Ants of the Hengduan Mountains: a new altitudinal survey and updated checklist for Yunnan Province highlight an understudied insect biodiversity hotspot

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Abstract
China’s Hengduan Mountain region has been considered one of the most diverse regions in the northern hemisphere. Its stunning topography with many deep valleys and impassable mountain barriers has promoted an astonishing diversification in many groups of organisms including plants, birds, mammals, and amphibians. However, the insect biodiversity in this region is still poorly known. Here, the first checklist of ant species from the Southern Hengduan Mountain region is presented, generated by sampling ant diversity using a wide array of collection methods, including Winkler leaf litter extraction, vegetation beating, and hand collection. 130 species/morphospecies from nine subfamilies and 49 genera were identified. Among them, 17 species from 13 genera represent new records for Yunnan province, and eight species are newly recorded for China. Moreover, we believe 41 novel morphospecies (31% of the total collected taxa) will prove to be new to science. These results highlight the rich ant fauna of this region and strongly sup-
port its status as a biodiversity hotspot. The current ant species checklist for the whole of Yunnan Province was updated by recording 550 named species from 99 genera. Taken together, our results suggest that the Yunnan ant fauna still remains under-sampled, and future sampling will likely yield many more species, among them many undescribed ones.

**Keywords**

biodiversity hotspot; checklist; China; Formicidae; Hengduan Mountains; new records; species

### Introduction

The Hengduan Mountain region, located in the southeastern part of the Qinghai-Tibet Plateau, is one of the 35 recognized biodiversity hotspots in the world (Myers et al. 2000). The unique landscape, geomorphology, microhabitat differentiation and geographic isolation created by tectonic uplift during the last eight million years has promoted an astonishing diversification in many groups of organisms, making this region one of the most diverse temperate regions in the northern hemisphere (Boufford 2014; Price et al 2014; Xing and Ree 2017). For example, it harbors nearly 40 percent of China’s vascular plant diversity (ca. 12,000 species), including more than 3,000 endemic species (Boufford 2014). However, aside from the well-documented plants and some vertebrates, the diversity of other groups, especially invertebrates in this region remains largely unknown. Insect taxonomic groups in particular have received limited attention, and our understanding of their diversity in the Hengduan Mountains is extremely fragmented.

Ants are an ecologically dominant component of many ecosystems in terms of their abundance, richness, and ecosystem function (Hölldobler and Wilson 1990). Globally, about 15,600 ant species and subspecies have been described (Bolton 2020), making them the most diverse group of social insects and one of the most diverse families of insects. Despite the fact that ant diversity is mainly concentrated within tropical regions (Dunn et al. 2009; Guénard et al. 2012; Economo et al. 2018), the ant fauna of many other regions is still poorly known, especially in Asia (Guénard et al. 2010). Compiling and curating comprehensive and accurate ant species checklists for these regions is essential not only for insights into ant taxonomy and systematics, but also for long-term monitoring and conservation of these ecosystems (Guénard et al. 2017). The goal of this study is to provide a better understanding of the poorly known ant biodiversity in China’s Hengduan Mountains. The ultra-variable topography of this region, ideal for creating numerous vicariance events, combined with its wide range of climatic zones has contributed to the exceptional richness of endemic species inhabiting this area. Nevertheless, the rough topography has also made access and exploration rather challenging in the past. Against the background of extraordinary levels of plant diversity harbored by the Hengduan Mountains, it remains unclear whether or not ants and other insects display similar patterns of high diversity and endemism in this region.

To address this gap, we here present the results of an ant biodiversity survey conducted in the Gaoligong Shan mountains (part of the Hengduan Mountains), Yunnan
Province, southwest China undertaken in 2019. Our goal is to present a complete species checklist of ants from the Gaoligong Mountains, including new records, as well as to update the current ant species checklist for the whole of Yunnan Province.

The Gaoligong Shan mountains (lat. 24°56’–28°22’N, long. 98°08’–98°50’E) comprise the western-most part of the Hengduan Mountain Range, and are among the most biodiversity-rich areas in Yunnan (Li et al. 2008; Dumbecher et al. 2011; Lo and Bi 2019). The ant fauna in the Gaoligong Shan mountains remains poorly understood, despite several studies focusing on ant diversity patterns that have recorded 62 ant species from 31 genera (Xu 2001a, b), but lack a comprehensive list of species collected.

Yunnan province is the richest province of China in terms of ant diversity (Guénard and Dunn 2012). The latest ant checklist of Yunnan was compiled almost 10 years ago and consisted of 462 ant species. Since then, new ant inventories have been conducted (e.g. Liu et al. 2015a), as well as new species descriptions (e.g., Guénard et al. 2013; Xu et al. 2014a, b; Liu et al. 2015b; Staab et al. 2018), and the identification of previously dubious records have sensibly modified our understanding of Yunnan’s ant diversity and species composition. Therefore, in this study, we also provide an update to the ant species checklist of Yunnan province and discuss future trends.

**Materials and methods**

Ant specimens were collected from natural forests along an elevational gradient on both the eastern and western slopes of the Gaoligong Mountains in July 2019. We sampled leaf litter ants from 16 sites at roughly 150 m elevational intervals from 600 m to 3000 m, following the standardized sampling protocol developed in Liu et al. 2016. At each site, we established a 400 m² quadrat (20 m × 20 m) and collected leaf litter samples at the four corners of the quadrat (1 m²). We also collected leaf litter within the quadrat to cover a variety of microhabitats. Finally, ants on the ground, lower vegetation, and tree branches were collected both by hand and using a beating sheet. Leaf litter samples were extracted using mini Winkler extractors for 72 hours using the shuffling method described in Guénard and Lucky (2011).

Ant specimens were first placed in 99% ethanol and later sorted into morphospecies and point mounted. Each mounted specimen was assigned a unique Museum of Comparative Zoology, Harvard University (MCZ) specimen code and collection labels. Extended depth of field specimen images were taken with a Leica DFC400 digital camera mounted on a Leica M205C stereomicroscope through the Leica Application Suite V4 software in the Ant Room at the MCZ. Specimens were identified to species/morphospecies using available keys, the digital resources on Antwiki (http://www.antwiki.org) and AntWeb (http://www.antweb.org), as well as reference museum material. All mounted and alcohol-preserved ant specimens are currently deposited in the Ant Room of the MCZ.

Distribution maps of species were generated from records included within the Global Ant Biodiversity Informatics (GABI) database and available at https://antmaps.org (Janicki et al, 2016; Guénard et al. 2017). These maps are based on records reported
at the country level, or at the first administrative division for the larger countries (China, India, Japan). For larger islands that form their own natural biogeographic units like Borneo, Sumatra, New Guinea, the distribution maps used the island boundary instead of political boundaries (see also Guénard et al. 2012).

Results

Ants of the Hengduan Mountain region

More than 3000 specimens were collected during this survey, and 130 species and morphospecies in 49 genera and nine subfamilies were identified. After identification of 88 valid species from the 130 total collected species, a total of 17 new species records are presented for Yunnan province and eight represent new records for China (see Table 1). The newly recorded species belong to 13 genera from four subfamilies. Moreover, the 41 morphospecies that could not be identified are likely to represent new species.

Within the recent collection, the most speciose ant genus is *Pheidole* with eleven species (8.5% of the total species collected in the survey), followed by *Camponotus* (ten species, 7.7%), and *Polyrhachis* (seven species, 5.4%). Other diverse genera include *Aphaenogaster* (six species, 4.6%), *Strumigenys* (six species, 4.6%), *Tetramorium* (six species, 4.6%), *Aenictus* (five species, 3.8%), and *Carebara* (five species, 3.8%). More details are presented in Table 2.

Here, we present the list of ant species that were collected in the Gaoligong Shan mountains (Table 1), as well as images for each species (Figs 1–136).

Updated ant checklist in Yunnan

The ant species list of Yunnan Province was generated using records from GABI available at https://antmaps.org (Janicki et al. 2016; Guénard et al. 2017). In total, the Yunnan ant fauna is composed of 99 genera and 550 named species and subspecies. Among them, the ant genera *Lasiomyrma*, *Lordomyrma*, and *Prionopelta* are only known from unidentified morphospecies. Through our collection and the records from GABI, we have added 125 species and subspecies to the list of ants of Yunnan since the last ant checklist (Guénard et al. 2012). We also excluded 26 species records from the previous list and explained our rationale in each case (Table 3).

In Yunnan, the most diverse ant genus is *Pheidole* with 42 named species, followed by *Polyrhachis* (33 species), *Camponotus* (30 species), and *Tetramorium* (29 species). Other diverse genera include *Crematogaster* (25 species), and *Strumigenys* (25 species). Although 15 ant genera contain more than ten named species in Yunnan, the majority of ant genera occurring in Yunnan seem to be not particularly diverse. For example, 35 genera are represented by only one species in Yunnan (Table 4).
Table 1. List of ant species (Formicidae) in the Gaoligong Shan mountains, Yunnan with their respective illustrations. * New to Yunnan province; **New to China.

| Species | Figure |
|---------|--------|
| Aenictus artipus Wilson, 1964 | Fig. 1 |
| **Aenictus brevinodus Jaitrong & Yamane, 2011** | Fig. 2 |
| Aenictus hodgsoni Forel, 1901 | Fig. 3 |
| Aenictus paradentatus Jaitrong, Yamane & Tasen, 2012 | Fig. 4 |
| *Aenictus watanaeiti Jaitrong & Yamane, 2013* | Fig. 5 |
| Cerapachys sulcinodis Emery, 1889 | Fig. 6 |
| Cerapachys sp. clm01 | Fig. 7 |
| Chrysaline costatus (Bharti & Wachkoo, 2013) | Fig. 8 |
| Dorylus orientalis Westwood, 1835 | Figs 9, 10 |
| Oeceraea biroi (Forel, 1907) | Fig. 11 |
| Amblyoponinae | |
| Stigmamima octodentatum (Xu, 2006) | Fig. 12 |
| Dolichoderinae | |
| Dolichoderus feae Emery, 1889 | Fig. 13 |
| Dolichoderus squamanodus Xu, 2001 | Fig. 14 |
| Dolichoderus taprobanicus (Smith, 1858) | Fig. 15 |
| Ochetellus glaber (Mayr, 1862) | Fig. 16 |
| Tapinoma melanocephalum (Fabricius, 1793) | Fig. 17 |
| Ectatomminae | |
| Gnamptogenys quadratinodules Chen, Lattke & Zhou, 2017 | Fig. 18 |
| Formicinae | |
| Anoplolepis gracilipes (Smith, 1857) | Fig. 19 |
| **Camponotus bellus leucodiscus Wheeler, 1919** | Fig. 20 |
| **Camponotus keibitzi Forel, 1913** | Fig. 21 |
| Camponotus lasisene Wang & Wu, 1994 | Figs 22, 23 |
| Camponotus mitsu (Smith, 1858) | Fig. 24 |
| Camponotus nicobarensis Mayr, 1865 | Fig. 25 |
| Camponotus sp. clm01 | Fig. 26 |
| Camponotus sp. clm02 | Fig. 27 |
| Camponotus sp. clm03 | Fig. 28 |
| Camponotus sp. clm04 | Fig. 29 |
| Camponotus sp. clm05 | Fig. 30 |
| Formica cunicularia Latreille, 1798 | Fig. 31 |
| Formica japonica Motschoulsky, 1866 | Fig. 32 |
| Lasius obscuratus Stitz, 1930 | Fig. 33 |
| *Lasius Himalayana Bingham, 1903 | Fig. 34 |
| Nylanderia bourbonica (Forel, 1886) | Fig. 35 |
| Nylanderia sp. clm01 | Fig. 36 |
| Nylanderia sp. clm02 | Fig. 37 |
| Oecophylla smaragdina (Fabricius, 1775) | Fig. 38 |
| Paraparatrechina sakunae (Ito, 1914) | Fig. 39 |
| Paraparatrechina sp. clm01 | Fig. 40 |
| Paraparatrechina sp. clm02 | Fig. 41 |
| Polyrhachis armata (Le Guillou, 1842) | Fig. 42 |
| Polyrhachis bivamata (Drury, 1773) | Fig. 43 |
| Polyrhachis divers Smith, 1857 | Fig. 44 |
| Polyrhachis furcata Smith, 1858 | Fig. 45 |
| Polyrhachis balladai Emery, 1889 | Fig. 46 |
| Polyrhachis illaudata Walker, 1859 | Fig. 47 |
| Polyrhachis laevigata Smith, 1857 | Fig. 48 |
| Species                                                                 | Figure |
|------------------------------------------------------------------------|--------|
| * Polyrhachis tibialis* Smith, 1858                                    | Fig. 49|
| * Prenolepis angularis* Zhou, 2001                                     | Fig. 50|
| * Prenolepis fustinoda* Williams & LaPolla, 2016                       | Fig. 51|
| Prenolepis sp. clm01                                                   | Fig. 52|
| Prenolepis sp. clm02                                                   | Fig. 53|
| * Pseudolatus emeryi* Forel, 1915                                      | Fig. 54|
| * Pseudolatus silvestrii* Wheeler, 1927                                | Fig. 55|
| ** Myrmicinae **                                                        |        |
| Aphaenogaster *feae* Emery, 1889                                       | Fig. 56|
| Aphaenogaster sp. clm01                                                | Fig. 57|
| Aphaenogaster sp. clm02                                                | Fig. 58|
| Aphaenogaster sp. clm03                                                | Fig. 59|
| Aphaenogaster sp. clm04                                                | Fig. 60|
| Aphaenogaster sp. clm05                                                | Fig. 61|
| * Cardiocondyla itsukii* Seifert, Okita & Heinze, 2017                 | Fig. 62|
| Cardiocondyla sp. clm01                                                | Fig. 63|
| Carebara acutipina (Xu, 2003)                                          | Fig. 64|
| Carebara affinis (Jerdon, 1851)                                        | Fig. 65|
| Carebara alitnoda (Xu, 2003)                                          | Fig. 66|
| Carebara bicornata (Xu, 2003)                                          | Fig. 67|
| Carebara sp. clm01                                                    | Fig. 68|
| * Catanacius marginatus* Bolton, 1974                                  | Fig. 69|
| Crematogaster quadriruga Forel, 1911                                   | Fig. 70|
| Crematogaster sp. clm01                                                | Fig. 71|
| Crematogaster sp. clm02                                                | Fig. 72|
| ** Dilobocondyla eguchii** Bharti & Kumar, 2013                        | Fig. 73|
| Gaoligongidris planodorsa Xu, 2012                                    | Fig. 74|
| Gauromyrmex sp. clm01                                                  | Fig. 75|
| Lordomyrma sp. clm01                                                   | Fig. 76|
| Monomorium *pharaonis* (Linnaeus, 1758)                                | Fig. 77|
| Monomorium sp. clm01                                                  | Fig. 78|
| Myrmica draco Radchenko, Zhou & Elms, 2001                             | Fig. 79|
| Myrmica pleorhityida Radchenko & Elmes, 2009                          | Fig. 80|
| Myrmica sp. clm01                                                     | Fig. 81|
| Myrmeicina sp. clm01                                                  | Fig. 82|
| Myrmeicina sp. clm02                                                   | Fig. 83|
| Myrmeicina sp. clm03                                                   | Fig. 84|
| Pheidole allani Bingham, 1903                                          | Figs 85, 86|
| Pheidole fervens Smith, 1858                                           | Fig. 87|
| Pheidole fervida Smith, 1874                                           | Fig. 88, 89|
| Pheidole gatesi (Wheeler, 1927)                                        | Fig. 90|
| Pheidole indica Mayr, 1879                                             | Fig. 91|
| Pheidole magna Eguchi, 2006                                            | Figs 92, 93|
| * Pheidole nodifera* (Smith 1858)                                      | Fig. 94|
| Pheidole zoeae Santschi, 1925                                          | Figs 95, 96|
| Pristomyrmex brevispinosus Emery, 1887                                 | Fig. 97|
| Pristomyrmex hamatus Xu & Zhang, 2002                                  | Fig. 98|
| Stenamma wumengense Liu & Xu, 2011                                    | Fig. 99|
| Strumigenys asamensis De Andrade, 1994                                | Fig. 100|
| Strumigenys strygax Bolton, 2000                                       | Fig. 101|
| ** Strumigenys taphra** (Bolton, 2000)                                 | Fig. 102|
| Strumigenys sp. clm01                                                  | Fig. 103|
| Strumigenys sp. clm02                                                  | Fig. 104|
| Strumigenys sp. clm03                                                 | Fig. 105|
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| Species | Figure |
|---------|--------|
| *Temnothorax striatus* Zhou, Huang, Yu & Liu, 2010 | Fig. 106 |
| *Temnothorax* sp. clm01 | Fig. 107 |
| *Temnothorax* sp. clm03 | Fig. 108 |
| *Tetramorium tonganum* Mayr, 1870 | Fig. 109 |
| *Tetramorium* sp. clm01 | Fig. 110 |
| *Tetramorium* sp. clm02 | Fig. 111 |
| *Tetramorium* sp. clm03 | Fig. 112 |
| *Tetramorium* sp. clm04 | Fig. 113 |
| *Vollenhovia pyrrhoria* Wu & Xiao, 1989 | Fig. 114 |
| *Vollenhovia* sp. clm03 | Fig. 115 |

### Ponerinae

| Species | Figure |
|---------|--------|
| Brachyponera lateipes (Mayr, 1862) | Fig. 116 |
| Ectomomyrmex lobocarenus (Xu, 1995) | Fig. 117 |
| **Ectomomyrmex obtusus** Emery, 1900 | Fig. 118 |
| Hypoponera sp. clm01 | Fig. 119 |
| Hypoponera sp. clm02 | Fig. 120 |
| Hypoponera sp. clm03 | Fig. 121 |
| Leptogenys birmana Forel, 1900 | Fig. 122 |
| Leptogenys kittingi (Mayr, 1870) | Fig. 123 |
| Odontomachus circulus Wang, 1993 | Fig. 124 |
| *Odontomachus fuscus* Wang, 1993 | Fig. 125 |
| Platethyrea parallela (Smith, 1859) | Fig. 126 |
| Ponera bawana Xu, 2001 | Fig. 127 |
| Ponera xanthid Xu, 2001 | Fig. 128 |

### Proceratinidae

| Species | Figure |
|---------|--------|
| Discothyrea banna Xu, Burwell & Nakamura, 2014 | Fig. 129 |
| Discothyrea diana Xu, Burwell & Nakamura, 2014 | Fig. 130 |
| Proceratium longigaster Karavaiev, 1935 | Fig. 131 |
| Proceratium longimenense Xu, 2006 | Fig. 132 |
| Proceratium zhaoi Xu, 2000 | Fig. 133 |

### Pseudomyrmecinae

| Species | Figure |
|---------|--------|
| Tetraponera allaborans (Walker, 1859) | Fig. 134 |
| Tetraponera attenuata Smith, 1877 | Fig. 135 |
| Tetraponera protensa Xu & Chai, 2004 | Fig. 136 |

### Table 2. Number of ant species of per genus collected in this survey as well the total number of each species per genus in Yunnan province.

| Genus                  | Gaoligongshan Mt. | Yunnan | Genus                  | Gaoligongshan Mt. | Yunnan |
|------------------------|-------------------|--------|------------------------|-------------------|--------|
| Camponotus             | 10                | 30     | Leptogenys             | 2                 | 17     |
| Pheidole               | 8                 | 42     | Monomorium             | 2                 | 6      |
| Polyrhachis            | 8                 | 32     | Odontomachus           | 2                 | 6      |
| Aphaenogaster          | 6                 | 10     | Ponera                 | 2                 | 14     |
| Strumigenys            | 6                 | 24     | Pseudomyrmex           | 2                 | 4      |
| Tetramorium            | 5                 | 29     | Pseudolasius           | 2                 | 6      |
| Aenictus               | 5                 | 19     | Vollenhovia            | 2                 | 3      |
| Carebara               | 5                 | 19     | Anoplolepis            | 1                 | 1      |
| Prenolepis             | 4                 | 7      | Brachyponera           | 1                 | 3      |
| Crematogaster          | 3                 | 25     | Cataulacus             | 1                 | 4      |
| Dolichoderus           | 3                 | 9      | Chrysaceae             | 1                 | 1      |
| Hypoponera             | 3                 | 7      | Dilobocondyla          | 1                 | 3      |
| Lasius                 | 2                 | 6      | Dorylus                | 1                 | 3      |
| Myrmica                | 3                 | 12     | Gaoligongidris         | 1                 | 1      |
Table 3. Ant species records that have been excluded from Yunnan when compared to the previous list. The explanation “Needs verification” usually signifies that the species has never been recorded before in this region and/or is easily mistaken for another species and likely to have been misidentified. “Dubious” means that the record occurrence is highly unlikely given the known species distribution. Notes provide additional references regarding records and/or further information.

| Excluded species records | Explanations | Notes |
|--------------------------|--------------|-------|
| Camponotus aethiops      | Needs verification | A Palearctic species with distribution in Asia needs confirmation |
| Camponotus spenceri      | Dubious      | An Australian species misreported previously |
| Cardiocondyla nuda       | Dubious      | Could be C. kagutsuchi, see Seifert 2003 |
| Discothyrea clavicornis  | Dubious      | A misidentification of D. diana |
| Discothyrea kamiteta     | Dubious      | A misidentification of D. banna |
| Formica fusca            | Needs verification | A Palearctic species with distribution in Asia needs confirmation |
| Hypoponera exoecata      | Needs verification | Species with distribution limited to East Asia |
| Lasius alienus           | Dubious      | See Seifert 2020 |
| Lasius emarginatus       | Dubious      | A West Palearctic species with distribution in Asia doubtful |
| Lasius fuliginosus       | Dubious      | See Espadaler et al. 2001 |
| Lasius niger             | Dubious      | See Seifert 1992 |
| Lasius productus         | Needs verification | Species with distribution limited to Japan and the Korean Peninsula |
| Lasius spathepus         | Needs verification | Species with distribution limited to Japan, the Korean Peninsula and Eastern Russia |
| Leptogenys yerburyi      | Dubious      | See Xu and He 2015 |
| Myrmica ireae            | Needs verification | See Chen et al. 2016. |
| Odontoponera transversa  | Dubious      | See Yamane 2009 |
| Proceratium deelemani    | Dubious      | Record represented a new species subsequently described in Staab et al. 2018. |
| Proceratium japonicum    | Dubious      | A misidentification of P. longisterr |
| Tetramorium melinus      | Needs verification | A central Asian species which presence in Yunnan requires confirmation |
| Tetenara trevorsculptura | Dubious      | An Indian species that is restricted to the Southwest. |
| Tetramorium globulinode   | Dubious      | An Afrotopical species incorrectly reported in Asia |
| Tetramorium khuen        | Dubious      | An endemic species in the Philippines |
| Tetramorium melinus      | Dubious      | A misidentification of T. wrighthonii |
| Tetraponera atakensi     | Dubious      | Phil Ward (Personal communication, 18 August 2015) |
| Tetraponera nigra        | Dubious      | Phil Ward (Personal communication, 18 August 2015) |
| Vollenhovia emeryi       | Dubious      | See Wetterer et al. 2015 |
### Table 4. Number of ant species (both native and exotic species) in Yunnan Province.

| Genus          | Native | Exotic | Genus          | Native | Exotic |
|----------------|--------|--------|----------------|--------|--------|
| *Pheidole*     | 42     | 0      | *Solenopsis*   | 2      | 1      |
| *Polyrhachis*  | 32     | 0      | *Acanthomyrmex*| 2      | 0      |
| *Camponotus*   | 30     | 0      | *Acropyga*     | 2      | 0      |
| *Tetramorium*  | 28     | 1      | *Echinopla*    | 2      | 0      |
| *Crematogaster*| 25     | 0      | *Meranoplus*   | 2      | 0      |
| *Strumigenys*  | 24     | 1      | *Myrmoteras*   | 2      | 0      |
| *Aenictus*     | 19     | 0      | *Paraparatrechina* | 2  | 0      |
| *Carebara*     | 19     | 0      | *Perissomyrmex*| 2      | 0      |
| *Ponera*       | 14     | 0      | *Pseudoneoponera* | 2  | 0      |
| *Tetraponera*  | 12     | 0      | *Rhopalomastix*| 2      | 0      |
| *Myrmica*      | 12     | 0      | *Trichomyrmex* | 0      | 2      |
| *Stigmatomma*  | 11     | 0      | *Vollenhovia*  | 2      | 0      |
| *Technomyrmex* | 11     | 0      | *Anoplolepis*  | 1      | 0      |
| *Aphaenogaster*| 10     | 0      | *Buniapone*    | 1      | 0      |
| *Nylanderia*   | 9      | 1      | *Centromyrmex* | 1      | 0      |
| *Dolichoderus* | 9      | 0      | *Cerapachy*    | 1      | 0      |
| *Ectomomyrmex* | 8      | 0      | *Chrysapace*   | 1      | 0      |
| *Leptotrema*   | 8      | 0      | *Diaecamma*    | 1      | 0      |
| *Colobopsis*   | 7      | 0      | *Emeryopone*   | 1      | 0      |
| *Hyponera*     | 5      | 2      | *Erromyrmex*   | 1      | 0      |
| *Prenolepis*   | 7      | 0      | *Euponera*     | 1      | 0      |
| *Tennothobax*  | 7      | 0      | *Gauliogonidris* | 1 | 0      |
| *Formica*      | 7      | 0      | *Gauromyrmex*  | 1      | 0      |
| *Gnamptogenys* | 7      | 0      | *Geomyrmex*    | 1      | 0      |
| *Myrmecina*    | 7      | 0      | *Harpegnathos* | 1      | 0      |
| *Anochetus*    | 6      | 0      | *Iridomyrmex*  | 1      | 0      |
| *Lasius*       | 6      | 0      | *Lasiummyrm*   | 1      | 0      |
| *Odontomachus* | 6      | 0      | *Lionetopum*   | 1      | 0      |
| *Pheidoleotus* | 5      | 0      | *Lioponera*    | 1      | 0      |
| *Cryptopone*   | 5      | 0      | *Lordomyrmex*  | 1      | 0      |
| *Monomorium*   | 5      | 0      | *Mesoponera*   | 1      | 0      |
| *Proceratium*  | 4      | 0      | *Messor*       | 1      | 0      |
| *Catagelatus*  | 4      | 0      | *Myrmicaria*   | 1      | 0      |
| *Plagiolepis*  | 3      | 1      | *Myrmix*       | 1      | 0      |
| *Pristomyrmex* | 4      | 0      | *Ochetellus*   | 1      | 0      |
| *Proanilla*    | 4      | 0      | *Odontoponera* | 1      | 0      |
| *Stenamma*     | 4      | 0      | *Octophyllia*  | 1      | 0      |
| *Tapinoma*     | 4      | 0      | *Ooceraea*     | 1      | 0      |
| *Brachyonera*  | 3      | 0      | *Parasycia*    | 1      | 0      |
| *Cardiocondyla*| 2      | 1      | *Paratrechina* | 0      | 1      |
| *Chronicen*    | 3      | 0      | *Philidris*    | 1      | 0      |
| *Dilobomyrmex* | 3      | 0      | *Prionopelta*  | 1      | 0      |
| *Discotyloga*  | 3      | 0      | *Probolomyrmex*| 1      | 0      |
| *Dorylus*      | 3      | 0      | *Rotastruma*   | 1      | 0      |
| *Karidris*     | 3      | 0      | *Simopone*     | 1      | 0      |
| *Leptanilla*   | 3      | 0      | *Sycia*        | 1      | 0      |
| *Lophomyrmex*  | 3      | 0      | *Vombisidrict* | 1      | 0      |
| *Myopias*      | 3      | 0      | *Yunodorylus*  | 1      | 0      |
| *Recurvidris*  | 3      | 0      |                |        |        |
**Aenictus artipus**

*Figure 1.* *Aenictus artipus* worker (MCZ-ENT00763651) **A** mesosoma in profile view **B** mesosoma in dorsal view **C** head in front view **D** global distribution map.
Aenictus brevinodus

Figure 2. Aenictus brevinodus worker (MCZ-ENT00763491, new to China) A mesosoma in profile view B mesosoma in dorsal view C head in front view D global distribution map.
Figure 3. *Aenictus hodgsoni* worker (MCZ-ENT00763191) A mesosoma in profile view B mesosoma in dorsal view C head in front view D global distribution map.

*Aenictus hodgsoni*
Figure 4. *Aenictus paradentatus* worker (MCZ-ENT00763384) A mesosoma in profile view B mesosoma in dorsal view C head in front view D global distribution map.

*Aenictus paradentatus*
Figure 5. *Aenictus watanasiti* worker (MCZ-ENT00764608, new to Yunnan) **A** mesosoma in profile view **B** mesosoma in dorsal view **C** head in front view **D** global distribution map.

*Aenictus watanasiti*
Figure 6. Cerapachys sulcinodis worker (MCZ-ENT00759751) **A** mesosoma in profile view **B** mesosoma in dorsal view **C** head in front view **D** global distribution map.

*Cerapachys sulcinodus*
**Figure 7.** *Cerapachys* sp1 worker (MCZ-ENT00763371) **A** mesosoma in profile view **B** mesosoma in dorsal view **C** head in front view.
**Chrysapace costatus**

**Figure 8.** *Chrysapace costatus* worker (MCZ-ENT00763341) **A** mesosoma in profile view **B** mesosoma in dorsal view **C** head in front view **D** global distribution map.
**Dorylus orientalis**

*Figure 9.* *Dorylus orientalis* minor worker (MCZ-ENT00760027) **A** mesosoma in profile view **B** mesosoma in dorsal view **C** head in front view **D** global distribution map.
**Dorylus orientalis** (soldier)

*Figure 10. Dorylus orientalis* major worker (MCZ-ENT00760028) **A** mesosoma in profile view **B** mesosoma in dorsal view **C** head in front view **D** global distribution map.
**Ooceraea biroi**

**Figure 11.** *Ooceraea biroi* worker (MCZ-ENT00759984) **A** mesosoma in profile view **B** mesosoma in dorsal view **C** head in front view **D** global distribution map.
Figure 12. *Stigmatoma octodentatum* worker (MCZ-ENT00759880) A mesosoma in profile view B mesosoma in dorsal view C head in front view D global distribution map.

*Stigmatoma octodentatum*
Figure 13. *Dolichoderus feae* worker (MCZ-ENT00763272) A mesosoma in profile view B mesosoma in dorsal view C head in front view D global distribution map.

*Dolichoderus feae*
**Figure 14.** *Dolichoderus squamanodus* worker (MCZ-ENT00762839) **A** mesosoma in profile view **B** mesosoma in dorsal view **C** head in front view **D** global distribution map.

*Dolichoderus squamanodus*
**Figure 15.** *Dolichoderus taprobanae* worker (MCZ-ENT00763246) **A** mesosoma in profile view **B** mesosoma in dorsal view **C** head in front view **D** global distribution map.

*Dolichoderus taprobanae*
Figure 16. *Ochetellus glaber* worker (MCZ-ENT00763401) **A** mesosoma in profile view **B** mesosoma in dorsal view **C** head in front view **D** global distribution map.

*Ochetellus glaber*
Figure 17. *Tapinoma melanocephalum* worker (MCZ-ENT00760062) **A** mesosoma in profile view **B** mesosoma in dorsal view **C** head in front view **D** global distribution map.

*Tapinoma melanocephalum*
Figure 18. Gnamptogenys quadrutinodules worker (MCZ-ENT00759741) A mesosoma in profile view B mesosoma in dorsal view C head in front view D global distribution map.

Gnamptogenys quadrutinodules
Figure 19. Anoplolepis gracilipes worker (MCZ-ENT00760060) A mesosoma in profile view B mesosoma in dorsal view C head in front view D global distribution map.
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Figure 20. *Camponotus bellus leucodiscus* worker (MCZ-ENT00760068, new to China) **A** mesosoma in profile view **B** mesosoma in dorsal view **C** head in front view **D** global distribution map.
**Camponotus keihitoi**

**Figure 21.** *Camponotus keihitoi* worker (MCZ-ENT00763692, new to China) **A** mesosoma in profile view **B** mesosoma in dorsal view **C** head in front view **D** global distribution map.
**Camponotus lasiselene**

**Figure 22.** *Camponotus lasiselene* minor worker (MCZ-ENT00763190) **A** mesosoma in profile view **B** mesosoma in dorsal view **C** head in front view **D** global distribution map.
Figure 23. *Camponotus lasiselene* major worker (MCZ-ENT00763247) A mesosoma in profile view B mesosoma in dorsal view C head in front view D global distribution map.

*Camponotus lasiselene*
Figure 24. *Camponotus mitis* worker (MCZ-ENT00763213) A mesosoma in profile view B mesosoma in dorsal view C head in front view D global distribution map.

*Camponotus mitis*
Figure 25. *Camponotus nicobarensis* worker (MCZ-ENT00763198) A mesosoma in profile view B mesosoma in dorsal view C head in front view D global distribution map.

*Camponotus nicobarensis*
Figure 26. *Camponotus* sp. clm01 worker (MCZ-ENT00762843) A mesosoma in profile view B mesosoma in dorsal view C head in front view.

*Camponotus* sp1
Figure 27. *Camponotus* sp. clm02 worker (MCZ-ENT00759861) A mesosoma in profile view B mesosoma in dorsal view C head in front view.
Figure 28. *Camponotus* sp. clm03 worker (MCZ-ENT00762821) **A** mesosoma in profile view **B** mesosoma in dorsal view **C** head in front view.
**Camponotus sp4**

*Figure 29.* *Camponotus* sp. clm04 worker (MCZ-ENT00762978) **A** mesosoma in profile view **B** mesosoma in dorsal view **C** head in front view.
Figure 30. *Camponotus* sp. clm05 worker (MCZ-ENT00763312) A mesosoma in profile view B mesosoma in dorsal view C head in front view.
**Figure 31.** *Formica cunicularia* worker (MCZ-ENT00759967) **A** mesosoma in profile view **B** mesosoma in dorsal view **C** head in front view **D** global distribution map.

*Formica cunicularia*
Figure 32. *Formica japonica* worker (MCZ-ENT00760066) A mesosoma in profile view B mesosoma in dorsal view C head in front view D global distribution map.
Lasius obscuratus

Figure 33. Lasius obscuratus worker (MCZ-ENT00760025, new to Yunnan) A mesosoma in profile view B mesosoma in dorsal view C head in front view D global distribution map.
Figure 34. *Lasius himalayanus* worker (MCZ-ENT00763360, new to Yunnan) **A** mesosoma in profile view **B** mesosoma in dorsal view **C** head in front view **D** global distribution map.

*Lasius himalayanus*
**Nylanderia bourbonica**

**Figure 35.** *Nylanderia bourbonica* worker (MCZ-ENT00760019) **A** mesosoma in profile view **B** mesosoma in dorsal view **C** head in front view **D** global distribution map.
Figure 36. *Nylanderia* sp. clm01 worker (MCZ-ENT00759776) A mesosoma in profile view B mesosoma in dorsal view C head in front view D global distribution map.
Figure 37. *Nylanderia* sp. clm02 worker (MCZ-ENT00759968) **A** mesosoma in profile view **B** mesosoma in dorsal view **C** head in front view **D** global distribution map.

* Nylanderia sp2
Figure 38. *Oecophylla smaragdina* worker (MCZ-ENT00763551) A mesosoma in profile view B mesosoma in dorsal view C head in front view D global distribution map.
Figure 39. *Paraparatrechina sakurae* worker (MCZ-ENT00759953) **A** mesosoma in profile view **B** mesosoma in dorsal view **C** head in front view **D** global distribution map.
Paraparatrechina sp1

Figure 40. *Paraparatrechina* sp. clm01 worker (MCZ-ENT00763500) A mesosoma in profile view
B mesosoma in dorsal view C head in front view D global distribution map.
Figure 41. *Paraparatotrechina* sp. clm02 worker (MCZ-ENT00763427) A mesosoma in profile view B mesosoma in dorsal view C head in front view D global distribution map.
Figure 42. *Polyrhachis armata* worker (MCZ-ENT00763282) **A** mesosoma in profile view **B** mesosoma in dorsal view **C** head in front view **D** global distribution map.

*Polyrhachis armata*
Figure 43. Polyrhachis bihamata worker (MCZ-ENT00763176). A mesosoma in profile view B mesosoma in dorsal view C head in front view D global distribution map.
Polyrhachis dives

Figure 44. *Polyrhachis dives* worker (MCZ-ENT00760042). **A** mesosoma in profile view **B** mesosoma in dorsal view **C** head in front view **D** global distribution map.
Polyrhachis furcata

Figure 45. Polyrhachis furcata worker (MCZ-ENT00763549) A mesosoma in profile view B mesosoma in dorsal view C head in front view D global distribution map.
Figure 46. *Polyrhachis halidayi* worker (MCZ-ENT00763195) A mesosoma in profile view B mesosoma in dorsal view C head in front view D global distribution map.
Figure 47. *Polyrhachis illaudata* worker (MCZ-ENT00760071) A mesosoma in profile view B mesosoma in dorsal view C head in front view D global distribution map.
Figure 48. *Polyrhachis laevigata* worker (MCZ-ENT00763568) A mesosoma in profile view B mesosoma in dorsal view C head in front view D global distribution map.
Figure 49. *Polyrhachis tibialis* worker (MCZ-ENT00763284). A mesosoma in profile view B mesosoma in dorsal view C head in front view D global distribution map.
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Figure 50. Prenolepis angularis worker (MCZ-ENT00763328, new to Yunnan). A mesosoma in profile view B mesosoma in dorsal view C head in front view D global distribution map.

Prenolepis angularis
Figure 51. *Prenolepis fustinoda* worker (MCZ-ENT00763200, new to Yunnan) A mesosoma in profile view B mesosoma in dorsal view C head in front view D global distribution map.

*Prenolepis fustinoda*
**Prenolepis sp1**

*Figure 52.* *Prenolepis* sp. clm01 worker (MCZ-ENT00763220) **A** mesosoma in profile view **B** mesosoma in dorsal view **C** head in front view.
Figure 53. *Prenolepis* sp. clm02 worker (MCZ-ENT00763467) **A** mesosoma in profile view **B** mesosoma in dorsal view **C** head in front view.

*Prenolepis* sp2
Figure 54. *Pseudolasius emeryi* worker (MCZ-ENT00762951) A mesosoma in profile view B mesosoma in dorsal view C head in front view D global distribution map.

*Pseudolasius emeryi*
Figure 55. *Pseudolasius silvestrii* worker (MCZ-ENT00762838) A mesosoma in profile view B mesosoma in dorsal view C head in front view D global distribution map.
**Aphenogaster feae**

*Figure 56. Aphaenogaster feae* worker (MCZ-ENT00763554) **A** mesosoma in profile view **B** mesosoma in dorsal view **C** head in front view **D** global distribution map.
**Aphenogaster sp1**

**Figure 57.** *Aphenogaster* sp. clm01 worker (MCZ-ENT00762870) **A** mesosoma in profile view **B** mesosoma in dorsal view **C** head in front view.
Figure 58. *Aphaenogaster* sp. clm02 worker (MCZ-ENT00763366) **A** mesosoma in profile view **B** mesosoma in dorsal view **C** head in front view.

*Aphaenogaster* sp2
**Aphaenogaster** sp3

Figure 59. *Aphaenogaster* sp. clm03 worker (MCZ-ENT00763603) **A** mesosoma in profile view **B** mesosoma in dorsal view **C** head in front view.
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**Aphenogaster sp4**

*Figure 60. Aphenogaster sp. clm04 worker (MCZ-ENT00764622) A mesosoma in profile view B mesosoma in dorsal view C head in front view.*
Figure 61. *Aphaenogaster* sp. clm05 worker (MCZ-ENT00762809) A mesosoma in profile view B mesosoma in dorsal view C head in front view.
Figure 62. *Cardiocondyla itsukii* worker (MCZ-ENT00762820, new to Yunnan) **A** mesosoma in profile view **B** mesosoma in dorsal view **C** head in front view **D** global distribution map.

*Cardiocondyla itsukii*

**Figure 62.** *Cardiocondyla itsukii* worker (MCZ-ENT00762820, new to Yunnan) **A** mesosoma in profile view **B** mesosoma in dorsal view **C** head in front view **D** global distribution map.
Cardiocondyla sp1

Figure 63. *Cardiocondyla* sp. clm01 worker (MCZ-ENT00763607) A mesosoma in profile view B mesosoma in dorsal view C head in front view.
Carebara acutispina

Figure 64. Carebara affinis worker (MCZ-ENT00759841) A mesosoma in profile view B mesosoma in dorsal view C head in front view D global distribution map.
Carebara affinis

Figure 65. Carebara acutispina worker (MCZ-ENT00759773) A mesosoma in profile view B mesosoma in dorsal view C head in front view D global distribution map.
Carebara altinoda

Figure 66. Carebara altinoda worker (MCZ-ENT00759928) A mesosoma in profile view B mesosoma in dorsal view C head in front view D global distribution map.
**Figure 67.** *Carebara bihornata* worker (MCZ-ENT00759796) A mesosoma in profile view B mesosoma in dorsal view C head in front view D global distribution map.

*Caerbara bihornata*
**Carebara sp1**

*Figure 68. Carebara sp. clm01 worker (MCZ-ENT00759855) A mesosoma in profile view B mesosoma in dorsal view C head in front view.*
Catalulacus marginatus

Figure 69. Catalulacus marginatus worker (MCZ-ENT00760045, new to Yunnan) A mesosoma in profile view B mesosoma in dorsal view C head in front view D global distribution map.
Figure 70. *Crematogaster quadriruga* worker (MCZ-ENT00759778) **A** mesosoma in profile view **B** mesosoma in dorsal view **C** head in front view **D** global distribution map.
Figure 71. *Crematogaster* sp. clm01 worker (MCZ-ENT00762837) A mesosoma in profile view B mesosoma in dorsal view C head in front view.
Figure 72. *Crematogaster* sp. clm02 worker (MCZ-ENT00762875) **A** mesosoma in profile view **B** mesosoma in dorsal view **C** head in front view.

*Crema*togaster sp2
Figure 73. *Dilobocondyla eguchii* worker (MCZ-ENT00763656, new to China) **A** mesosoma in profile view **B** mesosoma in dorsal view **C** head in front view **D** global distribution map.
**Gaoligongidris planodorsa**

**Figure 74.** *Gaoligongidris planodorsa* worker (MCZ-ENT00759792) A mesosoma in profile view B mesosoma in dorsal view C head in front view D global distribution map.
Grauromyrmex sp1

**Figure 75.** *Grauromyrmex* sp. clm01 worker (MCZ-ENT00764656) A mesosoma in profile view B mesosoma in dorsal view C head in front view D global distribution map.
Figure 76. *Lordomyrma* sp1 worker (MCZ-ENT00763514) A mesosoma in profile view B mesosoma in dorsal view C head in front view D global distribution map.
Figure 77. *Monomorium pharaonis* worker (MCZ-ENT00760064) **A** mesosoma in profile view **B** mesosoma in dorsal view **C** head in front view **D** global distribution map.
**Monomorium sp1**

*Figure 78. Monomorium* sp. clm01 worker (MCZ-ENT00759771) **A** mesosoma in profile view  **B** mesosoma in dorsal view  **C** head in front view.
**Myrmica draco**

**Figure 79.** *Myrmica draco* worker (MCZ-ENT00759985) **A** mesosoma in profile view **B** mesosoma in dorsal view **C** head in front view **D** global distribution map.
Myrmica pleiorhytida

Figure 80. Myrmica pleiorhytida worker (MCZ-ENT00759935) A mesosoma in profile view B mesosoma in dorsal view C head in front view D global distribution map.
Figure 81. *Myrmica* sp. clm01 worker (MCZ-ENT00763256) A mesosoma in profile view B mesosoma in dorsal view C head in front view.

*Myrmica* sp1
**Myrmecina sp1**

**Figure 82.** _Myrmecina_ sp. clm01 worker (MCZ-ENT00759959) A mesosoma in profile view B mesosoma in dorsal view C head in front view.
Figure 83. Myrmecina sp. clm02 worker (MCZ-ENT00759803). A mesosoma in profile view B mesosoma in dorsal view C head in front view.

Myrmecina sp2
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Figure 84. *Myrmecina* sp. clm03 worker (MCZ-ENT00763515). **A** mesosoma in profile view **B** mesosoma in dorsal view **C** head in front view.

*Myrmecina* sp3
Figure 85. *Pheidole allani* minor worker (MCZ-ENT00759865) **A** mesosoma in profile view **B** mesosoma in dorsal view **C** head in front view **D** global distribution map.

_Pheidole allani_
**Pheidole allani**

*Figure 86. Pheidole allani* major worker (MCZ-ENT00759866) **A** mesosoma in profile view **B** mesosoma in dorsal view **C** head in front view **D** global distribution map.
**Pheidole fervens**

**Figure 87.** *Pheidole fervens* worker (MCZ-ENT00764619) **A** mesosoma in profile view **B** mesosoma in dorsal view **C** head in front view **D** global distribution map.
**Figure 88.** *Pheidole fervida* minor worker (MCZ-ENT00759918) **A** mesosoma in profile view **B** mesosoma in dorsal view **C** head in front view **D** global distribution map.

*Pheidole fervida*
**Figure 89.** *Pheidole fervida* major worker (MCZ-ENT00760026) **A** mesosoma in profile view **B** mesosoma in dorsal view **C** head in front view **D** global distribution map.
Figure 90. *Pheidole gatesi* worker (MCZ-ENT00763577) A mesosoma in profile view B mesosoma in dorsal view C head in front view D global distribution map.
Figure 91. *Pheidole indica* worker (MCZ-ENT00762822) A mesosoma in profile view B mesosoma in dorsal view C head in front view D global distribution map.

*Pheidole indica*
**Figure 92.** *Pheidole magna* minor worker (MCZ-ENT00759762) **A** mesosoma in profile view **B** mesosoma in dorsal view **C** head in front view **D** global distribution map.

*Pheidole magna minor*
**Pheidole magna**

**Figure 93.** *Pheidole magna* major worker (MCZ-ENT00759980) **A** mesosoma in profile view **B** mesosoma in dorsal view **C** head in front view **D** global distribution map.
Pheidole nodifera

Figure 94. *Pheidole nodifera* worker (MCZ-ENT00759837, new to Yunnan) **A** mesosoma in profile view  **B** mesosoma in dorsal view  **C** head in front view  **D** global distribution map.
**Figure 95.** *Pheidole zoceana* minor worker (MCZ-ENT00760015) **A** mesosoma in profile view **B** mesosoma in dorsal view **C** head in front view **D** global distribution map.

*Pheidole zoceana*
Figure 96. Pheidole zoceana major worker (MCZ-ENT00760016) A mesosoma in profile view B mesosoma in dorsal view C head in front view D global distribution map.
Figure 97. *Pristomyrmex brevispinosus* worker (MCZ-ENT00763505) A mesosoma in profile view B mesosoma in dorsal view C head in front view D global distribution map.

*Pristomyrmex brevispinosus*
Figure 98. *Pristomyrmex hamatus* worker (MCZ-ENT00763502) A mesosoma in profile view B mesosoma in dorsal view C head in front view D global distribution map.
Figure 99. *Stenamma wumengense* worker (MCZ-ENT00762907) **A** mesosoma in profile view **B** mesosoma in dorsal view **C** head in front view **D** global distribution map.

*Stenamma wumengense*

Figure 99. *Stenamma wumengense* worker (MCZ-ENT00762907) **A** mesosoma in profile view **B** mesosoma in dorsal view **C** head in front view **D** global distribution map.
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Figure 100. *Strumigenys assamensis* worker (MCZ-ENT00759885) **A** mesosoma in profile view **B** mesosoma in dorsal view **C** head in front view **D** global distribution map.

*Strumigenys assamensis*
Figure 101. *Strumigenys strygax* worker (MCZ-ENT00763507)  
A mesosoma in profile view  
B mesosoma in dorsal view  
C head in front view  
D global distribution map.

*Strumigenys strygax*

Figure 101. *Strumigenys strygax* worker (MCZ-ENT00763507)  
A mesosoma in profile view  
B mesosoma in dorsal view  
C head in front view  
D global distribution map.
Figure 102. *Strumigenys taphra* worker (MCZ-ENT00759758, new to China) A mesosoma in profile view B mesosoma in dorsal view C head in front view D global distribution map.
Figure 103. *Strumigenys* sp. clm01 worker (MCZ-ENT00763511) A mesosoma in profile view B mesosoma in dorsal view C head in front view.

*Strumigenys* sp1
Figure 104. *Strumigenys* sp. clm02 worker (MCZ-ENT00759897) **A** mesosoma in profile view **B** mesosoma in dorsal view **C** head in front view.

*Strumigenys* sp2
**Figure 105.** *Strumigenys* sp. clm03 worker (MCZ-ENT00759991) **A** mesosoma in profile view **B** mesosoma in dorsal view **C** head in front view.
Figure 106. *Temnothorax striatus* worker (MCZ-ENT00759763, new to Yunnan) **A** mesosoma in profile view **B** mesosoma in dorsal view **C** head in front view **D** global distribution map.

*Temnothorax striatus*
**Figure 107.** *Temnothorax* sp1 worker (MCZ-ENT00759977)  
A mesosoma in profile view  
B mesosoma in dorsal view  
C head in front view.

*Temnothorax* sp1
Temnothorax sp3

Figure 108. *Temnothorax* sp. clm03 worker (MCZ-ENT00763303) A mesosoma in profile view B mesosoma in dorsal view C head in front view.
Figure 109. *Tetramorium tonganum* worker (MCZ-ENT00764651) A mesosoma in profile view B mesosoma in dorsal view C head in front view D global distribution map.
**Tetramorium sp1**

*Figure 110.* *Tetramorium* sp. clm01 worker (MCZ-ENT00759754) **A** mesosoma in profile view **B** mesosoma in dorsal view **C** head in front view.
**Tetramorium sp2**

**Figure 111.** *Tetramorium* sp. clm02 worker (MCZ-ENT00763454) **A** mesosoma in profile view **B** mesosoma in dorsal view **C** head in front view.
Tetramorium sp3

Figure 112. *Tetramorium* sp. clm03 worker (MCZ-ENT00760040) A mesosoma in profile view B mesosoma in dorsal view C head in front view.
Figure 113. *Tetramorium* sp. clm04 worker (MCZ-ENT00759856) **A** mesosoma in profile view **B** mesosoma in dorsal view **C** head in front view.
**Figure 114.** *Vollenhovia pyrrhoria* worker (MCZ-ENT00759854) **A** mesosoma in profile view **B** mesosoma in dorsal view **C** head in front view **D** global distribution map.

*Vollenhovia pyrrhoria*
**Figure 115.** *Vollenhovia* sp. clm03 worker (MCZ-ENT00764617) A mesosoma in profile view B mesosoma in dorsal view C head in front view.
Figure 116. *Brachyponera luteipes* worker (MCZ-ENT00759752) A mesosoma in profile view B mesosoma in dorsal view C head in front view D global distribution map.
Figure 117. *Ectomomyrmex lobocarenus* worker (MCZ-ENT00759748) **A** mesosoma in profile view **B** mesosoma in dorsal view **C** head in front view **D** global distribution map.

*Ectomomyrmex lobocarenus*
Figure 118. *Ectomomyrmex obtusus* worker (MCZ-ENT00759859, new to China) **A** mesosoma in profile view **B** mesosoma in dorsal view **C** head in front view **D** global distribution map.

*Ectomomyrmex obtusus*
Figure 119. *Hypoponera* sp1 worker (MCZ-ENT00759780) **A** mesosoma in profile view **B** mesosoma in dorsal view **C** head in front view.
Figure 120. Hypoponera sp. clm02 worker (MCZ-ENT00759849) A mesosoma in profile view B mesosoma in dorsal view C head in front view.
Figure 121. *Hypoponera* sp. clm03 worker (MCZ-ENT00759808) **A** mesosoma in profile view **B** mesosoma in dorsal view **C** head in front view.

*Hypoponera* sp3
**Figure 122.** *Leptogenys birmana* worker (MCZ-ENT00763178) **A** mesosoma in profile view **B** mesosoma in dorsal view **C** head in front view **D** global distribution map.

*Leptogenys birmana*
**Figure 123.** *Leptogenys kitteli* worker (MCZ-ENT00763321). A mesosoma in profile view B mesosoma in dorsal view C head in front view D global distribution map.

*Leptogenys kitteli*
**Odontomachus circulus**

**Figure 124.** *Odontomachus circulus* worker (MCZ-ENT00762856). **A** mesosoma in profile view **B** mesosoma in dorsal view **C** head in front view **D** global distribution map.
Figure 125. *Odontomachus fulgidus* worker (MCZ-ENT00760009, new to Yunnan) **A** mesosoma in profile view **B** mesosoma in dorsal view **C** head in front view **D** global distribution map.

*Odontomachus fulgidus*
**Platythyrea parallela**

**Figure 126.** *Platythyrea parallela* worker (MCZ-ENT00763657) **A** mesosoma in profile view **B** mesosoma in dorsal view **C** head in front view **D** global distribution map.
Ponera bawana

Figure 127. Ponera bawana worker (MCZ-ENT00759807) A mesosoma in profile view B mesosoma in dorsal view C head in front view D global distribution map.
Figure 128. *Ponera xantha* worker (MCZ-ENT00759845) **A** mesosoma in profile view **B** mesosoma in dorsal view **C** head in front view **D** global distribution map.

*Ponera xantha*
Figure 129. *Discothyrea banna* worker (MCZ-ENT00759809) **A** mesosoma in profile view **B** mesosoma in dorsal view **C** head in front view **D** global distribution map.

*Discothyrea banna*
Figure 130. *Discothyrea diana* worker (MCZ-ENT00759806) A mesosoma in profile view B mesosoma in dorsal view C head in front view D global distribution map.

*Discothyrea dina*
**Proceratium longigaster**

Figure 131. *Proceratium longigaster* worker (MCZ-ENT00759931) A mesosoma in profile view B mesosoma in dorsal view C head in front view D global distribution map.
Figure 132. Proceratium longmenensense worker (MCZ-ENT00763325) A mesosoma in profile view B mesosoma in dorsal view C head in front view D global distribution map.
**Proceratium zhaoi**

*Figure 133.* *Proceratium zhaoi* worker (MCZ-ENT00759857)  

A mesosoma in profile view  

B mesosoma in dorsal view  

C head in front view  

D global distribution map.
**Tetraponera allaborans**

**Figure 134.** *Tetraponera allaborans* worker (MCZ-ENT00763523) **A** mesosoma in profile view **B** mesosoma in dorsal view **C** head in front view **D** global distribution map.
Figure 135. *Tetraponera attenuata* worker (MCZ-ENT00763165) A mesosoma in profile view B mesosoma in dorsal view C head in front view D global distribution map.
Tetraponera protensa

Figure 136. Tetraponera protensa worker (MCZ-ENT00763526) A mesosoma in profile view B mesosoma in dorsal view C head in front view D global distribution map.
Yunnan ant list:

**AMBLYOPONINAE**

**Mystrium**: 1 species

*Mystrium camillae* Emery, 1989

**Prionopelta**: 1 species (undescribed)

*Prionopelta* sp.

**Stigmatomma**: 11 species

* Stigmatomma amblyops Karavaiev, 1935
* Stigmatomma awa (Xu, 2012)
* Stigmatomma crenatum (Xu, 2001)
* Stigmatomma kangba (Xu, 2012)
* Stigmatomma meilianum (Xu, 2012)
* Stigmatomma mulanae (Xu, 2000)
* Stigmatomma octodentatum (Xu, 2006)
* Stigmatomma rothneyi (Forel, 1900)
* Stigmatomma scrobiceps (Guénard, 2013)
* Stigmatomma silvestrii (Wheeler, 1928)
* Stigmatomma trilobum (Xu, 2001)

**DOLICHODERINAE**

**Chronoxenus**: 3 species

*Chronoxenus myops* (Forel, 1895)
*Chronoxenus walshii* (Forel, 1895)
*Chronoxenus wroughtonii* (Forel, 1895)

**Dolichoderus**: 9 species

*Dolichoderus affinis* Emery, 1889
*Dolichoderus feae* Emery, 1889
*Dolichoderus incisus* Xu, 1995
* Dolichoderus laotius Santschi, 1920
* Dolichoderus moggridgei Forel, 1886
* Dolichoderus sagmanotus* Xu, 2001
* Dolichoderus squamanodus* Xu, 2001
* Dolichoderus taprobanae* (Smith, 1858)
Dolichoderus thoracicus (Smith, 1860)

**Iridomyrmex:** 1 species

*Iridomyrmex anceps* (Roger, 1863)

**Liometopum:** 1 species

*Liometopum sinense* Wheeler, 1921

**Ochetellus:** 1 species

*Ochetellus glaber* (Mayr, 1862)

**Philidris:** 1 species

*Philidris laevigata* (Emery, 1895)

**Tapinoma:** 4 species

*Tapinoma geei* Wheeler, 1927  
*Tapinoma indicum* Wheeler, 1895  
*Tapinoma melanocephalum* (Fabricius, 1793)  
*Tapinoma wroughtonii* Forel, 1904

**Technomyrmex:** 11 species

*Technomyrmex albipes* (Smith, 1861)  
*Technomyrmex antennus* Zhou, 2001  
*Technomyrmex bicolor* Emery, 1893  
*Technomyrmex brunneus* Forel, 1895  
*Technomyrmex elatior* Forel, 1902  
*Technomyrmex horni* Forel, 1912  
*Technomyrmex kraepelini* Forel, 1905  
*Technomyrmex obscurior* Wheeler, 1928  
*Technomyrmex pratensis* (Smith, 1860)  
*Technomyrmex vitiensis* Mann, 1921  
*Technomyrmex yamanei* Bolton, 2007

**Dorylinae**

**Aenictus:** 19 species

* *Aenictus artipus* Wilson, 1964
Aenictus binghamii Forel, 1900
*Aenictus brevinodus* Jaitrong & Yamane, 2011
Aenictus ceylonicus (Mayr, 1866)
Aenictus dentatus Forel, 1911
Aenictus feae Emery, 1889
Aenictus fergusoni Forel, 1901
Aenictus grandis Bingham, 1903
Aenictus hodgsoni Forel, 1901
Aenictus laeviceps (Smith, 1857)
*Aenictus maneerati* Jaitrong & Yamane, 2013
*Aenictus paradentatus* Jaitrong & Yamane, 2012
Aenictus piercei Wheeler & Chapman, 1930
Aenictus punensis Forel, 1901
Aenictus shuckardi Forel, 1901
Aenictus thailandianus Terayama & Kubota, 1993
*Aenictus watanasiti* Jaitrong & Yamane, 2013
Aenictus westwoodi Forel, 1901
* Aenictus yangi Liu, 2015

**Cerapachys**: 1 species

Cerapachys sulcinodis Emery, 1889

**Chrysapace**: 1 species

* Chrysapace costatus (Bharti & Wachkoo, 2013)

**Dorylus**: 3 species

Dorylus laevigatus (Smith, 1857)
Dorylus orientalis Westwood, 1835
Dorylus vishnui Wheeler, 1913

**Lioponera**: 1 species

Lioponera longitarsus (Mayr, 1879)

**Ooceraea**: 1 species

Ooceraea biroi (Forel, 1907)

**Parasyscia**: 1 species

Parasyscia fossulata (Forel, 1895)
**Simopone**: 1 species

*Simopone yunnanensis* Chen, 2015

**Syscia**: 1 species

*Syscia typhla* Roger, 1861

**Yunodorylus**: 1 species

*Yunodorylus sexspinus* Xu, 2000

**ECTATOMMINAE**

**Gnamptogenys**: 6 species

*Gnamptogenys bicolor* (Emery, 1889)
*Gnamptogenys coccina* Zhou, 2001
*Gnamptogenys coxalis* (Roger, 1860)
*Gnamptogenys quadrutinodules* Chen, 2017
*Gnamptogenys sichuanensis* Lattke, 2004
*Gnamptogenys sinensis* Wu & Xiao, 1987
*Gnamptogenys treta* Lattke, 2004

**FORMICINAE**

**Acropyga**: 2 species

*Acropyga nipponensis* Terayama, 1985
*Acropyga yaeyamensis* Terayama & Hashimoto, 1996

**Anoplolepis**: 1 species

*Anoplolepis gracilipes* (Smith, 1857)

**Camponotus**: 28 species

*Camponotus albosparsus* Bingham, 1903
*Camponotus anningensis* Wu & Wang, 1989
*Camponotus auratiacus* Zhou, 2001
*Camponotus barbatus taylori* Forel, 1892
*Camponotus bellus leucodiscus* Wheeler, 1919
*Camponotus binghamii* Forel, 1894
*Camponotus chongqingensis* Wu & Wang, 1989
Camponotus compressus (Fabricius, 1787)
Camponotus confucii Forel, 1894
Camponotus cornis Wang & Wu, 1994
* Camponotus crassisquamis Forel, 1902
Camponotus dolendus Forel, 1892
Camponotus exiguo guttatus Forel, 1886
* Camponotus fuscivillosus Xiao & Wang, 1989
Camponotus holosericeus Emery, 1889
* Camponotus invidus Forel, 1892
* Camponotus itoi Forel, 1912
Camponotus japonicus Mayr, 1866
Camponotus jianghuaensis Xiao & Wang, 1989
Camponotus lasistene Wang & Wu, 1994
Camponotus minus Wang & Wu, 1994
Camponotus mitis (Smith, 1858)
Camponotus nicobarensis Mayr, 1865
Camponotus parius Emery, 1889
Camponotus pseudoirritans Wu & Wang, 1989
Camponotus pseudolendus Wu & Wang, 1989
* Camponotus radiatus Forel, 1892
Camponotus siemsseni Forel, 1901
Camponotus singularis (Smith, 1858)
Camponotus tonkinus Santschi, 1925
Camponotus vitiosus (Smith, 1874)

Colobopsis: 7 species

Colobopsis badia (Smith, 1857)
* Colobopsis ceylonica (Emery, 1925)
Colobopsis cotesii (Forel, 1893)
Colobopsis leonardi (Emery, 1889)
Colobopsis politae (Wu & Wang, 1994)
Colobopsis rothneyi (Forel, 1893)
Colobopsis vitrea (Smithi, 1860)

Echinopla: 2 species

* Echinopla cherapunjiensis Bharti & Gul, 2012
* Echinopla striata Smith, 1857

Formica: 5 species

Formica cunicularia Latreille, 1798
* Formica gagatoides Ruzsky, 1904
* Formica glabridorsis Santschi, 1925
* Formica lemani Bondroit, 1917
Formica japonica Motschoulsky, 1866
* Formica sanguinea Latreille, 1798
Formica sinensis Wheeler, 1913

**Gesomyrmex:** 1 species

* Gesomyrmex kalshoveni Wheeler, 1929

**Lasius:** 6 species

Lasius draco Collingwood, 1982
Lasius flavus (Fabricius, 1782)
* Lasius himalayanus Bingham, 1903
Lasius nipponensis Forel, 1912
* Lasius obscuratus Stitz, 1930
Lasius sichuense Seifert, 2020

**Lepisiota:** 8 species

Lepisiota acuta Xu, 1994
Lepisiota capensis (Mayr, 1862)
Lepisiota opaca (Forel, 1892)
* Lepisiota pulchella (Forel, 1892)
Lepisiota reticulata Xu, 1994
Lepisiota rothneyi (Forel, 1894)
Lepisiota rothneyi wroughtonii (Forel, 1902)
Lepisiota xichangensis (Wu & Wang, 1995)

**Myrmoteras:** 2 species

Myrmoteras binghamii Forel, 1893
Myrmoteras cuneonodus Xu, 1998

**Nylanderia:** 10 species

Nylanderia birmana (Forel, 1902)
Nylanderia bourbonica (Forel, 1886)
* Nylanderia emmae (Forel, 1894)
* Nylanderia flaviabdominis (Wang, 1997)
Nylanderia flavipes (Smith, 1874)
Nylanderia indica (Forel, 1894)
Nylanderia sharpii (Forel, 1899)
Nylanderia taylori (Forel, 1894)
Nylanderia vividula (Nylander, 1846) (Exotic)
Nylanderia yerburyi (Forel, 1894)

**Oecophylla:** 1 species

*Oecophylla smaragdina* (Fabricius, 1775)

**Paraparatrechina:** 2 species

* Paraparatrechina sakurae (Ito, 1914)
* Paraparatrechina sauteri (Forel, 1913)

**Paratrechina:** 1 species

*Paratrechina longicornis* (Latreille, 1802) (Exotic)

**Plagiolepis:** 4 species

*Plagiolepis alluaudi* Emery, 1894 (Exotic)
*Plagiolepis demangei* Santschi, 1920
*Plagiolepis exigua* Forel, 1894
* Plagiolepis jerdonii Forel, 1894

**Polyrhachis:** 32 species

*Polyrhachis armata* (Le Guillou, 1842)
*Polyrhachis bakana* Xu, 1998
*Polyrhachis bicolor* Smith, 1858
*Polyrhachis bihamata* (Drury, 1773)
*Polyrhachis brevicorpa* Xu, 2002
*Polyrhachis burmanensis* Donisthorpe, 1938
*Polyrhachis cornihamera* Xu, 2002
*Polyrhachis cornhumera* Zhou & Huang, 2002
*Polyrhachis cyphonota* Xu, 1998
*Polyrhachis dentibumera* Xu, 2002
*Polyrhachis dives* Smith, 1857
* Polyrhachis exercita* (Walker, 1859)
*Polyrhachis furcata* Smith, 1858
*Polyrhachis gibba* Emery, 1901
*Polyrhachis halidayi* Emery, 1889
* Polyrhachis hippomanae Emery, 1861
* Polyrhachis hippocapenes ceylonensis Emery, 1893
Polyrhachis illaudata Walker, 1859
Polyrhachis jianghuaensis Wang & Wu, 1991
Polyrhachis laevigata Smith, 1857
Polyrhachis moesta Emery, 1887
Polyrhachis orbihumera Xu, 2002
Polyrhachis paracamponota Wang & Wu, 1991
Polyrhachis proxima Roger, 1863
Polyrhachis pubescens Mayr, 1879
Polyrhachis punctillata Roger, 1863
Polyrhachis rastellata (Latreille, 1802)
Polyrhachis rotocippita Xu, 2002
Polyrhachis rufipes Smith, 1858
Polyrhachis thompsoni Bingham, 1903
Polyrhachis thrinax Roger, 1863
Polyrhachis tibialis Smith, 1858

Prenolepis: 7 species

Prenolepis angularis Zhou, 2001
* Prenolepis fustinoda Williams & LaPolla, 2016
* Prenolepis mediops Williams & LaPolla, 2016
Prenolepis melanogaster Emery, 1893
Prenolepis naoroji Forel, 1902
* Prenolepis shanialena Williams & LaPolla, 2016
* Prenolepis striata Chen & Zhou, 2018

Pseudolasius: 6 species

Pseudolasius bidenticypeus Xu, 1997
Pseudolasius cibdelus Wu & Wang, 1992
Pseudolasius emeryi Forel, 1911
Pseudolasius familiaris (Smith, 1860)
Pseudolasius risii Forel, 1894
Pseudolasius silvestrii Wheeler, 1927

LEPTANILLINAE

Leptanilla: 3 species

Leptanilla hunanensis Tang, Li & Chen, 1992
Leptanilla kunmingensis Xu & Zhang, 2002
Leptanilla yunnanensis Xu, 2002

**Protanilla**: 4 species

- Protanilla bicolor Xu, 2002
- Protanilla concolor Xu, 2002
- *Protanilla furcomandibula* Xu, 2002
- Protanilla gengma Xu, 2012

**MYRMICINAE**

*Acanthomyrmex*: 2 species

- *Acanthomyrmex glabfemoralis* Zhou & Zheng, 1997
- *Acanthomyrmex luciolae* Emery, 1893

*Aphaenogaster*: 9 species

- *Aphaenogaster beccarii* Emery, 1887
- *Aphaenogaster exasperata* (Smith, 1921)
- *Aphaenogaster famelica* (Smith, 1874)
- *Aphaenogaster feae* Emery, 1889
- *Aphaenogaster geei* Wheeler, 1921
- *Aphaenogaster japonica* Forel, 1911
- *Aphaenogaster lepida* Wheeler, 1930
- *Aphaenogaster rothneyi* (Forel, 1902)
- *Aphaenogaster schurri* (Forel, 1902)
- *Aphaenogaster smythiesii* (Forel, 1902)

*Cardiocondyla*: 3 species

- *Cardiocondyla itsukii* Seifert, Okita & Heinze, 2017 (*Exotic*)
- *Cardiocondyla obscurior* Wheeler, 1929
- *Cardiocondyla wroughtonii* (Forel, 1890)

*Carebara*: 18 species

- *Carebara acutispina* (Xu, 2003)
- *Carebara affinis* (Jerdon, 1951)
- *Carebara altinoda* (Xu, 2003)
- *Carebara asina* (Forel, 1902)
- *Carebara bengalensis* (Forel, 1902)
- *Carebara bibornata* (Xu, 2003)
Carebara curvispina (Xu, 2003)
* Carebara diversa (Jerdon, 1851)
* Carebara jiangxiensis Wu & Wang, 1995
Carebara lignata Westwood, 1840
* Carebara melasolena (Zhou & Zheng, 1997)
Carebara obtusidenta (Xu, 2003)
Carebara polyphemus (Wheeler, 1928)
Carebara rectidorsa (Xu, 2003)
Carebara reticapita (Xu, 2003)
Carebara striata (Forel, 2003)
Carebara taiponica (Wheeler, 1928)
Carebara trechideros (Zhou & Zheng, 1997)
Carebara wheeleri (Ettershank, 1966)

* Cataulacus: 4 species

Cataulacus granulatus (Latreille, 1802)
* Cataulacus marginatus Bolton, 1974
Cataulacus simoni Emery, 1893
Cataulacus taprobanae Smith, 1853

* Crematogaster: 25 species

Crematogaster anthracina Smith, 1857
* Crematogaster artifex Mayr, 1879
Crematogaster binghamii Forel, 1904
Crematogaster biroi Mayr, 1897
* Crematogaster contemta Mayr, 1879
Crematogaster dalyi Forel, 1902
Crematogaster dohrni Mayr, 1879
Crematogaster ebenina Forel, 1902
Crematogaster ferrarii Emery, 1888
Crematogaster hodgsoni Forel, 1902
* Crematogaster inflata Smith, 1857
Crematogaster macaoensis Wu & Wang, 1995
Crematogaster matsumurai Forel, 1901
Crematogaster nawai Ito, 1914
Crematogaster osakensis Forel, 1900
Crematogaster politula Forel, 1902
* Crematogaster quadriruga Forel, 1911
Crematogaster rogenhoferi Mayr, 1879
Crematogaster rothneyi Mayr, 1879
Crematogaster subnuda Mayr, 1879
Crematogaster travancorensis Forel, 1902
Crematogaster treubi Emery, 1896
Crematogaster walshi Forel, 1902
Crematogaster wroughtonii Forel, 1902
Crematogaster zoceensis Santschi, 1925

Dilobocondyla: 3 species

* Dilobocondyla eguchii Bharti & Kumar, 2013
Dilobocondyla fouqueti Santschi, 1910
* Dilobocondyla gasteroreticulata Bharti & Kumar, 2013

Erromyrma: 1 species

Erromyrma latinodis (Mayr, 1872)

Gaoligongidris: 1 species

Gaoligongidris planodorsa Xu, 2012

Gauromyrmex: 1 species

Gauromyrmex acanthinus (Karavaiev, 1935)

Kartidris: 3 species

Kartidris ashima Xu & Zheng, 1995
Kartidris nyos Bolton, 1991
Kartidris sparsipila Xu, 1999

Lasiomyrma: 1 species (undescribed)

Lasiomyrma sp.

Lophomyrmex: 3 species

Lophomyrmex bedoti Emery, 1893
Lophomyrmex birmanus Emery, 1893
Lophomyrmex quadrispinosus (Jerdon, 1851)

Lordomyrma: 1 species (undescribed)

Lordomyrma sp.
**Meranoplus**: 2 species

*Meranoplus bicolor* (Guérin-Méneville, 1844)
*Meranoplus laeviventris* Emery, 1889

**Messor**: 1 species

* Messor aciculatus* (Smith, 1874)

**Monomorium**: 5 species

*Monomorium chinense* Santschi, 1925
*Monomorium floricola* (Jerdon, 1851)
* Monomorium hainanense* Wu & Wang, 1995
*Monomorium orientale* Mayr, 1879
*Monomorium pharaonis* (Linnaeus, 1758)

**Myrmecina**: 5 species

* Myrmecina asiatica Okido, Ogata & Hosoishsi, 2020
* Myrmecina asthena Okido, Ogata & Hosoishsi, 2020
*Myrmecina curvispina* Zhou, Huang & Ma, 2008
*Myrmecina guangxiensis* Zhou, 2001
* Myrmecina sinensis Wheeler, 1921
*Myrmecina striata* Emery, 1889
*Myrmecina taiwana* Terayama, 1995

**Myrmica**: 11 species

*Myrmica curiosa* Radchenko, Zhou & Elmes, 2008
*Myrmica draco* Radchenko, Zhou & Elmes, 2008
* Myrmica excelsa Kupyanskaya, 1990
* Myrmica heterorhytida* Radchenko & Elmes, 2008
*Myrmica margaritae* Emery, 1889
*Myrmica pleiorhytida* Radchenko & Elmes, 2009
*Myrmica polyglypta* Radchenko & Rigato, 2008
*Myrmica ritae* Emery, 1889
*Myrmica serica* Wheeler, 1928
*Myrmica sinensis* Radchenko, Zhou & Elmes, 2008
*Myrmica titanica* Mayr, 2001
*Myrmica yunnanensis* Radchenko & Elmes, 2008
**Myrmicaria:** 1 species

*Myrmicaria brunnea* Saunders, 1842

**Perissomyrmex:** 2 species

*Perissomyrmex bidentatus* Zhou & Huang, 2006
*Perissomyrmex fissus* Xu & Wang, 2004

**Pheidole:** 42 species

*Pheidole allani* Bingham, 1903
*Pheidole binghamii* Forel, 1902
*Pheidole capellinii* Emery, 1902
*Pheidole constanciae* Forel, 1902
*Pheidole elongicephala* Eguchi, 2008
*Pheidole exasperata* (Mayr, 1866)
*Pheidole fervens* Smith, 1858
*Pheidole fervida* Smith, 1874
* *Pheidole fortis* Eguchi, 2006
*Pheidole gatesi* (Wheeler, 1927)
* *Pheidole hongkongensis* Wheeler, 1928
*Pheidole indica* Mayr, 1879
* *Pheidole indosinensis* Wheeler, 1928
*Pheidole jucunda* Forel, 1885
* *Pheidole laevicolar* Eguchi, 2006
* *Pheidole magna* Eguchi, 2006
*Pheidole multidens* Forel, 1902
*Pheidole nietneri* Emery, 1901
* *Pheidole nodifera* Smith, 1858
*Pheidole nodus* Smith, 1874
* *Pheidole ochracea* Eguchi, 2008
* *Pheidole parva* Mayr, 1865
*Pheidole pieli* Santschi, 1925
* *Pheidole plagiaria* Smith, 1860
* *Pheidole planifrons* Santschi, 1920
* *Pheidole rabo* Forel, 1913
*Pheidole roberti* Forel, 1902
* *Pheidole rugithorax* Eguchi, 2008
*Pheidole sagei* Forel, 1902
* *Pheidole singaporensis* Öz dikmen, 2010
*Pheidole sinica* (Wu & Wang, 1992)
* *Pheidole smythiesii* Forel, 1902
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Pheidole spathifera Forel, 1902
Pheidole sulciceps Roger, 1863
* Pheidole tandjongensis Forel, 1913
* Pheidole tjibodana Forel, 1905
* Pheidole tumida Eguchi, 2008
* Pheidole vieti Eguchi, 2008
* Pheidole vulgaris Eguchi, 2006
Pheidole watsoni Forel, 1902
Pheidole yeensis Forel, 1902
* Pheidole zoceana Santschi, 1925

Pheidole: 12 species

Pheidole brevispinosus Emery, 1887
Pheidole hamatus Xu & Zhang, 2002
Pheidole punctatus (Smith, 1860)
Pheidole sulcatus Emery, 1895

Pheidole: 12 species

Pristomyrmex: 4 species

Pristomyrmex brevispinosus Emery, 1887
Pristomyrmex hamatus Xu & Zhang, 2002
Pristomyrmex punctatus (Smith, 1860)
Pristomyrmex sulcatus Emery, 1895

Recurvidris: 3 species

* Recurvidris kemneri (Wheeler, 1954)
Recurvidris nuwa Xu & Zheng, 1995
Recurvidris recurvispinosa (Forel, 1890)

Recurvidris: 3 species

Rhopalomastix: 2 species

* Rhopalomastix rothneyi Forel, 1900
Rhopalomastix umbracapita Xu, 1999

Rhopalomastix: 2 species

Rotastruma: 1 species

* Rotastruma stenoceps Bolton, 1991

Rotastruma: 1 species

Solenopsis: 3 species

Solenopsis indagatrix Wheeler, 1928
Solenopsis invicta Buren, 1972 (Exotic)
Solenopsis jacoti Wheeler, 1923

Solenopsis: 3 species

Stenamma: 4 species

Stenamma ailaoense Liu & Xiu, 2011
Stenamma gurkhale DuBois, 1998
Stenamma jeriorum DuBois, 1998
Stenamma wumengense Liu & Xiu, 2011

**Strumigenys**: 24 species

Strumigenys ailaoshana Xu & Zhou, 2004
* Strumigenys assamensis De Andrade, 1994
Strumigenys dayui (Xu, 2000)
* Strumigenys doriae Emery, 1887
* Strumigenys dyschima (Bolton, 2000)
Strumigenys exilirhina Bolton, 2000
Strumigenys feae Emery, 1895
* Strumigenys kichijo (Terayama, 1996)
* Strumigenys leptothrix Wheeler, 1929
Strumigenys lewisi Cameron, 1886
* Strumigenys lyroessa (Roger, 1862)
* Strumigenys membranifera Emery, 1869 (Exotic)
* Strumigenys mitis (Brown, 2000)
Strumigenys mutica (Brown, 1949)
Strumigenys nanzanensis Lin & Wu, 1996
* Strumigenys nepalensis De Andrade, 1994
Strumigenys nongba (Xu & Zhou, 2004)
* Strumigenys paraposta Bolton, 2000
* Strumigenys rallarhina Bolton, 2000
* Strumigenys sauteri (Forel, 1912)
Strumigenys strygax Bolton, 2000
* Strumigenys sydorata Bolton, 2000
* Strumigenys taphra (Bolton, 2000)
* Strumigenys tritomea Bolton, 2000
Strumigenys yangi (Xu & Zhou, 2004)

**Temnothorax**: 7 species

Temnothorax angulohumerus Zhou, 2010
Temnothorax congruus (Smith, 1874)
Temnothorax hengshanensis (Huang, 2004)
Temnothorax nassonovi (Ruzsky, 1895)
Temnothorax orchidus Zhou, 2010
Temnothorax striatus Zhou, 2010
Temnothorax wui (Wheeler, 1929)

**Tetramorium**: 29 species

Tetramorium aptum Bolton, 1977
Tetramorium bicarinatum (Nylander, 1846)
Tetramorium cardiocarenurn Xu & Zheng, 1994
Tetramorium ciliatum Bolton, 1977
Tetramorium crepum Wang & Wu, 1988
Tetramorium cuneinode Bolton, 1977
Tetramorium cyclolobum Xu & Zheng, 1994
* Tetramorium difficile Bolton, 1977
* Tetramorium flavipes Emery, 1893
Tetramorium indosinense Wheeler, 1927
Tetramorium insolens (Smith, 1861)
Tetramorium kheperra (Bolton, 1976)
Tetramorium kraepelini Forel, 1905
Tetramorium lanuginosum Mayr, 1870
Tetramorium laparum Bolton, 1977
Tetramorium nipponense Wheeler, 1928
Tetramorium nursei Bingham, 1903
Tetramorium obtusidens Viehmeyer, 1916
Tetramorium pacificum Mayr, 1870
* Tetramorium parvispinum (Emery, 1893)
* Tetramorium polymorphum Yamane & Jaitrong, 2011
Tetramorium repletum Wang & Xiao, 1988
Tetramorium simillimum (Smith, 1851) (Exotic)
Tetramorium smithi Mayr, 1879
* Tetramorium tonganum Mayr, 1870
Tetramorium walshi (Forel, 1890)
* Tetramorium wroughtonii (Forel, 1902)
Tetramorium yerburi Forel, 1902
Tetramorium yulongense Xu & Zheng, 1994

Trichomyrmex: 2 species

Trichomyrmex destructor (Jerdon, 1851) (Exotic)
Trichomyrmex mayri (Forel, 1902) (Exotic)

Vollenhovia: 2 species

* Vollenhovia lucimandibula Wang, 2005
Vollenhovia pyrrhobia Wu & Xiao, 1989

Vombisidris: 1 species

* Vombisidris tibeta Xu & Yu, 2012
PONERINAE

Anochetus: 6 species

*Anochetus graeffei* Mayr, 1870
*Anochetus madaraszi* Mayr, 1897
*Anochetus mixtus* Radchenko, 1993
*Anochetus myops* Emery, 1893
*Anochetus risii* Forel, 1900
*Anochetus subcoecus* Forel, 1912

Brachyponera: 2 species

*Brachyponera brevidorsa* Xu, 1994
*Brachyponera chinensis* (Emery, 1895)
*Brachyponera luteipes* (Mayr, 1862)

Buniapone: 1 species

*Buniapone amblyops* (Emery, 1887)

Centromyrmex: 1 species

*Centromyrmex feae* (Emery, 1889)

Cryptopone: 5 species

*Cryptopone gigas* Wu & Wang, 1995
*Cryptopone recticlypea* Xu, 1998
*Cryptopone sauteri* (Wheeler, 1906)
*Cryptopone taivanae* (Forel, 1930)
*Cryptopone testacea* Emery, 1893

Diacamma: 1 species

*Diacamma rugosum* (Le Guillou, 1842)

Ectomomyrmex: 8 species

*Ectomomyrmex annamitus* (André, 1892)
*Ectomomyrmex astutus* (Smith, 1858)
*Ectomomyrmex javanus* Mayr, 1867
*Ectomomyrmex leeuwenhoeki* (Forel, 1886)
*Ectomomyrmex lobocarenus* (Xu, 1995)
* Ectomomyrmex obtusus Emery, 1900
Ectomomyrmex sauteri (Forel, 1912)
Ectomomyrmex zhengi (Xu, 1995)

**Emeryopone:** 1 species

Emeryopone melaina Xu, 1998

**Euponera:** 1 species

Euponera pilosior (Wheeler, 1928)

**Harpegnathos:** 1 species

Harpegnathos venator (Smith, 1858)

**Hypoponera:** 7 species

Hypoponera ceylonensis (Mayr, 1897)
Hypoponera confinis (Roger, 1860)
* Hypoponera ergatandria (Forel, 1893) (Exotic)
Hypoponera nippona (Santschi, 1937)
Hypoponera punctatissima (Roger, 1859) (Exotic)
Hypoponera sauteri Onoyama, 1989
Hypoponera truncata (Smith, 1860)

**Leptogenys:** 17 species

Leptogenys binghamii Forel, 1900
Leptogenys birmana Forel, 1900
Leptogenys chinensis (Mayr, 1870)
Leptogenys crassicorns Emery, 1895
* Leptogenys davydovi Karavaiev, 1935
Leptogenys diminuta (Smith, 1857)
* Leptogenys kitteli (Mayr, 1870)
* Leptogenys kraepelini Forel, 1905
Leptogenys laozii Xu, 2000
Leptogenys lucidula Emery, 1895
Leptogenys mengzii Xu, 2000
Leptogenys pangui Xu, 2000
* Leptogenys peuqueti (André, 1887)
* Leptogenys processionalis (Jerdon, 1851)
* Leptogenys rufida Zhou, 2012
* Leptogenys sunzii Xu, 2015
Leptogenys zhuangzii Xu, 2000

**Mesoponera:** 1 species

*Mesoponera melanaria* (Emery, 1893)

**Myopias:** 3 species

*Myopias conicara* Xu, 1998
*Myopias daia* Xu, 2014
*Myopias hania* Xu, 2012

**Odontomachus:** 6 species

*Odontomachus circulus* Wang, 1993
*Odontomachus fulgidus* Wang, 1993
*Odontomachus granatus* Wang, 1993
*Odontomachus monticola* Emery, 1892
*Odontomachus rixosus* Smith, 1857
*Odontomachus tensus* Wang, 1993

**Odontoponera:** 1 species

*Odontoponera denticulata* (Smith, 1858)

**Platythyrea:** 2 species

*Platythyrea clypeata* Forel, 1911
*Platythyrea parallela* (Smith, 1859)

**Ponera:** 14 species

*Ponera alisana* Terayama, 1986
*Ponera baka* Xu, 2001
*Ponera bawana* Xu, 2001
*Ponera chiponensis* Terayama, 1986
*Ponera diodonta* Xu, 2001
*Ponera longlina* Xu, 2001
*Ponera menglana* Xu, 2001
*Ponera nangongshana* Xu, 2001
*Ponera paedericera* Zhou, 2001
*Ponera pentodontos* Xu, 2001
*Ponera pianmana* Xu, 2001
*Ponera scabra* Wheeler, 1928
*Ponera sinensis* Wheeler, 1928  
*Ponera xantha* Xu, 2001

**Pseudoneoponera**: 2 species

*Pseudoneoponera bispinosa* (Smith, 1858)  
*Pseudoneoponera rufipes* (Jerdon, 1851)

**Proceratiinae**

**Discothyrea**: 3 species

*Discothyrea banna* Xu, 2014  
*Discothyrea diana* Xu, 2014  
*Discothyrea sauteri* Forel, 1912

**Probolomyrmex**: 1 species

*Probolomyrmex longiscapus* Xu & Zeng, 2000

**Proceratium**: 4 species

*Proceratium longigaster* Karavaiev, 1935  
*Proceratium longmenense* Xu, 2006  
*Proceratium shohei* Staab, 2018  
*Proceratium zhaoi* Xu, 2000

**Pseudomyrmecinae**

**Tetraponera**: 12 species

*Tetraponera allaborans* (Walker, 1859)  
*Tetraponera amargina* Xu & Chai, 2004  
*Tetraponera attenuata* Smith, 1877  
*Tetraponera binghami* (Forel, 1902)  
*Tetraponera concava* Xu & Chai, 2004  
*Tetraponera convexa* Xu & Chai, 2004  
*Tetraponera furcata* Xu & Chai, 2004  
*Tetraponera microcarpa* Wu & Wang, 1990  
*Tetraponera nitida* (Smith, 1860)  
*Tetraponera notabilis* Ward, 2001  
*Tetraponera protensa* Xu & Chai, 2004  
*Tetraponera rufonigra* (Jerdon, 1851)
Discussion

Ants in the Hengduan Mountain region

Field inventories and data synthesis efforts are essential for our understanding of ant diversity in ‘hotspots’ that harbor most of Earth’s biodiversity. Our study represents new survey data from an understudied region. We produce the first ant species checklist from China’s Hengduan Mountains (130 species).

A majority of the ant species were only collected below 1500 m, consistent with the strong effect of elevation on ant diversity observed elsewhere (Suppl. material 1, Fig. S1). This also suggests that future sampling in low elevation areas may increase species detection. For example, the number of *Strumigenys* species recovered in this survey is relatively low compared to the overall richness of this genus. This could be because we have relatively few collection events at low elevations where many of these species are known to occur. Indeed, all six *Strumigenys* species were collected below 1000 m from only three independent Winkler sampling sites.

Many of the new records in our collection such as *Aenictus brevinodus*, *Camponotus bellus leucodiscus*, *Cataulacus marginatus*, *Crematogaster quadriruga*, *Dilobocondyla eguchii*, *Gnamptogenys quadrutinodules*, and *Strumigenys taphra* represent the northern-most records of their known distributional ranges. Species records such as *Aenictus brevinodus*, *Camponotus bellus leucodiscus*, *Camponotus keihitoi*, *Cataulacus marginatus*, *Gnamptogenys quadrutinodules*, and *Strumigenys taphra* show a disjunction from the rest of their known distributions. It is unclear whether those records represent true biogeographic disjunctions, or sampling / taxonomic artifacts. Another potential reason could be that they were collected in the past, but have not been reported due to the lack of taxonomic infrastructure and species check lists from this region (Guénard et al. 2017). Additional inventories of ant diversity and taxonomic treatments are needed to answer these questions.

Despite the comparatively small area of China’s Hengduan Mountains that we explored for this inventory of myrmecofauna, we were able to collect 130 species, which accounts for more than 24 % of the total number of ant species (N = 550) for Yunnan province. Among them, more than 10% of the ant species that were collected in this survey represent new records for Yunnan province. Moreover, there are still more than 41 morphospecies (32% of the total collected) that we believe are undescribed and new to science. To date, three *Myrmecina* species (Figs 82–84) and one *Gauromyrmex* species (Fig. 75) are undergoing taxonomic revision, and species descriptions are being prepared.

Our sampling of the full ant diversity of the Hengduan mountain region is still relatively limited. For example, we only had one sampling site per elevation, which is insufficient to cover the complex topology of the Hengduan Mountains. We also only used leaf litter extraction and hand collection, which is unlikely to recover complete ant assemblages. The incorporation of additional sampling techniques into our methodology, such as pitfall trapping, soil baiting, twig sampling, light trapping and canopy fogging, will cover more strata and lifestyles, and thus significantly increase our rate of species discovery. Overall, our results highlight how little was previously known about
the ant fauna in this region and emphasize the need for further collecting in order to better understand the hidden ant biodiversity in China’s Hengduan Mountains, and Yunnan Province overall.

**Ants in Yunnan**

If the total species richness of ants in Yunnan, with 550 species, is still an underestimate of the full species numbers, the exceptional diversity of genera encountered in this region needs to be highlighted. With 99 genera, Yunnan generic diversity is only matched globally by a few regions in South East Asia, and Queensland, Australia. A major difference with other Asian regions lies in the composition of the genera retrieved and their origin. For instance, genera found in Borneo, Sumatra, Java, Vietnam, Thailand, Peninsular Malaysia are almost exclusively derived from tropical, Oriental origins. In contrast, the geographic location and topography of Yunnan province has promoted an intermixing of taxa from several biogeographic regions: the Oriental realm from the south, the Palearctic realm from the northwest, and the Sino-Japanese realm from the northeast. As a result, the composition of the Yunnan ant fauna includes both tropical, subtropical, and temperate elements. Such intermixed communities are evident even at a small scale. For instance, during previous fieldwork conducted in the Gaoligongshan Mountains in 2015 by two of the authors (BG and CL), for which specimens were unfortunately lost, the coexistence of tropical (*Dorylus, Ectomomyrmex*), subtropical (*Temnothorax*) and temperate genera (*Formica, Lasius*) was observed on a hillside at an elevation of about 1900 m on an ~ 250 m² patch of grassland. Interestingly, while this area exhibited a transition where fauna from distinctly different origins coexisted along a thin band of altitude, at lower elevations, tropical genera were dominant and at higher elevations, temperate genera became dominant. Overall, this generated an unexpectedly diverse faunal composition, with such mixed communities contemplated by Wheeler (1915) to explain the generic composition and diversity of fossil ants observed in Baltic amber. Possibly, the ant composition of genera now retrieved within Yunnan might represent the remains of a once more widespread assemblage found within Asia and Europe during the Miocene (Guénard et al. 2015). This highlights the specific nature of the Yunnan ant fauna and its importance in studying ant biogeography within Asia. It also serves as an excellent example of the formation and stability of ant community assemblages over time. Other neighboring regions such as Myanmar, Bhutan, Nepal or northeast India are likely to exhibit similar features, but to this point, the myrmecological exploration of these regions has been largely fragmentary (Guénard et al. 2010, 2012).

The diversity of Yunnan ants is also remarkable for particular ant genera for which their global peak of diversity is encountered in the region. While it is important to note that the global diversity of specific genera as well as their overall taxonomic descriptions remain incomplete, seven genera present their highest currently known global diversity in Yunnan (*Cryptopone*: 5 species, *Ectomomyrmex*: 8 species, *Kartidris*: 3 species, *Perissomyrmex*: 2 species, *Ponera*: 14 species, *Prenolepis*: 7 species, *Stigmatomma*: 11 species), while six others are remarkable by the level of global diversity there, among
the highest observed globally (Aenictus: 19 species, Carebara: 19 species, Dilobocondyla: 3 species, Myrmecina: 7 species, Proceratium: 4 species, Recurvidris: 3 species).

In conclusion, the important topographic variation, with mountain ranges aligned along a north-south axis combined with the presence of multiple climatic zones, including tropical rainforest in the lowland areas of the southern part of Yunnan create a diversity of microhabitats for supporting a diverse ant fauna. Moreover, the geographic position of Yunnan at the confluence of three biogeographic realms may promote ant diversity in the region. The collection of these 16 new ant records for Yunnan together with our previous discovery of 40 new ant records for Yunnan (Liu et al. 2015a) suggest that the true ant diversity in Yunnan is significantly higher. Moreover, the species diversity of some ant genera in nearby regions (based on data from GABI) also suggests that some ant genera sampled will ultimately be much more diverse in Yunnan (Guénard et al. 2017). For example, Hong Kong has recorded a similar diversity of Strumigenys species while having an area nearly 350 times smaller and a much less diverse topography compare to Yunnan (Tang et al. 2019), perhaps because leaf litter extraction has not been widely used for sampling ants in Yunnan. Thus, our survey to date indicates that further intensive sampling focused on different ecological strata (arboreal, leaf litter, subterranean) and combining various methods of extraction in both tropical and mountain habitats should yield many additional records and new species discovery in this region.

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Supplementary material 1

Figure S1. Ant species richness pattern along an elevational gradient in the Hengduan Mountains

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