or slightly reticulate. Petiolar node irregular rugose, bottom of petiole and postpetiole shiny and slightly reticulate. Gaster smooth.

Pilosity: dorsal surface of head with sparse short erect hairs, present in occipital margin but absent behind eyes to occipital corner frontally; antennal scape with abundant short appressed hairs; funiculus with longer appressed hairs; mandibles with sparser short suberect hairs. Dorsal margin of mesosoma with sparse, short erect hairs. Petiole with several short erect hairs at the highest point of the node and a neat circle of short erect hairs on posterior margin, postpetiole similar; legs with abundant short appressed hairs. The first segment of the gaster has sparse erect or suberect hairs mixed with sparse short appressed hairs, with short appressed hairs gradually decreasing in the remaining segments.

Color: head and mandibles reddish brown, head dark in frontal view; base of antennal scape red, apex black. Mesosoma reddish, with several dark, stragglng lines. Waist red overall. Gaster black.



Figure 1. Holotype of *Temnothorax gui* sp. nov. (worker), En-425083: a) body in lateral view, b) head in full-face view, c) body in dorsal view.

Paratype workers (n = 4). TL 3.6–4.5, HL 1.04–1.19, HW 0.89–1.07, SL 0.69–0.81, ED 0.18–0.22, PW 0.61–0.75, WL 1.18–1.37, PL 0.40–0.48, PH 0.33–0.38, DPW 0.23–0.28, PPL 0.29–0.30, PPH 0.31–0.38, PPW 0.30–0.36, CI 86–92, SI 74–78, PI 57–60, PHI 70–78, PPI 106–122, PPHI 97–100, WI 128–133. As holotype worker, but body size somewhat larger or smaller, body color darker, and clypeus concave weaker.

Allometry: By fitting the allometric equation, the results of this analysis indicate that there may indeed be a significant allometric growth relationship between certain measurements of the new species. Observing the allometric coefficient of the fitted equations, head length (HL) and head width (HW) show positive allometric growth ($b = 1.2834 > 1$, $R^2 = 0.9553$; Fig. 2a). However, negative allometric growth was observed for head width (HW) and mesosomal length (WL) ($b = 0.81223 < 1$, $R^2 = 0.9974$; Fig. 2b), petiolar width (DPW) and postpetiolar width (PPW) ($b = 0.84926 < 1$, $R^2 = 0.9631$; Fig. 2c), and pronotal width (PW) and postpetiolar width (PPW) ($b = 0.85161 < 1$, $R^2 = 0.9668$; Fig. 2d). Given the paucity of type material for this new species, detailed analyses will need to be investigated once a large amount of material has been obtained.

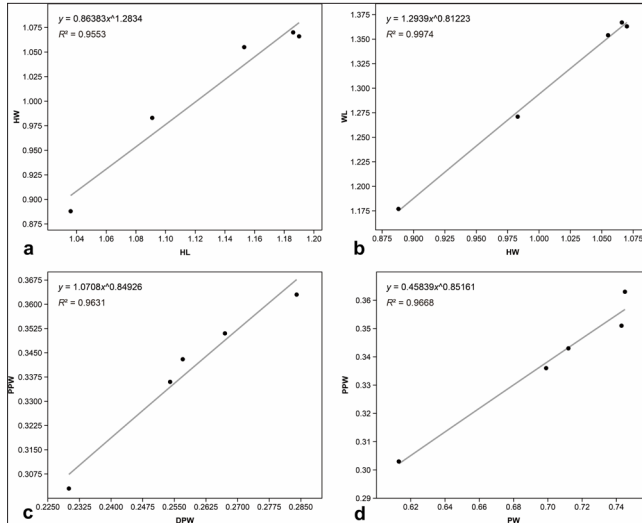


Figure 2. Allometric equation fitting for workers of *Temnothorax gui* sp. nov. (n = 5): a) length and width of the head, b) head width and mesosomal length, c) petiolar width and postpetiolar width, d) pronotal width and postpetiolar width.

Diagnosis: The new species is similar to *T. leyeensis* Zhou et al., 2010 and *T. lichun* Qian & Xu, 2024 through comparison of colour photographs of the type specimens, but can be distinguished *T. leyeensis* by its simpler and lustrous sculpture which relatively sparse and fine reticulated throughout; simply and irregularly reticulate promesonotum which not interspersed by fine reticulation in center; smooth and shiny gaster anteriorly which lack of coarse sculpture anteriorly; reddish mesosomal colour. It can be distinguished *T. lichun* by its horizontally striated area of the vertex, sparsely punctured head, shorter propodeal spines, and shorter petiolar peduncle.

Distribution: Yunnan Province, China (Fig. 3).

A New Bicolor Species of the Ant Genus *Temnothorax*

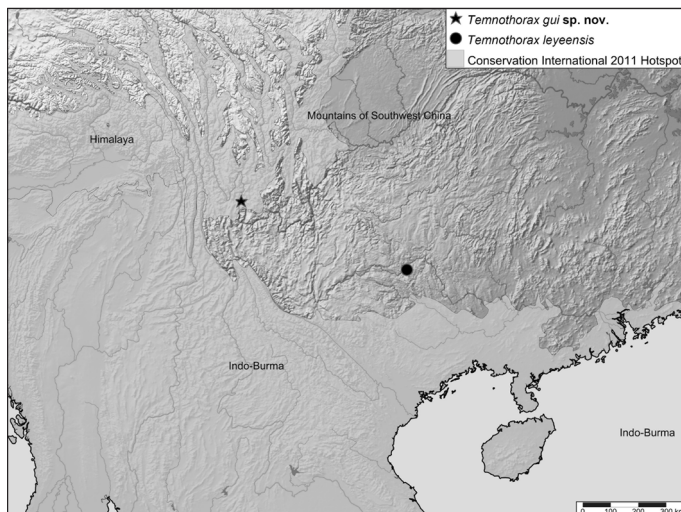


Figure 3. Geographical distributions of *Temnothorax gui* sp. nov. and *T. leyeensis*. Locality information of *T. leyeensis* was obtained from the original literature (Zhou et al., 2010). Visualized with SimpleMappr.

Biology: Type specimens where from collection. Little is known about the biology of the new species, except that it lives in forests.

Etymology: The Latin name of this new species refers to the collector of the type specimens, Yu-Hua GU, in honor of his contribution to this study.

Update of the preliminary key to known *Leptothorax* and *Temnothorax* species in China

The key was derived from Qian & Xu (2024) and originally contained 65 key couplets. For the sake of accuracy, we have made appropriate adjustments to the 42nd couplet in the original key. The new species *T. gui* sp. nov. was added, and the 63rd couplet was split into a 63' couplet.

42. In lateral view, the most concave point at the junction of propodeal spine and propodeal base to mesonotum strongly straight (Fig. 4a)43.

- In lateral view, the most concave point at the junction of propodeal spine and propodeal base to mesonotum not straight, usually arcuate in centre and rarely slightly depressed at junction with propodeal spine (Figs. 4b–d)55.

63. Head dorsum reticulate or distinctly punctate on the central area. Propodeal spines relatively longer and posterodorsally pointed in lateral view. Body color brownish yellow, head and gaster black (Figs. 5a, c)63'.

- Head dorsum loosely longitudinally rugose on the central area. Propodeal spines relatively shorter and suberect in lateral view. Body color blackish brown, head and gaster black (Figs. 5b, d) [Oriental Region: China: Sichuan] *T. dongzhi* Qian & Xu, 2024.

63'. Head overall sculpture much simpler and lustrous, with relatively sparse and fine reticulated sculpture. Promesonotum in dorsal view only irregularly reticulate

not interspersed with fine reticulation centrally. Anterior region of gaster smooth and shiny, without coarse sculpture. Colour of mesosoma reddish (Figs. 6a, c, e) [Oriental Region (Fig. 3): China: Yunnan (type locality)] *T. gui* sp. nov.

- Head overall densely and strongly reticulated. Pronotum in dorsal view with strong and fine reticulation centrally. Anterior region of gaster with distinctly coarse sculpture. Colour of mesosoma orange (Figs. 6b, d, f) [Oriental Region (Fig. 3): China: Guangxi (type locality)] *T. leyeensis* Zhou et al., 2010.

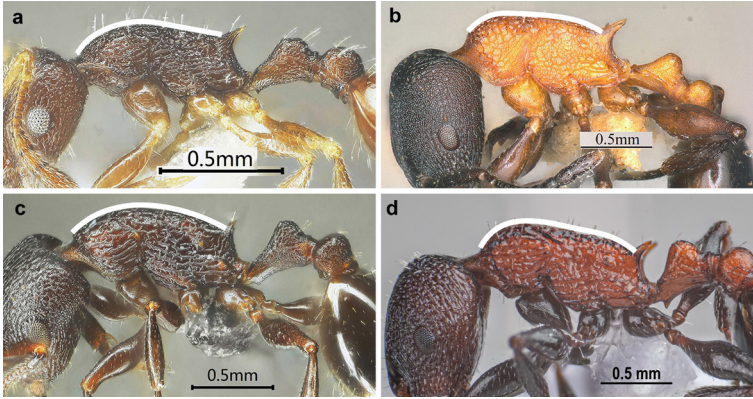


Figure 4. Lateral view of *Temnothorax* workers: a) *T. xiaoxue* Qian & Xu, b) *T. leyeensis*, c) *T. dongzhi*, d) *T. gui* sp. nov. Images a–c cited from Qian & Xu (2024).

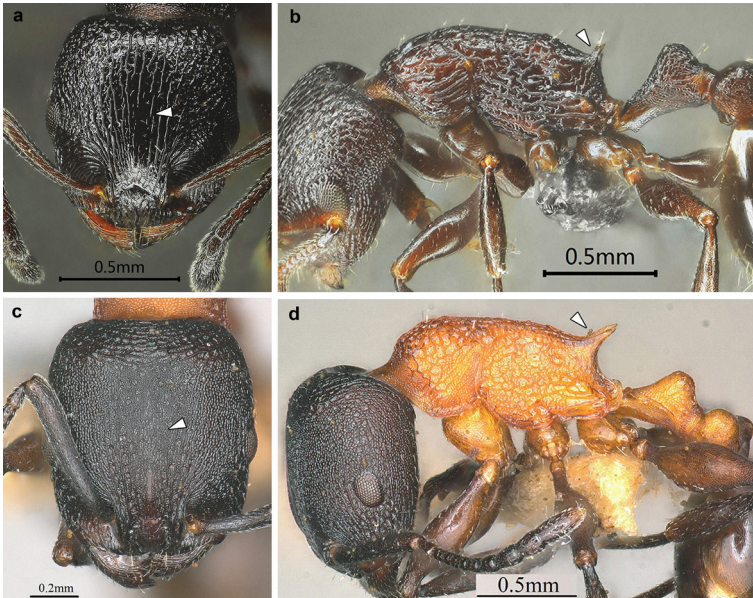


Figure 5. Full-face view (a, c) and lateral view (b, d) of *Temnothorax* workers: a, b) *T. dongzhi*, c, d) *T. leyeensis*. Images cited from Qian & Xu (2024).

A New Bicolor Species of the Ant Genus *Temnothorax*

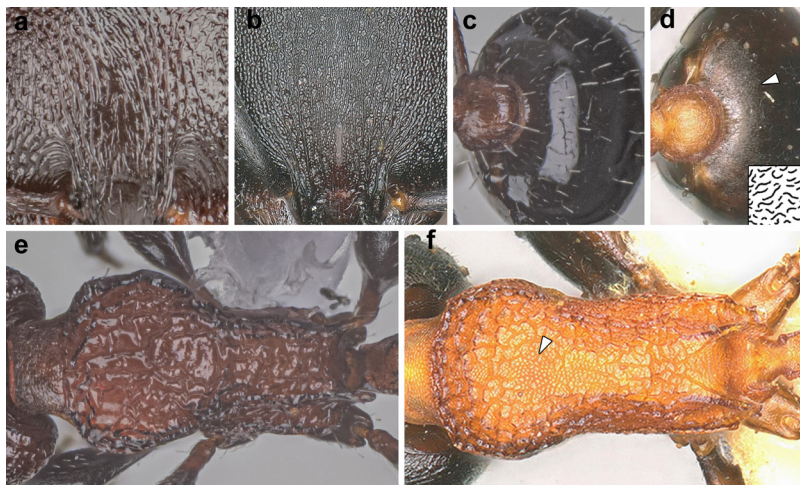


Figure 6. Front (a, b), gaster (c, d), and mesosoma in dorsal view (e, f) of *Temnothorax* workers: a, c, e) *T. gui* sp. nov., b, d, f) *T. leyeensis*. Images of *T. leyeensis* cited from Qian & Xu (2024).

ACKNOWLEDGMENTS

We thank Prof. Zheng-Hui XU for his help (Southwest Forestry University, China). We are also grateful to Mr. Shuo-Jie WANG (Sun Yat-sen University, China) for his help in preserving the type specimens.

REFERENCES

- Antmaps.org. <http://antmaps.org/> (Accessed 15th June, 2024)
- Beckers, R., Goss, S., Deneubourg, J., & Pasteels, J.M. (1989). Colony size, communication and ant foraging strategy. *Psyche A Journal of Entomology*, 96(3-4), 239–256. <https://doi.org/10.1155/1989/94279>.
- Bolton, B. (1994). *Identification guide to the ant genera of the world*. Cambridge, Mass.: Harvard University Press, 222 pp.
- Bolton, B. (1995). *A new general catalogue of the ants of the world*. Cambridge, Mass.: Harvard University Press, 504 pp.
- Bolton, B. (2003). Synopsis and classification of Formicidae. *Memoirs of the American Entomological Institute*, 71, 1-370.
- Bolton, B. (2024). An Online Catalog of the Ants of the World. AntCat. Available from <http://www.antcat.org/> (Accessed 08th October, 2024)
- Chang, Y. & He, D. (2001). Study on the ant genus *Leptothorax* Mayr in northwest region of China. *Journal of Ningxia Agricultural College*, 22(2), 1-4.
- Donisthorpe, H. (1943). A list of the type-species of the genera and subgenera of the Formicidae. [concl.]. *Annals and Magazine of Natural History*, 10(11), 721-737.
- Dupont, S., Price, B., & Blagoderov, V. (2015). IMP: The customizable LEGO® Pinned Insect Manipulator. *ZooKeys*, 481, 131–138. <https://zookeys.pensoft.net/articles.php?id=4667>
- Eguchi, K., Bui, T. V., & Yamane, S. (2011). Generic synopsis of the Formicidae of Vietnam (Insecta: Hymenoptera), Part I — Myrmicinae and Pseudomyrmecinae. *Zootaxa*, 2878, 1-61.

- Hamer, M. T., Lee, R. H., & Guénard, B. (2023). First record of the genus *Temnothorax* Mayr, 1861 (Formicidae: Myrmicinae) in Hong Kong, with descriptions of two new species. *European Journal of Taxonomy*, 879, 116–135. <https://doi.org/10.5852/ejt.2023.879.2165>
- Hammer, Ø., Harper, D. A. T., & Ryan, P. D., (2001). PAST: Paleontological statistics software package for education and data analysis. *Palaeontologia Electronica*, 4(1), 1-9.
- Huang, J. & Zhou, S. (2006). A checklist of family Formicidae of China-Myrmicinae (Part I) (Insecta: Hymenoptera). *Journal of Guangxi Normal University: Natural Science Edition*, 24(3), 87-94. <https://doi.org/10.3969/j.issn.1001-6600.2006.03.023>
- Huang, J., Chen, B., & Zhou, S. (2004). A new species of the ant genus *Leptothorax* Mayr (Hymenoptera, Formicidae) from Hunan, China. *Acta Zootaxonomica Sinica*, 29(4), 766-768.
- Huxley, J. S. (1924). Constant differential growth-ratios and their significance. *Nature*, 114, 895-896.
- Mayr, G. (1861). *Die europäischen Formiciden. Nach der analytischen Methode bearbeitet*. Wien: C. Gerolds Sohn, 80 pp. <https://doi.org/10.5962/bhl.title.14089>
- Ogata, K. 1991. A generic synopsis of the poneroid complex of the family Formicidae (Hymenoptera). Part II. Subfamily Myrmicinae. *Bulletin of the Institute of Tropical Agriculture Kyushu University*, 14, 61-149.
- Prebus, M. (2017). Insights into the evolution, biogeography and natural history of the acorn ants, genus *Temnothorax* Mayr (Hymenoptera: Formicidae). *BMC Evolutionary Biology*, 17(250), 1-22. <https://doi.org/10.1186/s12862-017-1095-8>
- Prebus, M. (2021). Taxonomic revision of the *Temnothorax salvini* clade (Hymenoptera: Formicidae), with a key to the clades of New World *Temnothorax*. *PeerJ*, 9, e11514. <https://doi.org/10.7717/peerj.11514>
- Qian, Y. & Xu, Z. (2024). Taxonomy of the ant genera *Leptothorax* Mayr, 1855 and *Temnothorax* Mayr, 1861 (Hymenoptera: Formicidae) of China with descriptions of twenty-eight new species and a key to the known Chinese species. *European Journal of Taxonomy*, 936, 1-97. <https://doi.org/10.5852/ejt.2024.936.2569>
- Snelling, R., Borowiec, M., & Prebus, M. (2014). Studies on California ants: a review of the genus *Temnothorax* (Hymenoptera, Formicidae). *ZooKeys*, 372, 27-89(372, 27–89). <https://doi.org/10.3897/zookeys.372.6039>
- Terayama, M. (2009). A synopsis of the family Formicidae of Taiwan (Insecta: Hymenoptera). *Research Bulletin of Kanto Gakuen University. Liberal Arts*, 17, 81-266.
- Wang, W. (1998). A taxonomic study of ant in Hubei area. *Journal of Hubei Institute for Nationalities*, 16(3), 83-89.
- Ward, P. S., Brady, S. G., Fisher, B. L., & Schultz, T. R. (2015). The evolution of myrmicine ants: phylogeny and biogeography of a hyperdiverse ant clade (Hymenoptera: Formicidae). *Systematic Entomology*, 40, 61-81. <https://doi.org/10.1111/syen.12090>
- Wu, J. & Wang, C. (1995). *The Ants of China*. Beijing: China Forestry Publishing House, x + 214 pp.
- Zhou, S. (2001). *Ants of Guangxi*. Guilin, China: Guangxi Normal University Press, 255 pp.
- Zhou, S., Huang, J., Yu, D., & Liu, Z. (2010). Eight new species and three newly recorded species of the ant genus *Temnothorax* Mayr (Hymenoptera: Formicidae) from the Chinese mainland, with a key. *Sociobiology*, 56, 7-26.