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● *Dorcus zhouchaoi* sp. nov., a new stag beetle from Sichuan, China (Coleoptera: Lucanidae)

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Abstract: A new species of the genus *Dorcus* MacLeay, 1819 (Coleoptera: Lucanidae: Lucaninae), *D. zhouchaoi* sp. nov., is described and illustrated from Sichuan, China. It is closely related to *D. liyingbingi* Huang & Chen, 2013, *D. menci*us (Kriesche, 1935) and *Dorcus tianlongi* Wang & Zhou, 2019. Diagnostic characters of the four species are compared.

Keywords: Diagnosis, Dorcini, morphology, new species, taxonomy

● 中国四川一锹甲新种——周超大锹（鞘翅目：锹甲科）

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摘要: 本文描绘了一种产于中国四川的大锹属新种——周超大锹 *Dorcus zhouchaoi* sp. nov.（鞘翅目：锹甲科：锹甲亚科）。该新种近于李氏大锹 *D. liyingbingi* Huang & Chen, 2013、孟子大锹 *D. menci*us (Kriesche, 1935)与天龙大锹 *Dorcus tianlongi* Wang & Zhou, 2019。本文比较了此四种锹甲的鉴别特征。

关键词: 鉴别，刀锹族，形态，新种，分类

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Introduction

The genus *Dorcus* MacLeay, 1819 (Coleoptera: Lucanidae: Lucaninae: Dorcini) is a speciose group of stag beetles with members distributed in the Nearctic, Oriental and Palearctic Realms. However, the genus dispersal centre is in Aisa with many congeners similar in external morphology. Huang & Chen (2013, 2017) excellently revised Chinese species of *Dorcus* in the fascicles II and III of their milestone books, *Stag Beetles of China*. Up to date, 73 species (ignoring subspecies) were recorded from China (Huang & Chen 2013, 2017, 2020, 2023; Bartolozzi *et al.* 2016; Wang & Zhou 2019; Huang *et al.* 2020).

In the present study, we describe and illustrate a new *Dorcus* species based on a series of specimens from Sichuan Province of China. The differential diagnosis of the new species from its closely related species *D. liyingbingi* Huang & Chen, 2013, *D. menciuis* (Kriesche, 1935) and *D. tianlongi* Wang & Zhou, 2019 is provided.

Material and methods

Specimens were relaxed and softened in a HH-2 digital homoeothermic water bath at 44.4°C for 12 hours and then placed in distilled water for cleaning and dissection. In order to examine the genitalia of both sexes, the abdomens were detached and treated with a 10% solution of potassium hydroxide for 12 hours, then transferred to distilled water to flush the remaining KOH and stop any further bleaching. After examination, the dissected body parts were mounted on a slide using Euparal Mounting Medium for future studies. Images were taken with a Canon macro photo lens MP-E 65 mm on a Canon 5DsR. Images of the same object at different focal planes were combined using Zerene Stacker 1.04 stacking software. Adobe Photoshop CS6 was used for postprocessing. The terminology adopted in this paper for external features of the body and genitalia follows Holloway (2007) and Huang & Chen (2010, 2013, 2017). Measurement criteria in millimetres (mm) follow Wang & Zhou (2019).

The material examined for this study is deposited in the following collections: **BMNH**—Natural History Museum (formerly British Museum), London, United Kingdom; **CTLH**—collection of Tian-Long He, Huainan, China; **MYNU**—Invertebrate collection of Mianyang Normal University, Mianyang, China.

Taxonomy

Genus *Dorcus* MacLeay, 1819 大锹属

Dorcus zhouchaoi sp. nov. 周超大锹

<https://zoobank.org/D1767CD4-45E0-4059-AEC8-9C8583555FB5>

Figs 1A–F; 2A–G; 3A–D

Type material: 18♂♂14♀♀. **Holotype:** 1♂ (BMNH), **CHINA, Sichuan:** Liangshan Prefecture, Huidong County, Xinjie Town [新街镇], 2200 m, 3.VIII.2022, Tian-Long He leg. **Paratypes:** 2♂♂2♀♀ (2♂♂1♀ in MYNU and 1♀ in BMNH), same as holotype except 5.VIII.2021, Zheng-You Gao leg.; 3♂♂1♀ (CTLH), same as holotype except 2800 m, 11.VIII.2021, Zheng-You Gao leg.; 3♂♂3♀♀ (CTLH), same as holotype except 2600 m, 20.VIII.2021, Zheng-You Gao leg.; 5♂♂2♀♀ (CTLH), same as holotype; 4♂♂6♀♀ (CTLH), same as holotype except 2.VII.2024, Guo-Quan Jiang leg.

Etymology. The new species is dedicated to our friend, Mr. Chao Zhou (Chengdu, China), an enthusiastic amateur entomologist. The name is a noun in the genitive case.

Description. Holotype, large-sized male. Size relatively small for the genus, body 30.3 mm long, widest at anterior 1/3 of pronotum. Length of particular parts (mm): head (4.4), mandible (4.9), pronotum (6.7), elytra (14.6); width (mm): head (9.7), pronotum (11.3), elytra (10.7).

Habitus (Figs 1A, B). Color black. Body generally lustreless and glabrous; some distinct, recumbent, yellowish pubescence sparsely present on lateral parts of metasternum and densely along posterior margin of abdominal sternite VII.

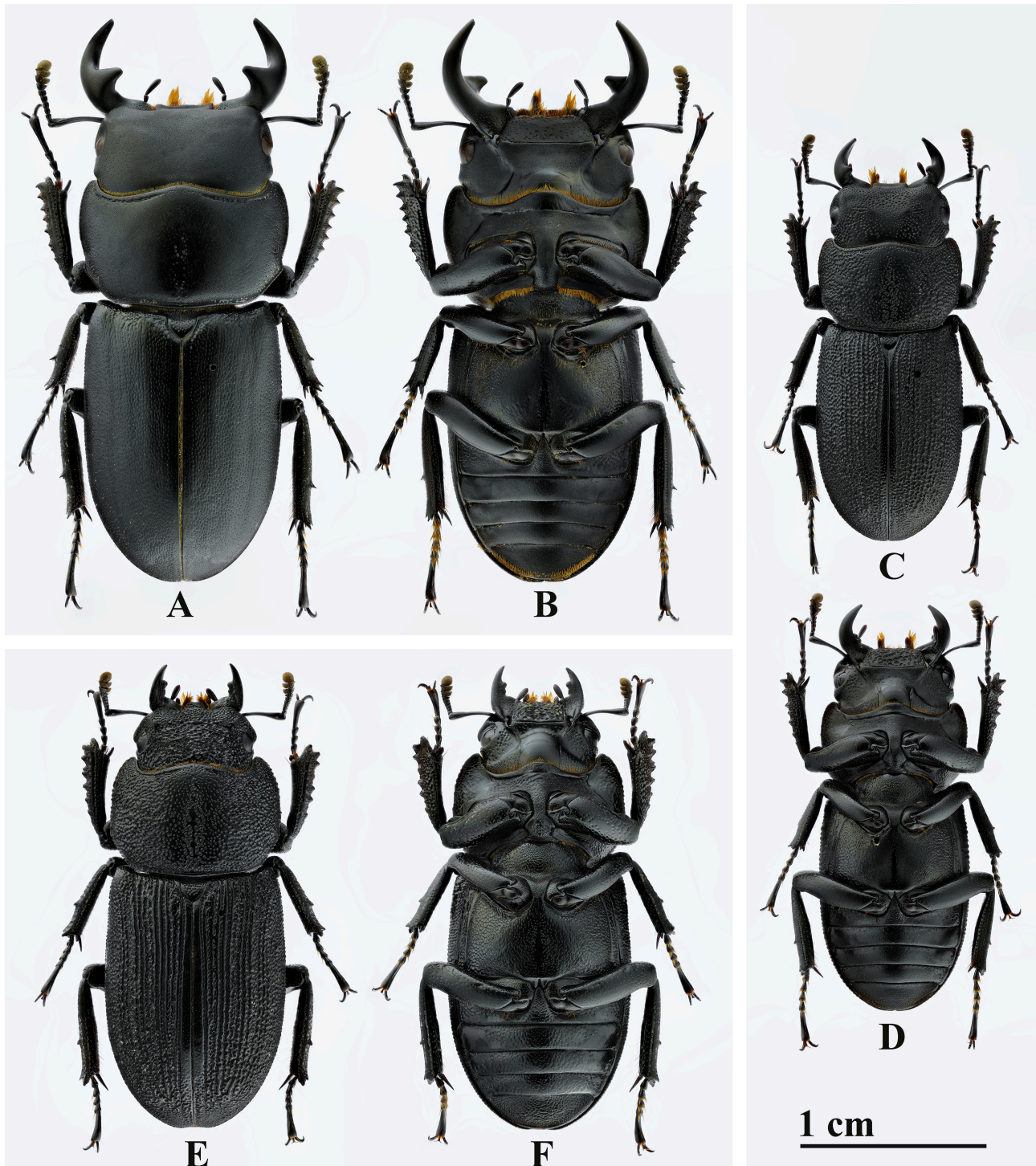


FIGURE 1. *Dorcus zhouchaoi* sp. nov.: **A, B** holotype, ♂, large-sized **C, D** paratype, ♂, small-sized **E, F** paratype, ♀. (**A, C, E** dorsal views **B, D, F** ventral views)

Head about 2.2 times as broad as long, broadest at postocular processes, surface sparsely and irregularly covered with fine punctures, interstices shagreened. Vertex inconspicuously depressed in a triangular center area. Clypeolabrum shortly transverse, slightly protruding in medial part of anterior margin. Mandible about 1.1 times as long as head, distinctly incurved at middle; one single inner tooth present at basal 1/3, pointing inward and round at apex. Preocular margin slightly arcuate. Postocular margin bulged into a round process. Antennal club with three pubescent antennomeres; antennomere 7 sharp at inner apical angle; antennomeres 8–10 lamellate. Mentum

subtrapezoidal, coarsely punctate, with anterolateral angles rounded. Submentum inverted trapezoidal, finely punctate. Gula elongate, smooth.

Pronotum 1.7 times as wide as long, widest at anterior 1/3, and 1.2 times as wide as head. Lateral margin gently arcuate before posterior angle. Posterior margin slightly bisinuate. Lateral angles lacking. Posterior angles roundly obtuse. Surface mostly smooth, slightly depressed along posterior part of midline, sparsely and irregularly covered with fine punctures, strengthening in depression and lateral parts, interstices shagreened.

Scutellar shield linguiform. Surface finely and roundly punctate, interstices microreticulate.

Elytra 1.4 times as long as wide, widest around anterior 1/3, with width subequal to pronotum. Surface smooth, except coarse punctures at base, most densely covered with fine punctures which as if in rows.

Legs. Protibia with 6–7 large teeth, slightly acute along outer margin; apex bifurcate with branches slightly acute at tip. Except apical spurs and spines, each meso- and metatibia with one sharp spine and one denticle along outer margin.

Male genitalia. Abdominal tergite VIII (Fig. 2C) subhexagonal, with subtriangular membranous area at middle of anterior half; sternite VIII (Fig. 2D) transverse, with transverse membranous area at middle of anterior part. Abdominal tergite IX (Fig. 2E) round at posterior margin, with lateral extensions relatively slender (Fig. 2F); pleurite IX (Fig. 2E) separated dorsally; sternite IX (Fig. 2G) with small subtriangular membranous area at middle of posterior margin. Aedeagus (Fig. 3A) in ventral view about 2.2 times as long as wide; basal piece (Figs 3A, B) distinctly constricted in anterior part, about 1.4 times as long as parameres, with paired sclerotized large dorsal plates (Fig. 3B); ventral caudal plate (Fig. 3A) not bifurcate at apex; paramere without basal process (Figs 3A, B), weakly upturned at apex (Fig. 3C); median lobe (Fig. 3A) slender and biarcuate, about half length of parameres; flagellum (Figs 3A–C) long, trifurcate, about 4.7 times as long as parameres, apex strongly enlarged.

Male paratypes. Body 21.2–29.3 mm long. **Small-sized male.** Length of particular parts (mm, n=3): head (3.2), mandible (2.7), pronotum (4.9), elytra (11.1); width (mm): head (6.5), pronotum (7.8), elytra (7.9).

Habitus (Figs 1C, D). Color black. Body somewhat lustrous and glabrous; metasternum almost without pubescence; some fine, recumbent, yellowish and pubescence sparsely along posterior margin of abdominal sternite VII.

Head about twice as broad as long, broadest at canthi, surface densely and irregularly covered with coarse punctures, interstices shagreened. Vertex inconspicuously depressed in a triangular center area. Clypeolabrum shortly transverse, slightly emarginate at anterior margin. Mandible about 6/7 length of head, distinctly incurved at middle; one single inner tooth present at basal 1/3, pointing inward and round at apex. Preocular margin arcuate. Postocular margin bulged into a round process. Mentum subtrapezoidal, rather coarsely punctate, with anterolateral angles rounded. Submentum inverted trapezoidal, moderately punctate. Gula elongate, smooth.

Pronotum 1.6 times as wide as long, widest at anterior 1/3, and 1.2 times as wide as head. Lateral margin gently arcuate. Posterior margin almost simply curved. Lateral and posterior angles both lacking. Surface mostly smooth, slightly depressed along posterior part of midline, densely and irregularly covered with rather coarse punctures, strengthening in depression and lateral parts, interstices shagreened.

Scutellar shield linguiform. Surface moderately and roundly punctate, interstices microreticulate.

Elytra 1.4 times as long as wide, widest around anterior 2/5, with width subequal to pronotum. Surface rugose, except small round punctures beside suture, most rather densely covered with rather coarse punctures which as if in rows.

Legs. Protibia with 5–6 large teeth, more or less blunt along outer margin; apex bifurcate with branches blunt at tip. Except apical spurs and spines, each meso- and metatibia with one sharp spine along outer margin.

Male genitalia just like large-sized individuals.

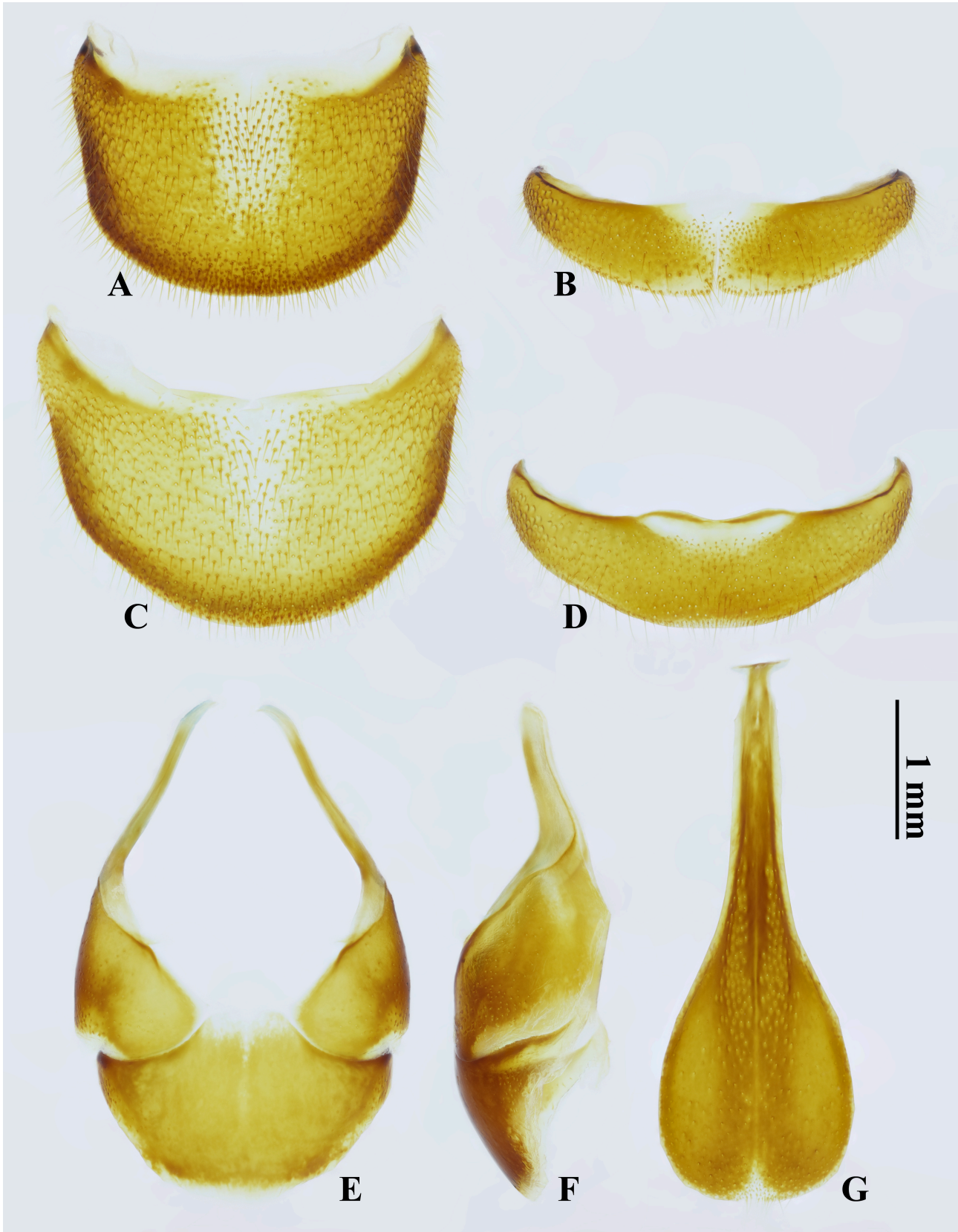


FIGURE 2. Abdominal segments VIII & IX of *Dorcus zhouchaoi* sp. nov.: **A** tergite VIII, ♀ **B** sternite VIII, ♀ **C** tergite VIII, ♂ **D** sternite VIII, ♂ **E** tergite and pleurite IX, ♂ **F** ditto, ♂ **G** sternite IX, ♂. (**A**, **C**, **E** dorsal views **B**, **D**, **G** ventral views **F** lateral view)

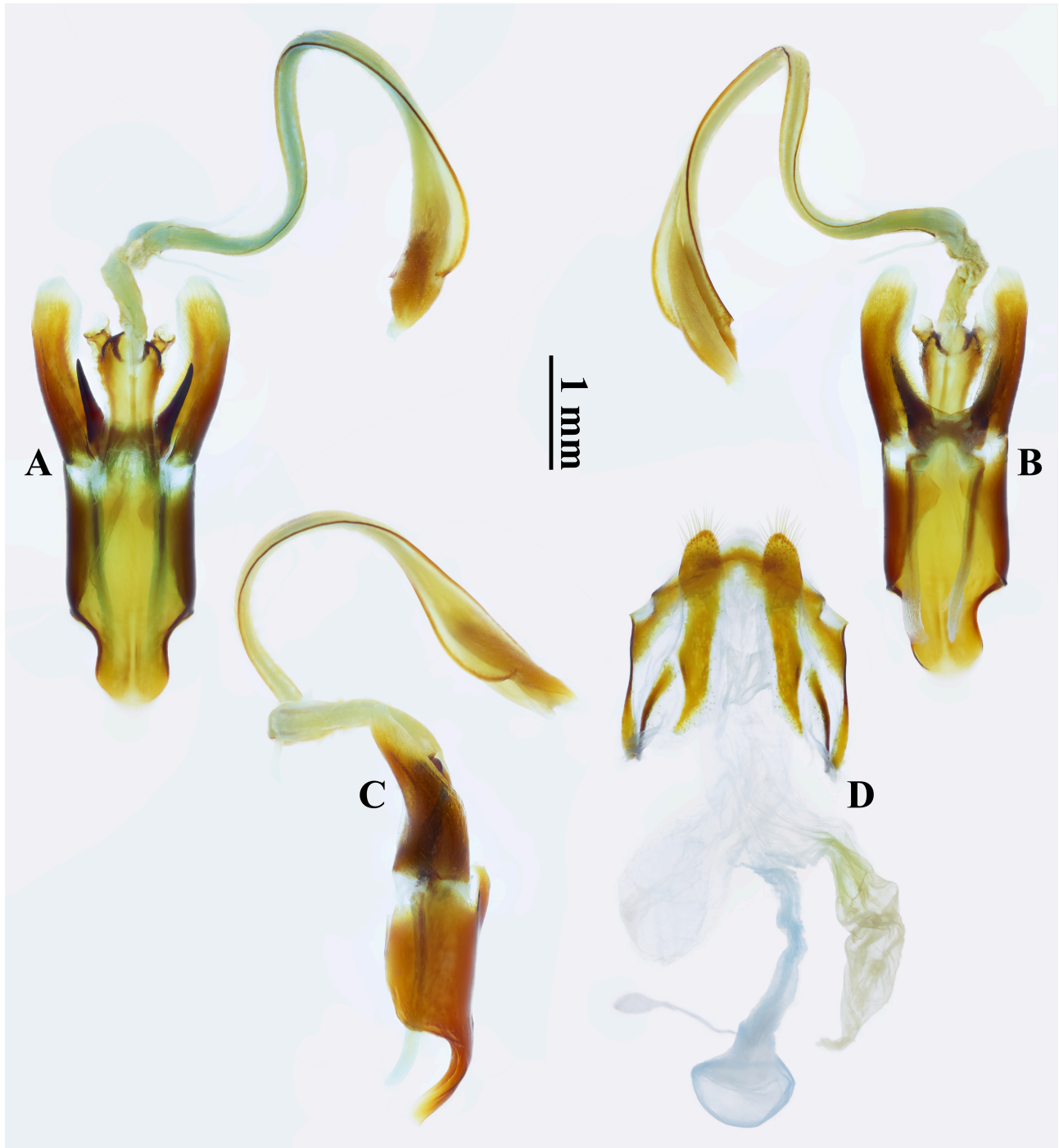


FIGURE 3. Genitalia of *Dorcus zhouchaoi* sp. nov.: A–C aedeagus D female genitalia. (A, D ventral views B dorsal view C lateral view)

Female paratypes. Body 24.5–25.2 mm long. Length of particular parts (mm, n=3): head (3.3 mm), mandible (2.5 mm), pronotum (6.2 mm), elytra (13.4 mm); width: head (6.7 mm), pronotum (9.2 mm), elytra (9.8 mm).

Habitus (Figs 1E, F). Color black. Body somewhat lustrous and glabrous; metasternum almost without pubescence; some fine, recumbent, yellowish and pubescence sparsely along posterior margin of abdominal sternite VII.

Head about twice as broad as long, broadest at canthi, surface strongly rugose, densely and irregularly covered with rather coarse punctures, interstices shagreened. Vertex inconspicuously depressed anteriorly. Clypeolabrum small, subtrapezoidal, slightly emarginate at anterior margin. Canthus without posterior angle. Mandible about 3/4 length of head, right and left ones similar to each other, each with one dorsal tooth, one inner tooth ahead of middle and two slight protuberance basally. Preocular margin slightly emarginate. Postocular margin relatively short. Mentum subtrapezoidal, rugose, rather coarsely punctate, with anterolateral angles rounded. Submentum inverted trapezoidal, moderately punctate. Gula elongate, smooth.

Pronotum 1.5 times as wide as long, widest at anterior 4/9, and 1.4 times as wide as head. Lateral margin crenulated, gently arcuate. Posterior margin almost simply curved. Surface mostly smooth, densely and irregularly covered with rather coarse punctures, strengthening along posterior part of midline and in lateral parts, interstices shagreened.

Scutellar shield linguiform. Surface moderately and roundly punctate, interstices microreticulate.

Elytra 1.4 times as long as wide, widest around anterior 3/8, about 1.1 times as wide as pronotum. Surface rugose, except small round punctures beside suture, most rather densely covered with rather coarse punctures which in rows. Longitudinal carinae relatively narrow.

Legs. Protibia with 5–6 large teeth, more or less bluntly rounded along outer margin; apex bifurcate with branches bluntly rounded at tip. Except apical spurs and spines, each meso- and metatibia with one spine along outer margin.

Female genitalia. Abdominal tergite VIII (Fig. 2A) semicircular, with broad membranous area at middle of anterior half, without lateral angle; sternite VIII (Fig. 2B) with subtriangular membranous area at middle of anterior half and rather thin membranous area along midline of posterior half, weakly emarginate at middle of posterior margin. Hemisternite (Fig. 3D) with apical part slender and narrowly round at apical margin. Central conjunction of tergite IX (Fig. 3D) protruding medially and roundly narrowed at tip. Spermatheca (Fig. 3D) inflated, suboval and weakly sclerotized. Spermathecal duct (Fig. 3D) short. Spermathecal gland (Fig. 3D) small, oval and membranous. Spermathecal gland duct (Fig. 3D) slender and thin. Accessory gland (Fig. 3D) oblong.

Differential diagnosis. This new species should be assigned to the *Dorcus reichei* group (*sensu* Huang & Chen, 2013). It can be distinguished from *Dorcus liyingbingi* Huang & Chen, 2013, *D. menci* (Kriesche, 1935) and *D. tianlongi* Wang & Zhou, 2019 by the combination of characters shown in Tables 1 & 2.

Distribution. China (Sichuan).

TABLE 1. Selected important morphological differences among large-sized males of *Dorcus liyingbingi* Huang & Chen, 2013, *D. menci*us (Kriesche, 1935), *D. tianlongi* Wang & Zhou, 2019 and *D. zhouchaoi* **sp. nov.**

Characters	<i>D. liyingbingi</i>	<i>D. menci</i> us	<i>D. tianlongi</i>	<i>D. zhouchaoi</i> sp. nov.
Body size	moderate	relatively large	moderate	relatively small
Head	widest at postocular process	widest at eyes	widest at eyes	widest at postocular process
Mandible	incurved at middle, single-toothed; inner tooth present at basal 1/3, pointing inward and round at apex	incurved at apical 1/3, triple-toothed in large size or double-toothed (the small one vestigial but still visible) in small size; largest inner tooth present at basal 1/3 and round at apex	incurved at middle, single-toothed; inner tooth present at middle, pointing forward and truncated at apex	incurved at middle, single-toothed; inner tooth present at basal 1/3, pointing inward and round at apex
Pronotum	lateral angles acute	lateral angles obtuse	lateral angles obtuse	lateral angles lacking
Protibia	outer teeth more or less acute	outer teeth more or less acute	outer teeth more or less bluntly rounded	outer teeth slightly acute
Tergite VIII	membranous area relatively smaller	membranous area relatively broader	membranous area relatively smaller	membranous area relatively broader
Sternite VIII	a pair of membranous areas at middle of anterior part	a pair of or a transverse membranous area at middle of anterior part	a transverse membranous area at middle of anterior part	a transverse membranous area at middle of anterior part
Tergite IX	lateral extensions relatively slender	lateral extensions relatively stouter	lateral extensions relatively slender	lateral extensions relatively slender
Pleurite IX	separated dorsally	separated dorsally	conterminous dorsally	separated dorsally
Sternite IX	a small protuberance at middle of posterior margin	a transverse membranous area along posterior margin	a small membranous area at middle of posterior margin	a small membranous area at middle of posterior margin
Aedeagal basal piece	ventral plate at apical end bifurcate at apex	ventral plate at apical end not bifurcate at apex	ventral plate at apical end not bifurcate at apex	ventral plate at apical end not bifurcate at apex
Median lobe	relatively wide, constricted in middle	relatively wide, hardly constricted in middle	relatively slender, distinctly constricted in middle	slender, distinctly constricted in middle

TABLE 2. Selected important morphological differences among females of *Dorcus liyingbingi* Huang & Chen, 2013, *D. menci*us (Kriesche, 1935), *D. tianlongi* Wang & Zhou, 2019 and *D. zhouchaoi* **sp. nov.**

Characters	<i>D. liyingbingi</i>	<i>D. menci</i> us	<i>D. tianlongi</i>	<i>D. zhouchaoi</i> sp. nov.
Canthus	?	without posterior angle	with rounded posterior angle	without posterior angle
Mandible	?	left with one inner tooth around middle and three small tubercles basally	left with one inner tooth ahead of middle and one slight protuberance basally	left with one inner tooth ahead of middle and two slight protuberance basally
Pronotum	densely and irregularly covered with coarse punctures	smooth, only densely covered with coarse punctures along margins	densely and irregularly covered with coarse punctures except smooth areas beside midline	densely and irregularly covered with rather coarse punctures
Protibia	with 5–6 outer teeth	with 6–7 outer teeth	without outer teeth, weakly undulated along outer margin	with 5–6 outer teeth
Sternite VIII	?	transverse membranous area at middle of anterior half and wide membranous area along midline of posterior half	oblong membranous area at middle of anterior half and moderately wide membranous area along midline of posterior half	subtriangular membranous area at middle of anterior half and rather thin membranous area along midline of posterior half
Hemisternite	apical part longer, round at apical margin	apical part longer, round at apical margin	apical part shorter, straight at apical margin	apical part slender, narrowly round at apical margin
Spermatheca	smaller, globular	larger, suboval	smaller, reniform	smaller, suboval
Spermathecal gland duct	slender and thin	short and thick	slender and thin	slender and thin
Accessory gland	oblong	oblong	clavate	oblong

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Additional information

Author contributions: Conceptualization: C-B Wang & T-L He. Project administration: T-L He. Resources: T-L He. Supervision: T-L He. Visualization: C-B Wang. Writing—original draft: C-B Wang. Writing—review and editing: C-B Wang & T-L He.

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