Notes on the genus *Dendrocerus* Ratzeburg (Hymenoptera, Megaspilidae) from China, with description of two new species

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Abstract

Species of the genus *Dendrocerus* Ratzeburg, 1852 (Hymenoptera: Megaspilidae) from China were studied. Six species are recorded, of which two known species, *D. carpenteri* (Curtis, 1829) and *D. laticeps* (Hedicke, 1929) are re-described; and two species are described as new to science, *D. anisodontus* Wang, Chen and Mikó sp. nov. and *D. bellus* Wang, Chen and Mikó sp. nov.. Sequences of the 28S rDNA were generated to associate both sexes of the same species.

Keywords

Ceraphronoidea, DNA barcoding, hyperparasitoid, redescription, taxonomy
Introduction

The family Megaspilidae comprises more than 450 species in 12 genera worldwide, whereas the Chinese fauna is still insufficiently studied (Dessart 2006; Iemma et al. 2016). *Dendrocerus* Ratzeburg, 1852 is the most economically important genus of Megaspilidae (Fergusson 1980), because they are hyperparasitoids and attack the primary parasitoids of aphids. Species of *Dendrocerus* seem to be generalists (Takada 1973; Fergusson 1980; Martens and Johnson 2018). For example, the host complex of *Dendrocerus carpenteri* (Curtis, 1829) includes at least two genera of Cynipoidea and 7 genera of Chalcidoidea (Fergusson 1980). *Dendrocerus* was erected with *D. lichtensteini* Ratzeburg, 1852 as the type species, a synonym of *Ceraphron halidayi* Curtis, 1829. This species was later designated as a type species of *Lygocerus*, a genus proposed as new by Förster (1856). Dessart (1966) synonymised *Lygocerus* with *Dendrocerus*, and *D. lichtensteini* with *C. halidayi*. *Dendrocerus* is a cosmopolitan genus, with 118 described species worldwide. There were only 15 *Dendrocerus* species recorded from the Oriental region (Johnson and Musetti 2004; Trietsch et al. 2018) and four species are known from China: *D. angustus* Dessart, 1999, *D. carpenteri*, *D. aphidum* (Rondani, 1877), and *D. laticeps* (Hedicke, 1929).

Based on antennal characters, Dessart (1995) proposed five species-groups for *Dendrocerus halidayi*, *carpenteri*, *serricornis*, *punctipes* and *penmaricus* (Bijoy and Rajmohana 2014). Species of the *halidayi* species-group generally have ramose antennae, but the *D. mexicali* species complex have moveable branches (Burks et al. 2016). The males of the *D. halidayi* species-group are characterized by their ramose antennae, and by the long branches on proximal 4, 5 or 6 flagellomeres. There are 22 species of this group worldwide (Pezzini et al. 2014). Two new species under *D. halidayi* species-group, viz., *D. bellus* and *D. anisodontus* are hereby described and illustrated.

Materials and methods

This work is based upon the specimens in the following collections, with abbreviations used in the text: AHNU, Auhui Normal University, Anhui, China; IZCAS, Institute of Zoology, Chinese Academy of Sciences, Beijing, China; SYSBM, Sun Yat-sen University, The Museum of Biology, Guangzhou, China. Specimens were obtained from sweep nets, Malaise traps, and yellow pan traps.

Considering that sexual dimorphism is common in *Dendrocerus*, we sequenced the gene marker 28S rDNA to associate the female and male of the same species. Genomic DNA was extracted from a female and male of each putative species using a nondestructive DNA extraction protocol as described in Taekul et al. (2014). The primers for 28S amplification followed Zhang et al. (2008). Polymerase chain reactions (PCRs) were performed using a 25 μL system and conducted in a T100 Thermal Cycler (Bio-Rad). Thermocycling conditions were: an initial denaturing step at 94 °C for 1 min, followed by 35 cycles of 94 °C for 1 min, 50 °C for 30 s, 72 °C for 30 s and
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an additional extension at 72 °C for 5 min. Amplicons were directly sequenced in both directions with forward and reverse primers by GENERAL BIOL (Anhui, China). Chromatograms were assembled with Sequencing Analysis 6 (ThermoFisher Scientific, Gloucester, UK). All the amplified sequences were deposited into GenBank (see Table 1). The genetic distances were calculated using the Kimura 2-parameter (K2P) model in MEGA X (Kumar et al. 2018).

All voucher specimens were then point-mounted and air-dried. Photographs were taken with a Leica M205A stereomicroscope and a Leica DFC-500 digital camera, with extended focusing software. To prepare male genitalia for study, apical metasomal segments were removed from specimens and placed in 35% H₂O₂ for 24 hours, 5% acetic acid for 24 hours, distilled water for one hour and then transferred to a droplet of glycerin on a concavity slide. Dissections were performed in glycerin by using #5 forceps and #2 insect pins.

Abbreviations and morphological terms (Table 2) follows Mikó and Deans (2009). Measurements are given in microns. Genitalia terminology follows Hymenoptera Anatomy Ontology (Yoder et al. 2010).

Results

In the present paper, we describe two new species of Dendrocerus: D. anisodontus Wang, Chen and Mikó sp. nov. and D. bellus Wang, Chen and Mikó sp. nov., bringing the species number of this genus to six for China. The morphological re-description and photographs are provided for D. carpenteri and D. laticeps. No Chinese specimens of D. angustus and D. aphidum are available for this study.

Eight 28S sequences of four species (length ranged from 633 to 641 bp) from China were attained and uploaded to GenBank (Table 1). The pairwise corrected genetic distances based on 28S rDNA sequences of four species, including the two new species, are shown in Table 3. Sequences of both sexes of three putative species (D. anisodontus, D. bellus and D. carpenteri) are 100% identical, confirming the correct association of female and male of the species. Whereas interspecific genetic distances among different Dendrocerus species range from 0.008 to 0.030. This will be helpful for molecular identification and the association of the female and male of the same species in this genus.

| Table 1. Detail information of sequenced samples and accession numbers. |
|------------------|----------------|------------------|---------------------------|
| Species          | Sex          | Location              | GenBank accession number |
| D. carpenteri    | male         | Shandong, Yucheng     | MZ340592                |
|                  | female       | Anhui, Chuzhou, Mingguang | MZ340590               |
| D. laticeps      | female       | Anhui, Chuzhou, Mingguang | MZ340593               |
|                  | male         | Anhui, Chuzhou, Mingguang | MZ340624               |
| D. bellus sp. nov.| female       | Guangdong, Guangzhou  | MZ344975                |
|                  | male         | Guangdong, Guangzhou  | MZ344976                |
| D. anisodontus sp. nov.| female       | Yunnan, Menghai, Mt. Bulang | MZ344977               |
|                  | male         | Yunnan, Menghai, Mt. Bulang | MZ344978               |
Taxonomy

**Dendrocerus** Ratzeburg, 1852

*Dendrocerus* Ratzeburg, 1852: 180. Type species: *Dendrocerus lichtensteinii* Ratzeburg, by monotypy (= *Ceraphron halidayi* Curtis).

**Diagnosis.** Head moderately transverse; facial pit absent in most species. Males usually with an obtuse ocellar triangle (POL longer than LOL). Male flagellomeres usually asymmetrical, serrate or trapezoidal. Some species also have branched flagellomeres (*D. mexicali* group). Metapleural sulcus shape usually straight. Sternaulus never present. Medioventral conjunctiva of gonostyle-volsella complex (parossiculi fusion) absent. Wings never absent (Trietsch et al. 2020).

**Dendrocerus carpenteri** (Curtis, 1829)

Figs 1, 2

*Ceraphron carpenteri* Curtis, 1829: 249.
*Cerapilron crispus* Curtis, 1829: 249. Nomen nudum.
*Ceraphron elegals* Curtis, 1829: 249. Nomen nudum.
*Megaspilus carpenteri* (Curtis) Stephens, 1829: 401.
*Calliceras carpellteri* (Curtis) Westwood, 1840: 77.
*Ceraphroll hyalinatus* Thomson, 1858: 291.
*Lygocerus carpenteri* (Curtis) Marshall, 1868: 158.
*Coryne carpenteri* (Curtis) Buckton, 1876: pl. 7.
*Megaspillts niger* Howard, 1890: 247.
Table 3. Genetic distance of 28S of four *Dendrocerus* species (F = female, M = male).

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|
| 1. *D. carpenteri* M | | | | | | | 0.000 |
| 2. *D. carpenteri* F | | | | | | | 0.008 |
| 3. *D. laticeps* F | | | | | | | 0.008 |
| 4. *D. laticeps* F | | | | | | | 0.000 |
| 5. *D. bellus* sp. nov. M | 0.030 | 0.030 | 0.022 | 0.022 | | | |
| 6. *D. bellus* sp. nov. F | 0.030 | 0.030 | 0.022 | 0.022 | 0.000 | | |
| 7. *D. anisodontus* sp. nov. M | 0.013 | 0.013 | 0.008 | 0.008 | 0.027 | 0.027 | |
| 8. *D. anisodontus* sp. nov. F | 0.013 | 0.013 | 0.008 | 0.008 | 0.027 | 0.027 | 0.000 |

Trichosteresis proxima Kieffer, 1907: 32.
Trichosteresis punctatipennis Kieffer, 1907: 33.
Lygocerus rlijiventris Kieffer, 1907: 45.
Lygocerus campestris Kieffer, 1907: 48.
Lygocerus aphidivorus Kieffer. 1907: 49.
Lygocerus aphidivorus var. inconspicuus Kieffer, 1907: 50.
Lygocerus testaceimanus Kieffer, 1907: 51.
Lygocerus aphidum Kieffer, 1907: 52.
Lygocerus giraudi Kieffer, 1907: 52.
Lygocerus cameroni Kieffer, 1907: 56.
Lygocerus thomsoni Kieffer, 1907: 57.
Lygocerus inquilinus Kieffer, 1917: 349.
Trichosteresis carpenteri (Curtis) Morley, 1929: 55.
Lygocerus ambianus Dessart, 1965: 158.
Deldrocerus britannicus Dessart, 1966: 12.
Deldrocerus tischbeini Dessart, 1966: 12.
Deldrocerus carpenteri (Curtis) Dessart, 1970: 142.

Material examined. China • 1 male, 2 females; Jiangsu, Suzhou; 20.IV.2019; H. Li leg.; (AHNU) • 4 females; Shandong, Yucheng; 17.V.2019; R. Zhang leg.; (IZCAS) • 3 females; Anhui, Chuzhou, Mingguang; 28.IV.2019; H. Li leg. (SYSBM).

Redescription. Male. Body length: 1.8 mm.

Coloration (Fig. 1): Cranium, mesosoma and metasoma black. Eyes, mouth-parts light brown; ocelli brownish yellow. Antennae black. Legs chocolate brown with brownish-yellow joints. Syntergum dark brown to black (Fig. 1G); gaster black or brown, mostly smooth. Pterostigma, costal vein, and radial vein brown (Fig. 1F). Body pubescence white; marginal fringes of wings brown.

Head (Fig. 1C): Slightly wider than mesosoma (about 1.1× wider than mesosoma). HH: EHf = 1.8–1.9. HH: HL = 1.2–1.3. HW: IOS = 1.7–1.8. HW: HH = 1.1–1.2. CSB: Mean: 550–630 μm. POL longer than OOL and ocellar triangle with broad base. OOL: LOL = 1.4–1.6. POL: OOL = 1.4–1.5. Covered with short pubescence except glabrous clypeus and adjacent areas; head concolorous below and above eye midlevel; mandibles and palps brown. Facial pit present.
Intertorular carina absent. Preoccipital lunula present, more distinct and transverse in males than in females. Hyperoccipital carina present medially, not extending to eyes laterally. Preoccipital furrow present.

**Antennae** (Fig. 1C): Scape about 1.1× longer than combined length of pedicel and F1. Scape length vs. pedicel length: 3.5–4.9. Scape length vs. F1 length: 1.6–3.8. F1 length vs. pedicel length: 1.3–2.2. F1 length vs. F2 length: 1.1–1.4. Longest flagellomere: F1. Basal flagellar segments ventrally slightly concave; strongly serrate, gradually becoming less serrate distally. Flagellar pubescence long, at least as long as breadth of antenomeres.

**Mesosoma** (Fig. 1B, D): Pronotum not elongate. AscW/PscW = 0.7–0.8. Mesosoma slightly narrow (1.4× longer than wide) (Length/width/height = 770/550/550 μm); coriaceous in sculpture, densely pubescent. Mesoscutum: (Length/width = 380/490 μm); mesoscutum 1.3× wider than long, with more or less straight anterior margin. Transverse pronotal sulcus and posterior pronotal sulcus
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Present, distinct. Mesonotum wider than long, almost quadrate. Notauli complete, strongly angled and convergent posteriorly. Mesos scutellum broad and convex. Lateral axillary area distinctly higher than long. Mesopleural sulcus present. Propodeum medially short. Posterior propodeal carina present, more distinct laterally. Posterdorsal metepisternal area trapezoid-shaped.

**Wings (Fig. 1F):** Total wing length 1.3 mm. Hyaline, pterostigma (Length/width = 170/90 μm) nearly semicircular but distal edge almost straight. Radius (190 μm), strongly curved, often continuing distally without pigmentation.

**Metasoma (Fig. 1G):** Metasoma concolorous with mesosoma. Metasoma 1.5× longer than wide (Length/width/height = 800/540/406 μm). Syntergum with crenulate collar, clearly with neck. Rest of metasoma smooth, but with dense punctures in middle and posterior of syntergum. Several strong transverse gastric carinae present in basal portion of metasoma; gastrocoeli not evident; posterior tergites with setae.

**Male Genitalia (Fig. 2):** Genitalia with short cupula. Harpe median margin smooth and without tooth. Distal margin of harpe in lateral view blunt. Gonostipes longer than wide, fused dorsally; apical margin (part of gonostipes) with three teeth outward (Fig. 2A). Median notch of distodorsal margin of gonostipes square.

**Female (Fig. 3):** Body length: 1.8–2.1 mm. As for male except scape longer (scape about 1.3× longer than combined length of pedicel and F1). Pedicel and F1 approximately equal in length. Rest of flagellar segments short (L/B about 1.1–1.6), except F9 which is usually twice as long as broad. Flagellomeres flattened ventrally. Antenna black but distal end of pedicel sometimes lighter; weakly papillate, with short dense pubescence.

**Distribution.** China (Shandong, Shanghai, Anhui, Zhejiang, Jiangsu, Hubei, Jiangxi, Fujian, Taiwan, Guizhou, Yunnan); Australasian, Oceanian, Neotropical, Oriental, and Palearctic.

*Figure 2. Dendrocerus carpenteri* (Curtis, 1829), male, genitalia **A** dorsal view **B** ventral view.
Dendrocerus laticeps (Hedicke, 1929)

Fig. 4

Atritomellus laticeps Hedicke, 1929: 60.
Lygocerus laticeps (Hedicke) Hellen, 1966: 15.
Dendrocerus laticeps (Hedicke) Dessart, 1972: 186.

Material examined. CHINA • 2 females; Anhui, Chuzhou, Mingguang; 28.IV.2019; H. Li leg. (AHNU).

Description. Female: Body length: 1.8–1.9 mm.

Coloration (Fig. 4): Cranium and mesosoma black, metasoma alutaceous to black. Mouthparts brown or yellow; eyes light brown; ocelli brown. Flagellum black or brown. Basal scape and AIII yellow, with other antennae segments black. Legs usually
yellow, sometimes darkened proximally, especially on lateral side of hindlegs. Syntergum yellow to dark brown (Fig. 4G). Pterostigma, costal vein, and radial vein light brown (Fig. 4F). Body pubescence white; marginal fringes of wings brown.

**Head (Fig. 4C):** Slightly wider than mesosoma (about 1.2× wider than mesosoma). HH: EHf = 1.8–1.9. HH: HL = 0.8–1.0. HW: IOS = 1.5–1.7. HW: HH = 0.9–1.0. CSB: Mean: 520–600 μm. POL longer than OOL and ocellar triangle with broad base. OOL: LOL = 1.6–1.8. POL: OOL = 1.1–1.2. Broad and pubescence short; head concolorous below and above eye midlevel; mandibles and palps yellow. Facial pit present. Interocular carina distinct. Eyes usually large. Ocellus triangle broad and short lateral ocelli well separated from eyes. Preoccipital lunula present. Occipital carina strongly developed. Preoccipital furrow present.

**Antennae (Fig. 4C):** Scape about 1.6× longer than combined lengths of pedicel and F1. Scape length vs. pedicel length: 4.1–4.8. Scape length vs. F1 length: 2.8–3.3. F1 length vs. pedicel length: 1.5–1.8. F1 length vs. F2 length: 1.2–1.5. Longest flagel-
lomere: F1. F1 longer than F2. Pedicel long. F1 long and thin, about 3 times as long as broad, distal flagellar segments broader, less elongate, with flat area ventrally. F2 sometimes slightly asymmetrical. Scape never completely dark, normally (when viewed dorsally) with distinct light-coloured basal band, but sometimes indistinct. Pubescence rather short.

**Mesosoma (Fig. 4):** Pronotum not elongate. AscW/PscW = 0.8–0.9. Mesosoma slightly narrow (1.3× longer than wide) (Length/width/height = 560/420/470 μm); coriaceous in sculpture, densely pubescent. Mesoscutum: (Length/width = 281/300 μm); mesoscutum 1.1× wider than long, with more or less straight anterior margin. Notauli very distinct but present only anteriorly, disappearing immediately after bend. Median furrow distinct. Lateral axillar area longer than high. Mesopleural sulcus present. Median projection of lateral prodeal carina present. Anterior metanotal margin with conspicuous furrow passing under apex of scutellum. Propodeum with projections posteriorly. Sparsely crenulate furrow. Median propodeal projection weakly developed. Lateral thoracic segments bordered by conspicuous foveolate or crenulate furrows. Posterodoral metapleural area trapezoid-shaped.

**Wings (Fig. 4F):** Total wing length 1.1 mm. Clear, pubescence long, fringe long and obvious. Prerostigma noticeably semioval, long and thin (Length/width = 130/80 μm). Radius (160 μm), curved a little in the middle and slightly logger (1.2×) than pterostigma; forewing densely pubescent and marginal fringes numerous; hindwing without venation.

**Metasoma (Fig. 4G):** Metasoma lighter than mesosoma. Mesosoma 1.5× longer than wide (Length/width/height = 560/420/470 μm). Syntergum with crenulate collar, clearly with neck. Rest of metasoma smooth, but with numerous pit-like punctuations in middle and posterior of T3. Several strong transverse gastric carinae present in basal portion of metasoma; gastrocoeli not evident; five terminal segments visible dorsally with numerous hairs.

**Distribution.** China (Shandong, Anhui, Jiangsu, Hubei, Fujian, Guangdong, Guangxi); Australasian; Oceanian; Nearctic; Palearctic; Oriental.

**Dendrocerus anisodontus** Wang, Chen & Mikó, sp. nov.  
http://zoobank.org/8C5BDFA5-7F51-4218-B83F-6C6A81022948  
Figs 5–7

**Diagnosis.** This new species belongs to the *D. halidayi* species-group and can be separated from other species by the following characteristics: metasoma concolorous with mesosoma and head; intertorular carina present, blunt harpe with numerous setae; distal parossiculal projection cone.

**Material examined.** **Holotype** **CHINA** • male; Yunnan, Menghai, Mt. Bulang; 20.VII–21.VIII.2019; L. Ma leg. (SYSBM). **Paratypes** (29 males, 89 females)

**CHINA** • 1 female; Hebei, Baoding, Hebei Agri. Unv. West Campus; MT; 12–19. VII.2017; F. Fan (SYSBM) • 2 females; same collection data as for preceding; 20–27.
**Notes on Dendrocerus**

VI.2017; (IZCAS) • 4 females; same collection data as for preceding; 27.VI–4.VII.2017; (AHNU) • 1 female; Shandong, Shange; MT; 26.I.2018; J. Yan leg.; (SYSBM) • 4 females, same collection information as for preceding; 4–10.VIII.2018; (IZCAS) • 1 female; Zhejiang, Mt. Fengyang; 28.VII.2007; L. Zhu leg.; (AHNU); • 1 female; Zhejiang, Mt. Tianmu, 1200 m; 25–29.VII.2011; H. Chen leg.; (SYSBM) • 1 male; Zhejiang, Mt. Gutian; 5.VII.2015 • 1 female; Hunan, Mt. Mangshan; YPT; 13.VIII.2010; H. Chen leg.; (IZCAS) • 1 male; Fujian, Minging County, Huangchulin Nature Reserve; 13–17.VII.2005; J. Liu leg.; (AHNU) • 2 males; Guangdong, Nanling National Natural Reserve; 8–17.VIII.2010 • H. Chen and H. Chen leg.; (AHNU) • 1 female; Guangdong, Nanling Protection Station; YPT; 16–17.V.2011; Z. Xu leg.; (SYSBM) • 1 male; same collection information as for preceding; 1200 m; 17.V.2011; N. Wei leg.; (IZCAS) • 1 female; Guangdong, Mt. Nankun; 19.VIII.2016; Z. Xu leg.; (AHNU) • 1 male; Guangdong, Guangzhou, SYSU Bamboo Garden; 20.I–18.II.2019; H. Chen leg.; (SYSBM) • 1 male; same collection information as for preceding; 23.VII.2018–20.I.2019; H. Chen leg.; (IZCAS) • 1 female; same collection information as for preceding; 10.I–18.IV.2020; H. Chen leg.; (IZCAS) • 1 male; Guangdong, Huizhou City,
Mt. Gutian; 30.V–30.VI.2019; L. Chen et al. leg.; (AHNU) • 1 female; Guangdong, Qingyuan, Lian Zhou; YPT; 10–13.VI.2019; H. Chen leg.; SCAU 3049491 (AHNU) • 1 female; Guangdong, Dongguan City, Mt. Daling; 20–30.IX.2019; L. Chen et al. leg.; (IZCAS) • 1 male, 1 female; Guangdong, Guangzhou City, South China Botanical Garden; 7.II–16.III.2020; H. Huang et al. leg.; (SYSBM) • 1 male; Hainan, Baisha County, Jiujiaying; 11.VII.2010; H. Chen leg.; (IZCAS) • 1 female; Hainan, Mt. Diaoluo; YPT; 12–13.VII.2010; H. Chen et al. leg.; (SYSBM) • 1 female; Hainan, Jianfengling; 14–16.VII.2010; H. Chen leg.; (AHNU) • 7 females; Hainan, Danzhou City, Institute of Environmental and Plant Protection; 20–30.VI.2019; S. Dong leg.; SCAU 3049465 (SYSBM) • 2 females, same collection information as for preceding; 4–20.VI.2019; S. Dong leg.; SCAU 3049467 (IZCAS) • 1 female; Same collection information as for preceding; 30.VI–10.VII.2019; S. Dong leg.; SCAU 3049474 (AHNU) • 2 females; Same collection information as for preceding; 30.VII–10.VIII.2019; S. Dong leg.; SCAU 3049488 (SYSBM) • 1 female; Same collection information as for preceding; 30.VII–10.VIII.2019; S. Dong leg.; SCAU 3049474 (IZCAS) • 2 females, Same collection information as for preceding; 30.VII–10.VIII.2019; S. Dong leg.; SCAU 3049489 (AHNU) • 2 females; Same collection information as for preceding; 10–20.VIII.2019; S. Dong leg.; SCAU 3049481 (SYSBM) • 5 females; Same collection information as for preceding; 20–30.VIII.2019; S. Dong leg.; SCAU 3049484 (IZCAS) • 6 females; Same collection information as for preceding; 30.VIII–10.IX.2019; S. Dong leg.; SCAU 3049480 (AHNU) • 4 females; Same collection information as for preceding; 30.XI–30.XII.2019; S. Dong leg.; SCAU 3049487 (IZCAS) • 1 female; Same collection information as for preceding; 20–30.XI.2019, S. Dong leg.; SCAU 3049473 (AHNU) • 1 female; Same collection information as for preceding; 30.XI–30.XII.2019; S. Dong leg.; SCAU 3049469 (SYSBM) • 3 males, 5 females; Same collection information as for preceding; 20–30.IX.2019; S. Dong leg.; SCAU

Figure 6. *Dendrocerus anisodontus* Wang, Chen and Mikó sp. nov., male, holotype, genitalia A dorsal view B lateral view. Abbreviations: harpe (hrp), gonostipes (gsp).
Figure 7. *Dendrocerus anisodontus* Wang, Chen and Mikó sp. nov., female, paratype A dorsal habitus B head and mesosoma, dorsal view C lateral habitus D head and mesosoma, lateral view E head, anterior view F wings G metasoma, dorsal view.
Guangxi, Nanning, Mt. Longshan, 370 m; 1–2.VII.2011; Z. Xu leg.; (IZCAS) • 1 female; Sichuan, Pingwu, Baimazhai; 25.VII.2005; H. Zhang leg.; (AHNU) • 1 male; Sichuan, Yaan City, Zhangjiashan Park; 14.VII.2006; Z. Gao leg.; (SYSBM) • 1 male; Shaanxi, Liping Forest Experiment Station; 23.VII.2004; Q. Wu leg.; (IZCAS) • 1 male; Guizhou; Leigong Mountain Forest Farm; 1.VI.2005; H. Zhang leg.; (IZCAS) • 2 females; Guizhou, Kuankuoshui Protection Center; 3.12.2010; J. Zeng leg.; (SYSBM) • 1 male, 1 female; Sichuan, Yaan City, Zhangjiashan Park; 15.VII.2006; Z. Gao leg.; (IZCAS) • 1 male; Yunnan, Xianggelila Gaoshan Botanical Garden; 27.III.2017; J. Zeng leg.; (IZCAS) • 1 female, 2 females; Yunnan, Xishuangbanna Rainforest, 599 m; 24.IV–31.V.2017; L. Ma leg.; (SYSBM) • 1 male; Yunnan, Xishuangbanna Rainforest, 599 m; 24.IV–31.V.2017; L. Ma leg.; (SYSBM) • 1 female; Yunnan, Xianggelila Gaoshan Botanical Garden; 27.III.2017; J. Zeng leg.; (IZCAS) • 1 female; Sichuan, Yaan City, Zhangjiashan Park; 15.VII.2006; Z. Gao leg.; (IZCAS) • 1 male; Guizhou; Leigong Mountain Forest Farm; 1.VI.2005; H. Zhang leg.; (IZCAS) • 2 females; Guizhou, Kuankuoshui Protection Center; 3.12.2010; J. Zeng leg.; (SYSBM) • 1 male, 1 female; Yunnan, Gejiu, Lüchun County; 25.VII.2003; (AHNU) • 1 female; Yunnan, Xianggelila Gaoshan Botanical Garden; 27.III.2017; J. Zeng leg.; (IZCAS) • 1 female; Yunnan, Xishuangbanna Rainforest, 599 m; 24.IV–31.V.2017; L. Ma leg.; (SYSBM) • 1 male; Yunnan, Xishuangbanna Rainforest, 599 m; 24.IV–31.V.2017; L. Ma leg.; (SYSBM) • 1 female; Same collection information as for preceding; 21.VIII–20.IX.2019; L. Ma (IZCAS).

**Description. Male:** Body length: 1.8–2.1 mm.

**Coloration (Fig. 5):** Cranium, mesosoma and metasoma black; eyes brown to black; ocelli brown; scape and basal pedicel yellow; flagellum dark brown to black; fore and mid coxa along with femur and tibia brown with brownish joints; syntergum brown (Fig. 5A); pterostigma and costal vein brown; radial vein brown (Fig. 5F); body pubescence white; marginal fringes of wings brown.

**Head (Fig. 5C):** Slightly wider than mesosoma (about 1.1× wider than mesosoma). HH: EHf = 1.9–2.1. HH: HL = 1.2–1.6. HW: IOS = 1.8–1.9. HW: HH = 1.2–1.3. CSB: Mean: 350–470 μm. POL longer than OOL and ocellar triangle with broad base. OOL: LOL = 1.8–1.9. OOL: POL = 1.0–1.1. Head shape transverse in dorsal view, concolorous below and above eye midlevel. Preoccipital lunula absent (Fig. 5B). Facial pit absent. Intratorular carina distinct; ocular suture prominent and foveolate; frons with sparse hairs; densely pubescent at gena (Fig. 5B); Preoccipital furrow present.

**Antennae (Fig. 5C):** Ramose with six branches; scape nearly four times longer than wide; pedicel small and almost globular. Scape length vs. pedicel length: 4.7–4.8. Scape length vs. F1 length: 3.6–3.7. F1 length vs. pedicel length: 1.3–1.5. F1 length vs. F2 length: 0.9 μm. Longest flagellomere: F9. Length of setae on flagellomere vs. flagellomere width: setae as long as or shorter than width of flagellomeres. Basal flagellar segments clearly asymmetrical, with long projections.

**Mesosoma (Fig. 5B, D):** Pronotum not elongate. AscW/PscW = 0.7–0.8. Mesosoma slightly narrow (1.1× longer than wide) (Length/width/height = 640/600/560 μm); cariaceous in sculpture, densely pubescent. Mesoscutum: (Length/width = 350/570 μm); mesoscutum 1.6× wider than long, with more or less straight anterior margin; anterior corners of mesoscutum sharply angled; mesoscutal humeral sulcus evident; coarsely foveolate notaui angled sharply. Median mesoscutal sulcus present and complete, terminating adjacent to the transscutal articulation (Fig. 5B); scutellum 0.9× longer than wide, narrowed at apex with densely setose lateral margin; lateral scutellar carina evident; scutellum convex and highly sculptured with numerous hairs; metanotum and propodeum carinated. Posterodorsal metapleural area trapezoid-shaped. Mesopleural sulcus present.
**Wings (Fig. 5F):** Total wing length 1.5 mm. Hyaline. Pterostigma (Length/width = 220/110 μm) elliptical, 2.0× longer than wide; distal edge of pterostigma truncated; Radius (270 μm), curved a little in the middle and slightly logger (1.2×) than pterostigma; forewing densely pubescent and marginal fringes numerous; hind-wing without venation. Dark area on fore wing absent.

**Metasoma (Fig. 5G):** Metasoma concolorous with mesosoma. Mesosoma 1.6× longer than wide (Length/width/height = 830/510/430 μm). Syntergum with crenulate collar, clearly with neck. Rest of metasoma smooth, but with numerous pit like punctuations in middle and posterior of T3. Eight strong transverse gastral carinae present in basal portion of metasoma; gastrocoeli not evident; five terminal segments visible dorsally with numerous hairs.

**Male genitalia (Fig. 6):** Genitalia with short cupula. Harpe longer than gonostipes in lateral view; simple and not bilobed. Distal margin of harpe in lateral view blunt. Lateral setae of harpe present, but sparse (Fig. 6B). Gonostipes longer than wide, fused dorsally; apical margin (part of gonostipes) cleft medially (Fig. 6A). Median notch of distodorsal margin of gonostipes oval. Distal parossicular projection rounded.

**Females (Fig. 7):** Body length: 1.9–2.1 mm. Scape about 2.6× longer than combined length of pedicel and F1. Scape length vs. pedicel length: 4.1–4.6. Scape length vs. F1 length: 2.8–3.3. F1 length vs. pedicel length: 1.5–1.7. F1 length vs. F2 length: 0.8–0.9. Longest flagellomere: F3. Other than genitalia differences and sexual dimorphism in the antennae, there are no obvious differences between males and females.

**Distribution.** China (Hebei, Shandong, Zhejiang, Hunan, Fujian, Guangdong, Hainan, Guangxi, Sichuan, Shaanxi, Guizhou, Yunnan).

**Etymology.** The species name is a Greek masculine adjective meaning “unequal tooth”, signifying the irregular branches of the antennae of males.

**Remarks.** Like most *Dendrocerus* males, the lateral extension of the basal flagellar segments is the most notable character of *D. anisodontus* sp. nov. This is likely a device to increase the olfactory efficiency of the male, probably in its response to sex pheromones released by the female (Fergusson, 1980).

**Dendrocerus bellus** Wang, Chen & Mikó, sp. nov.
http://zoobank.org/F0D399A4-6F74-490E-AE4B-675A5FA59F15
Figs 8–10

**Diagnosis.** This new species belongs to the *D. halidayi* species group, and is close to *D. caelebs* but can be distinguished by its smaller body size (only 1.1–1.2 mm), unobvious notauli, body coloration, median notch of distodorsal margin of gonostipes triangle and spatulated-shaped harpe.

**Material Examined.** Holotype CHINA • male; Guangdong, Guangzhou, SYSU Bamboo Garden; 10.I–18.IV.2020; H. Chen leg.; (SYSBM) Paratypes (15 males, 17 females) CHINA • 7 males, 1 female; Guangdong, Guangzhou, University Town 2nd Forest; 20.I–17.II.2017; H. Chen leg.; (AHNU) • 1 male, 1 female; Guangdong,
Guangzhou, University Town, 22.VII.2018–20.I.2019, H. Chen leg.; (AHNU) • 1 female; Guangdong, Dongguan, Mt. Daling, 10–20.IX.2019; L. Chen et al. leg.; (SYSBM) • 2 females; Guangdong, Guangzhou, South China Botanical Garden, 7.II–16.III.2020, H. Huang et al. leg.; (IZCAS) • 1 male; Guangdong, Huizhou, Mt. Gutian; 30.XI–30.XII.2019, L. Chen et al. leg.; (IZCAS) • 1 female; Same collection information as preceding; 20–30. IX.2019; L. Chen et al. leg.; (SYSBM) • 2 females; Guangdong, Dongguan, Mt. Daling; 30.X–30.XI.2019; L. Chen et al. leg.; (SYSBM) • 1 female; Guangdong, Mt. Dinghu; 30.XI–30.XII.2019; L. Chen et al. leg.; (IZCAS) • 4 males, 8 females; Guangdong, Guangzhou, SYSU bamboo garden; 10.I–17.IV.2020; H. Chen leg.; (IZCAS) • 1 male; Sichuan, Yaan City, Zhangjiashan Park; 14.VII.2006; Z. Gao; (AHNU) • 1 male; Yunnan, Menghai, Mt. Bulang, 1595 m; 28.V–28.VI.2019; SCAU 3049495 (AHNU).

**Description.** **Male:** Body length: 1.1–1.2 mm.
Notes on *Dendrocerus*

**Coloration (Fig. 8):** Cranium, mesosoma and metasoma dark brown; eyes brown; ocelli yellow. Scape yellow, pedicel and flagellum dark brown. Fore and mid coxa along with femur and tibia yellow; syntergum dark brown (Figs 8A, G); pterostigma dark brown; costal vein and radial vein brown (Fig. 8F); body pubescence white; marginal fringes of wings brown.

**Head (Fig. 8C):** Head width, dorsal view: slightly wider than mesosoma (about 1.2× wider than mesosoma). HH: EHf = 1.7–1.9. HH: HL = 1.1–1.2. HW: IOS = 1.7. HW: HH = 1.1–1.2. CSB: Mean: 330–360 μm. POL shorter than OOL and ocellar triangle with broad base. OOL: LOL = 1.6–1.7. OOL: POL = 1.0–1.1. Head shape transverse in dorsal view; concolorous below and above eye midlevel. Preoccipital lunula absent (Fig. 8B). Facial pit absent. Intertorular carina curved; ocular suture prominent and foveolate; frons with sparse hairs; densely pubescent at gena (Fig. 8B). Facial pit present. Preoccipital furrow present.

**Antennae (Fig. 8C):** Scape nearly five times longer than wide; pedicel small and almost globular. Scape length vs. pedicel length: 6.0–7.0. Scape length vs. F1 length: 2.7–3.2. F1 length vs. pedicel length: 2.3–2.7. F1 length vs. F2 length: 0.9–1.0. Longest flagellomere: F9. Length of setae on flagellomere vs. flagellomere width: setae as long as or shorter than width of flagellomeres. Basal flagellar segments clearly asymmetrical, strongly serrate.

**Mesosoma (Fig. 8B, D):** Pronotum (Prn) not elongate. Anterior mesocutal width (AscW) vs. posterior mesocutal width (PscW): AscW/PscW = 0.7–0.8. Mesosoma slightly narrow (1.4× longer than wide) (Length/width/height = 407/350/440 μm); coriaceous in sculpture, densely pubescent. mesoscum: (Length/width = 127/206 μm); mesoscum 1.6X wider than long, with more or less straight anterior margin; anterior corners of mesoscum sharply angled; mesoscum humeral sulcus evident; notaui thin and unobvious. Median mesoscum...

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**Figure 9.** *Dendrocerus bellus* Wang, Chen and Mikó sp. nov., male, holotype, genitalia A dorsal view B ventral view.
sulcus present and complete, terminating adjacent to the transscutal articulation (Fig. 8B); scutellum 0.9× longer than wide, narrowed at apex with densely setose lateral margin; lateral scutellar carina evident; scutellum convex and highly sculptured with numerous hairs; metanotum and propodeum carinated. Posterodorsal metapleural area trapezoid. Mesopleural sulcus present.

Wing (Fig. 8F): Total wing length 0.9 mm. Hyaline. Pterostigma (Length/width = 180/90 μm) elliptical, 2.0× longer than wide; distal edge of pterostigma truncated; Radius (130 μm), curved a little in the middle and slightly shorter (0.7×) than pterostigma; forewing tinted with light brown, densely pubescent and marginal fringes numerous; hind wing without venation. Dark area on fore wing present.

Metasoma (Fig. 8G): Metasoma lighter than mesosoma. Mesosoma 1.6× longer than wide (Length/width/height = 500/320/220 μm). Syntergum with crenulate collar, clearly with neck. Rest of metasoma smooth. Strong transverse gastral carinae pre-
Notes on *Dendrocerus*

sent in basal portion of metasoma; gastrocoeli not evident; five terminal segments visible dorsally with numerous hairs.

**Male genitalia (Fig. 9):** Genitalia with short cupula. Harpe longer than gonostipes in lateral view, with numerous terminal long and slender setae; harpe shape spatulate and oriented medially. Lateral setae of harpe present, but sparse. Gonostipes longer than wide, fused dorsally; apical margin curved medially, spatulated-shaped. Volsella black, with sharped apically. Median notch of distodorsal margin of gonostipes triangle. Distal parossiculal projection pointed.

**Females (Fig. 10):** Body length: 1.35–1.44 mm. Head yellow below and brown above eye midlevel, mandibles and palps yellow. Mesosoma and metasoma yellowish, tinged with brown; eyes white; ocelli white to yellowish. Scape, pedicel and basal flagellar segments yellowish. Legs yellowish; syntergum light brown (Figs 10A, G). Metasoma darker than mesosoma. Flagellar segments symmetrical and cylindrical. Other characteristics similar to male.

**Distribution.** China (Guangdong, Hainan, Sichuan, Yunnan).

**Etymology.** The species name is a Latin masculine adjective meaning “beautiful and exquisite”, signifying the beautiful coloration, especially in female.

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