

**A new contribution to knowledge of the genus
Aulacostethus Waterhouse (Coleoptera: Lucanidae: Lucaninae)
revealing a new species from Yunnan, China**

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Taxonomy, new species, *Aulacostethus*, Coleoptera, Lucanidae, Lucaninae, China

Abstract. A new species of stag beetle, *Aulacostethus zenghuae* sp. nov. (Coleoptera: Lucanidae: Lucaninae), from Yunnan, China is described, which was formerly misidentified as *A. doani* Baba, 2000. The differential diagnosis of the new species from *A. doani* is provided. Important morphological characters of the new species are illustrated.

INTRODUCTION

Aulacostethus Waterhouse, 1869 (Coleoptera: Lucanidae: Lucaninae: Dorcini) is a small genus of stag beetles with only four members distributed in the Oriental Region (Huang & Chen 2013, Bartolozzi et al. 2016). Huang & Chen (2013) excellently revised the four species of *Aulacostethus* from China in the fascicle II of their milestone books, Stag Beetles of China. In their work, three specimens (1 ♂, 2 ♀♀) from Jinping County, Yunnan Province were identified as *Aulacostethus doani* Baba, 2000, which was only recorded from Sapa of North Vietnam before. However, after studying specimens from the same locality, we realized that this species is actually unknown to science. Thus, in the present study, we describe and illustrate it as a new species, *Aulacostethus zenghuae* sp. n. The differential diagnosis of the new species from *A. doani* is provided. Important distinguishing morphological characters of the new species are illustrated in colour plates.

MATERIALS AND METHODS

Specimens were relaxed and softened in a HH-2 digital homoeothermic water bath at 44.4°C for 24 hours, then transferred to distilled water for cleaning, observation 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 the examination, the body parts were mounted on a glass slide with Euparal Mounting Medium for future studies. Habitus photographs were taken using a Canon macro photo lens MP-E 65mm on a Canon 5DsR. Detailed photographs with transmitted light were performed using a Shanghai BM-SG12S microscope with a Canon 550D. The final deep focus images were created with Zerene Stacker 1.04 stacking software. Adobe Photoshop CS6 was used for post-processing. The morphological terminology follows Holloway (2007) and Huang & Chen (2010, 2013, 2017).

The material examined for this study is deposited in the following institutional and private collections:

CTLH - collection of Tian-Long He, Huainan, China

MAHU - Museum of Anhui University, Hefei, China

Measurement criteria in millimetres (mm) are as follows:

Body length: length between the apex of mandible and the elytral apex along the midline.

Elytral length: length between the basal border and the apex of elytra along suture.

Elytral width: maximum width of both elytra combined.

Head length: length between the anterior apex of clypeus and the posterior margin of occiput along the midline.

Head width: maximum width of head (including eyes).

Mandible length: length from the apex of mandible to its base.

Pronotal length: length of the pronotum along the midline.

Pronotal width: maximum width of pronotum.

The following material of *Aulacostethus* was studied for comparison:

Aulacostethus archeri Waterhouse, 1869 (Figs. 4C-D). CHINA, Xizang: 1 ♂, Shannan City, Cona County, Lebugou, 2017.VI.6 (CTLH).

Aulacostethus tianmuxing Huang & Chen, 2013 (Figs. 4E-H; 5D-E). CHINA, Zhejiang: 2 ♂♂, Tianmushan [= Mt. Tianmu], Sanmuping, 2011.VII.28-29, Ji-Bin Liang & Zhen-Xing Zhang leg. (CTLH); 2 ♀♀, Tianmushan, firebreak to Xianrending, 2016.VII.10, Li Jin leg. (CTLH).

RESULTS

Genus *Aulacostethus* Waterhouse, 1869

Aulacostethus zenghuae sp. nov.

(Figs. 1A; 2; 3B; 4A-B; 5A-B; 6; 7)

Huang & Chen 2013: 312 (*Aulacostethus doani*; misidentified; diagnosis; illustrations; distribution).

Type material. Holotype (♂): CHINA, Yunnan: Jinping County, Fenshuiling Nature Reserve, 2.VI.2016, Tian-Long He leg. (MAHU). Paratypes: (1 ♀): same data as holotype (CTLH); (1 ♀): same data as holotype except: 13.VI.2019 (CTLH) [still living, bred by Tian-Long He].

Description. Male holotype. Size moderate within the genus, body 36.1 mm long, widest at middle of elytra. Length of different body parts: head (5.2 mm), mandible (8.0 mm), pronotum (7.0 mm), elytra (15.9 mm); width: head (11.4 mm), pronotum (12.4 mm), elytra (13.3 mm).

Habitus (Figs. 1A; 2A-C). Colour black. Body generally glabrous; some distinct, recumbent, yellowish and sparse pubescence present on apical and lateral parts of metasternum.

Head (Figs. 3B; 4A-B) wider than long, widest at postocular processes. Clypeolabrum transverse, subtrapezoidal, and shallowly emarginate at apical margin. Forehead with anterior margin forming a prominent trisinate ridge, of which median projection is protruded to a rounded tip. Disc with a semicircular depressed area. Mandible about 1.5 times as long as head, gently incurved in apical part; one single inner tooth present at basal 1/3, pointing inward and rounded at apex; an imperceptible weak protuberance present at apical 1/3. Postocular margin weakly bulged into a round process. Antennal club with 3 antennomeres; antennomere VII short, sharp at inner margin; antennomeres VIII-X lamellate.

Pronotum (Figs. 3B; 4A) 1.8 times wider than long, widest at obtuse hind angles.

Legs (Figs. 1A; 2A-C). Protibia with 3 distinct large teeth, generally acute along outer margin; apex bifurcate with branches generally acute at tip. Except apical spurs and spines, each mesotibia and metatibia with one distinctly-sharp lateral spine.

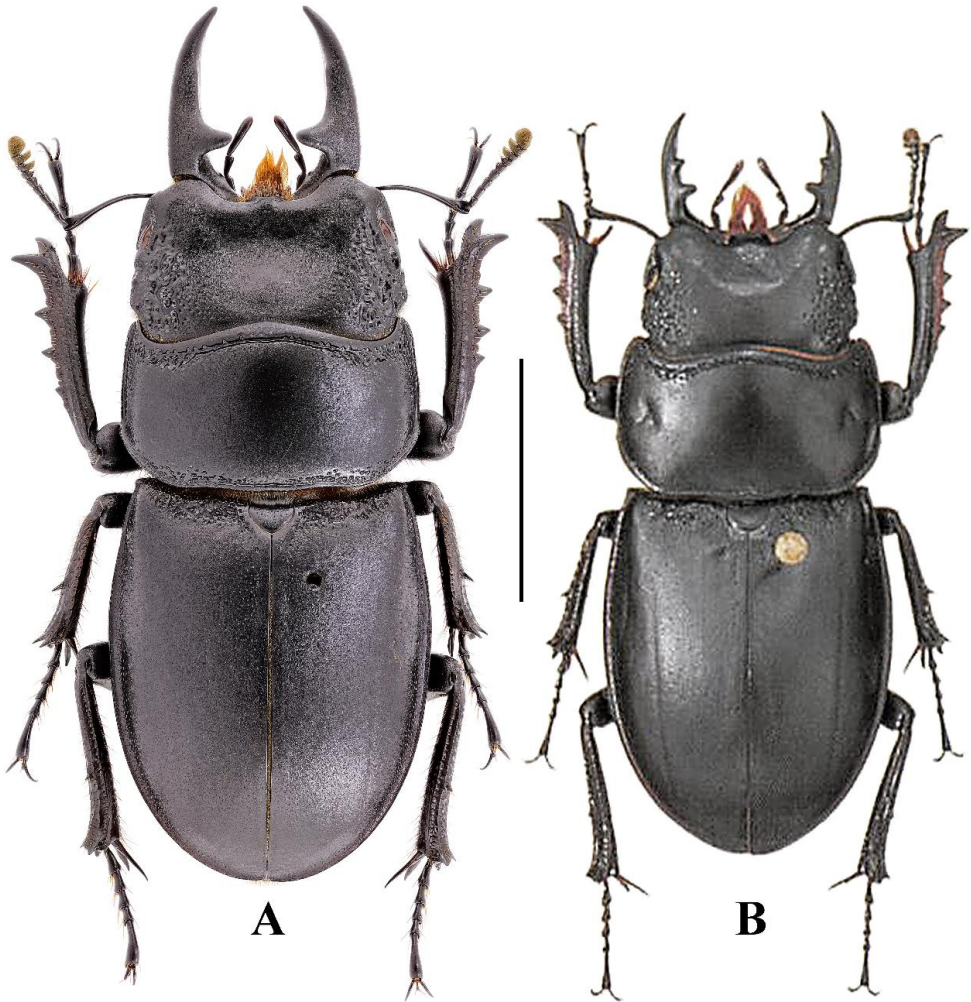


Fig. 1. Male habitus of *Aulacostethus* spp. in dorsal view: A- *A. zenghuai* sp. nov., holotype; B- *A. doani* Baba, 2000, holotype (after Baba, 2000). Scale bar = 1.0 cm.

Male genitalia. Abdominal tergite VIII (Fig. 6A) with a longitudinal membranous area at middle of basal half; abdominal sternite VIII (Fig. 6B) with an ∞ -shaped membranous area at middle of basal part. Abdominal tergite IX (Fig. 6F) with a longitudinal membranous area at middle of basal half; abdominal pleurite IX (Fig. 6F) separated dorsally; abdominal sternite IX (Fig. 6E) almost without visible membranous area. Aedeagus (Fig. 7A) in ventral view about 2.9 times longer than wide. Basal piece (Figs. 7A-B) distinctly constricted in basal part, about 1.7 times as long as parameres, with a pair of sclerotized dorsal plates (Fig. 7B); ventral plate (Fig. 7A) semicircular and membranous at apex of distal end of basal piece. Paramere without basal process (Fig. 7B); apex round in lateral view (Fig. 7C). Penis (Fig. 7A) relatively slender and weakly incurved at apical part, distinctly shorter than parameres. Flagellum (Figs. 7A-C) short but strong, about 3.4

times as long as parameres; apical half trifurcate; lateral branches (Fig. 7D) lanceolate; central branch (Fig. 7D) about 4.4 times longer than lateral branch, with apex weakly enlarged.

Female paratypes. Body 31.5 mm long. Length of different body parts ($n=2$): head (4.1 mm), mandible (2.8 mm), pronotum (7.6 mm), elytra (16.8 mm); width: head (8.7 mm), pronotum (12.5 mm), elytra (13.4 mm).

Habitus (Figs. 2D-E). Colour black. Body generally glabrous; some distinct, recumbent, yellowish and sparse pubescence present on apical and lateral parts of metasternum.

Head (Figs. 5A-B). Canthus with rounded posterior angle. Clypeolabrum small, distinctly emarginate in middle. Right mandible different from left one: both with one inner tooth, and a longitudinal carina in centre of dorsal surface which is gently emarginate at middle, whilst the left one still with a smaller protuberance under anterobasal part of inner tooth. Postocular margin hardly bulged into process.

Pronotum (Fig. 5A) 1.6 times wider than long, widest at obtuse hind angles. Lateral margin slightly crenulate. Disc finely, shallowly and sparsely punctate, while coarsely punctate near outer margins, even forming a groove near anterior margin.

Legs (Figs. 2D-F). Protibia with 3 large teeth, generally acute along outer margin; apex bifurcate with branches rounded at tip. Except apical spurs and spines, each mesotibia and metatibia with one distinctly sharp lateral spine.

Female genitalia. Abdominal tergite VIII (Fig. 6C) with a longitudinal membranous area at middle of basal half and without lateral angles. Abdominal sternite VIII (Fig. 6D) with a diamond-shaped membranous area along the midline and emarginate at middle of posterior margin. Hemisternite (Fig. 7E) weakly emarginate at apical margin. Spermatheca (Fig. 7E) well sclerotized, inflated and oviform. Spermathecal duct (Fig. 7E) relatively short. Spermathecal gland (Fig. 7E) membranous, small and oviform. Spermathecal gland duct (Fig. 7E) slender and thin. Accessory gland (Fig. 7E) large and oviform.

Differential diagnosis. The type series of *Aulacostethus doani* Baba, 2000 (Figs. 1B; 3A, C-D; 5C) is deposited in some Japanese private collections and hardly accessible, and thus, previous Chinese researchers and we can only consider data with references to the original literature. Huang & Chen (2013) identified this new species as *A. doani* with mentioning the following statement on page 313 "It differs from the type specimens only in having a single inner tooth on mandible, but with a trace of denticle at the beginning of apical third of the mandible." As described above, in other words, the "trace of denticle" is an imperceptible weak protuberance. Looking at Figs. 3A-D, where *Aulacostethus* males are arranged from large to small at the same scale, it should be apparent that the holotype of *A. zenghuae* sp. nov. presents a difference. *A. doani* has always two distinct teeth near middle even in small size, while the new species has a single tooth only, which is even larger in medium-sized *A. doani*.

Aulacostethus zenghuae sp. nov. is also somewhat similar to *A. archeri* Waterhouse, 1869 (Figs. 4C-D), *A. rudimentalis* (Houlbert, 1914) and *A. tianmuxing* Huang & Chen, 2013 (Figs. 4E-H; 5D-E), but we only illustrate some distinguishing morphological characters based on available specimens; more photographs and comparisons were already provided by Huang & Chen (2013), so we do not repeat them here.

Etymology. The new species is dedicated to Zeng-Hua Tang, the mother of the collector Tian-Long He. The name is a noun in the genitive.

Distribution. China (Yunnan).

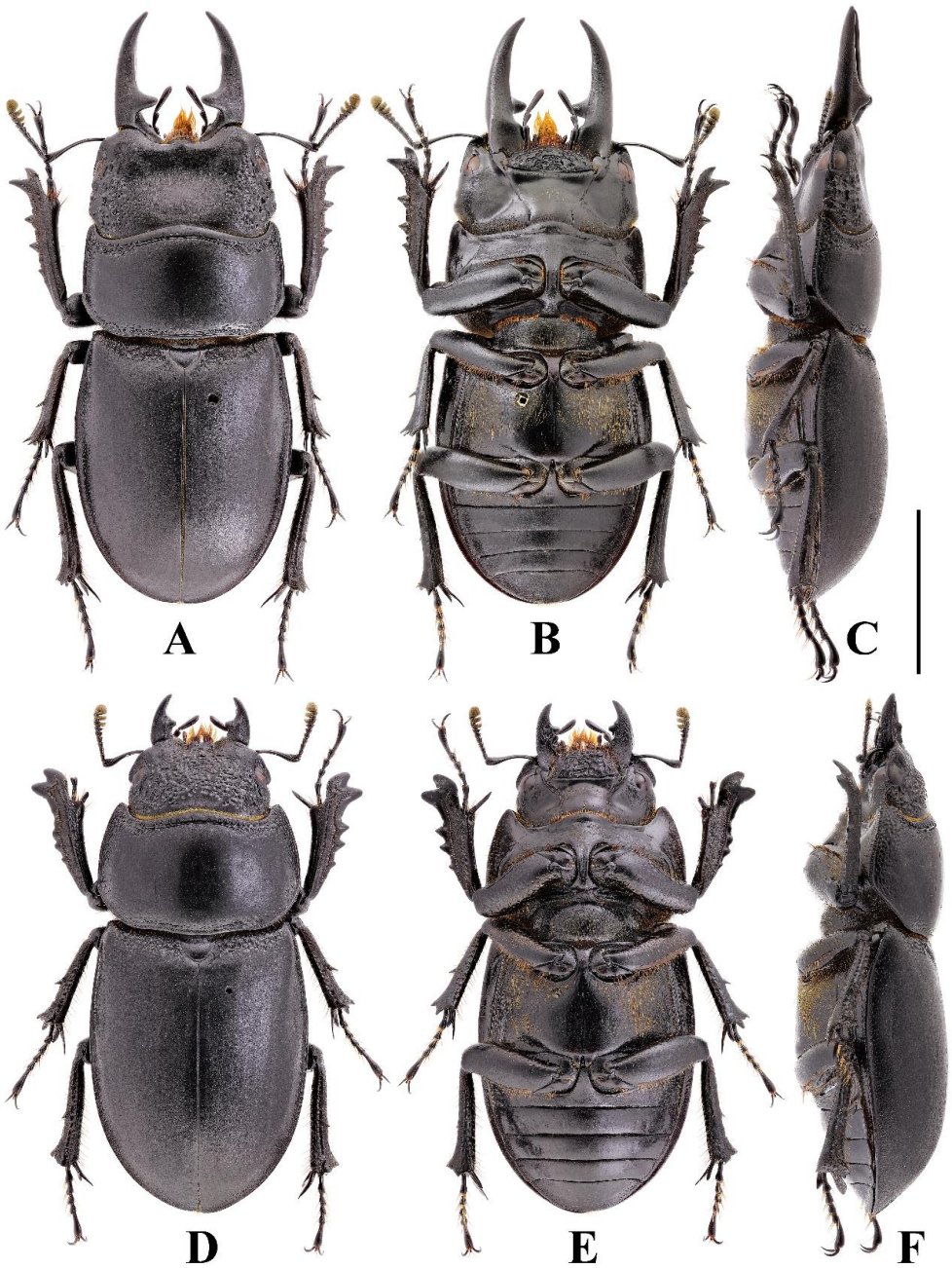


Fig. 2. Habitus of *Aulacostethus zenghuae* sp. nov. in dorsal (A, D), ventral (B, E) and lateral (C, F) view: A-C, male, holotype; D-F, female, paratype. Scale bar = 1.0 cm.

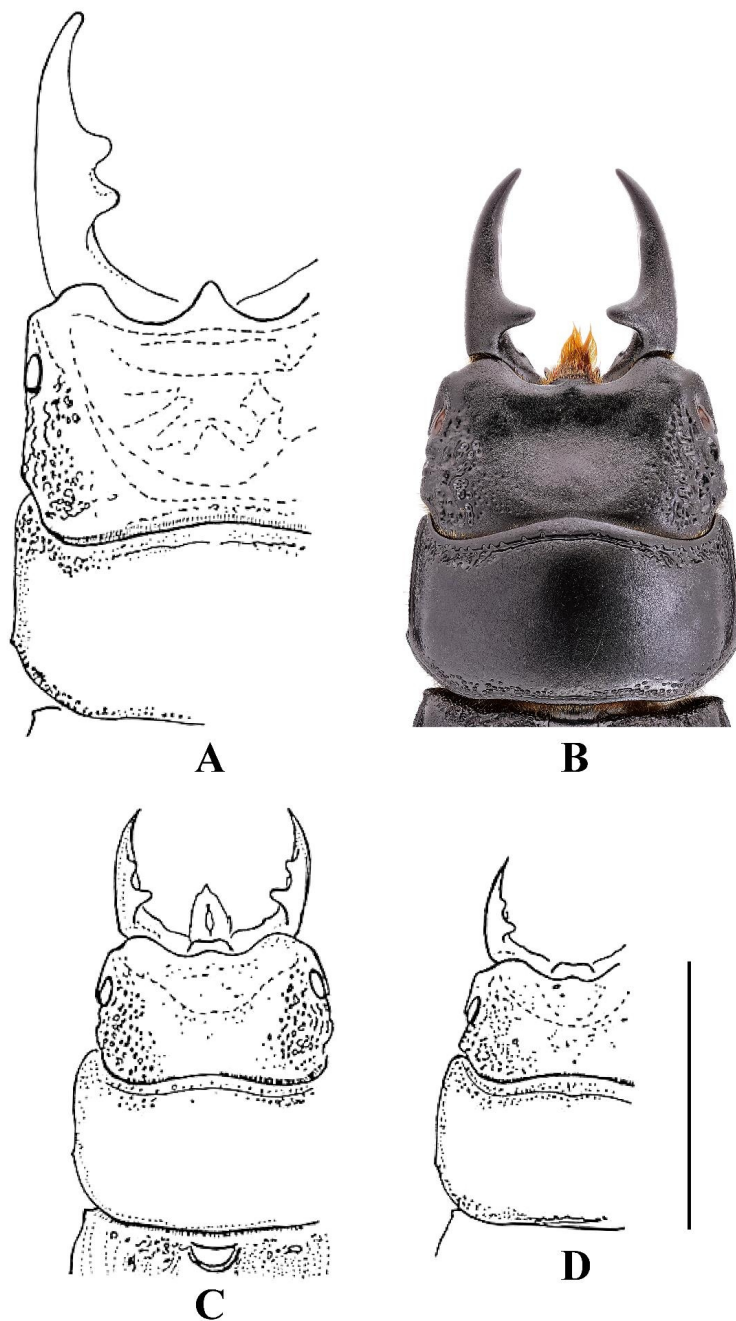


Fig. 3. Male heads and pronota of *Aulacostethus* spp. in dorsal view. A, C-D *A. doani* Baba, 2000 (after Baba, 2000) A large size, paratype C medium size, holotype D small size, paratype B *A. zenghuae* sp. nov., holotype. Scale bar = 1.0 cm.

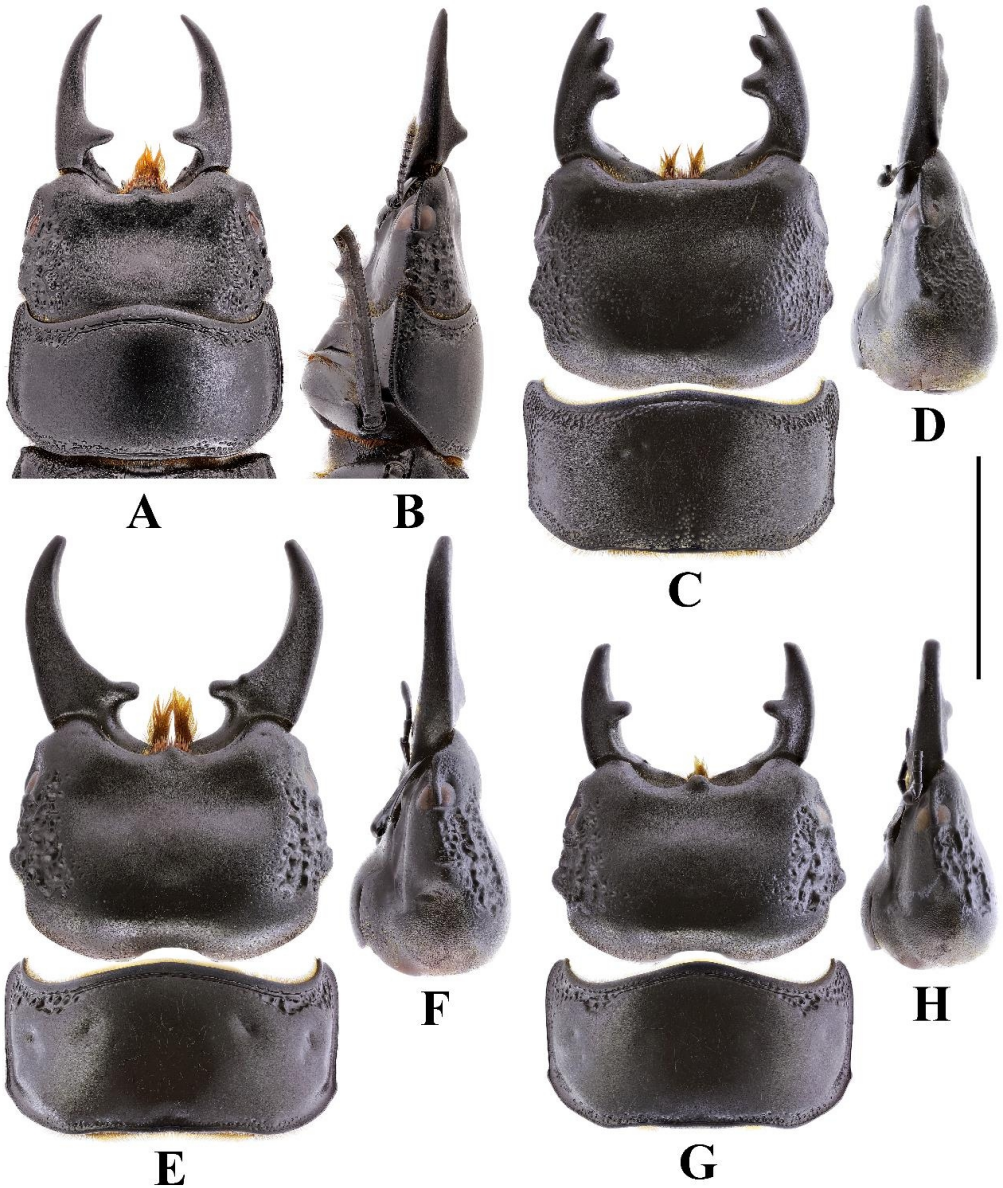


Fig. 4. Male heads and/or pronota of *Aulacostethus* spp. in dorsal (A, C, E, G) and lateral (B, D, F, H) view. A-B *A. zenghuai* sp. nov., holotype C-D *A. archeri* Waterhouse, 1869, small size from Xizang E-F *A. tianmuxing* Huang & Chen, 2013, large size from Zhejiang G-H ditto, small size from Zhejiang. Scale bar = 1.0 cm.

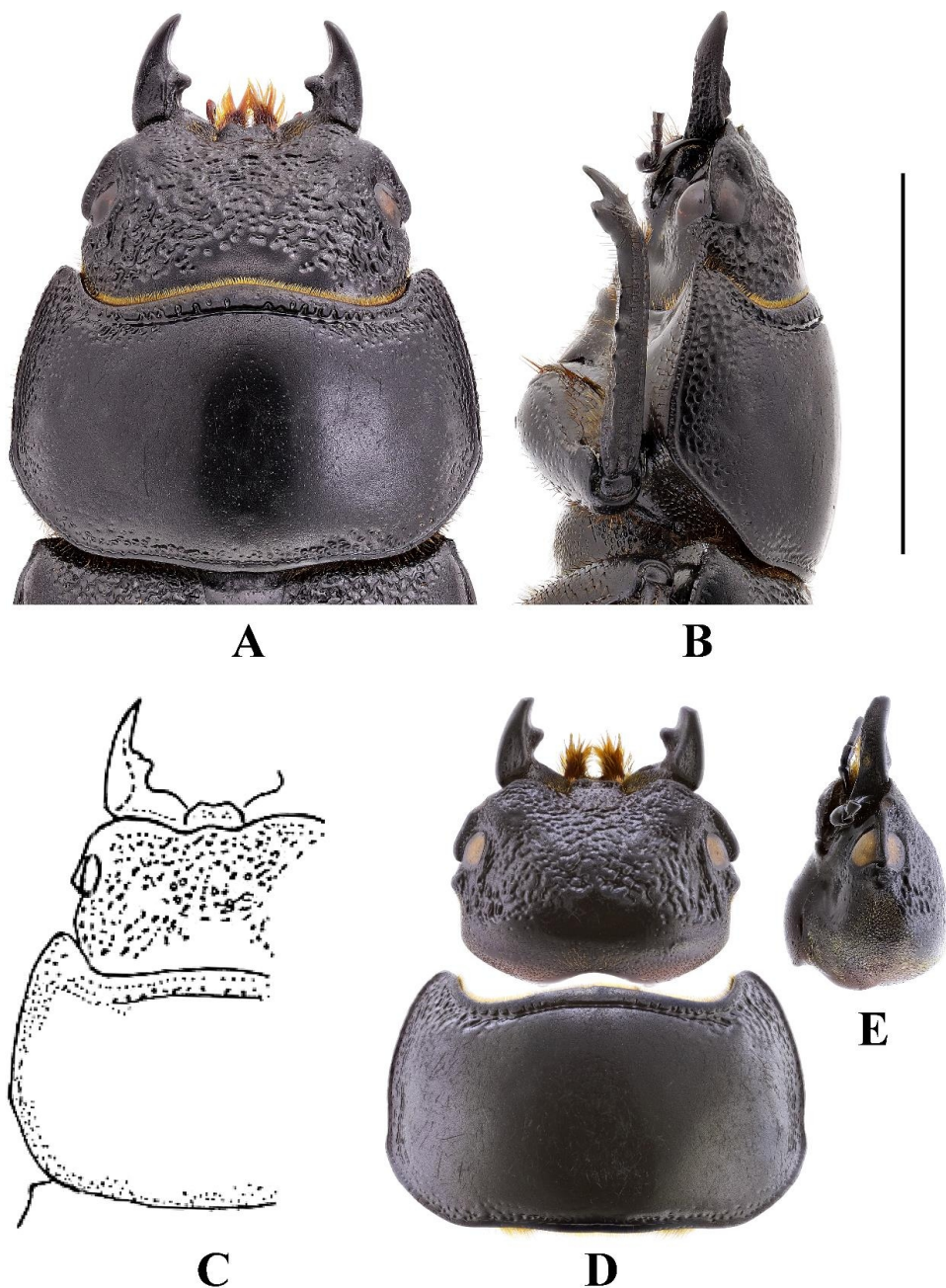


Fig. 5. Female heads and/or pronota of *Aulacostethus* spp. in dorsal [A, C-D) and lateral (B, E) view. A-B *A. zenghuai* sp. nov., holotype C *A. doani* Baba, 2000, paratype (after Baba, 2000) D-E *A. tianmuxing* Huang & Chen, 2013 from Zhejiang. Scale bar = 1.0 cm.

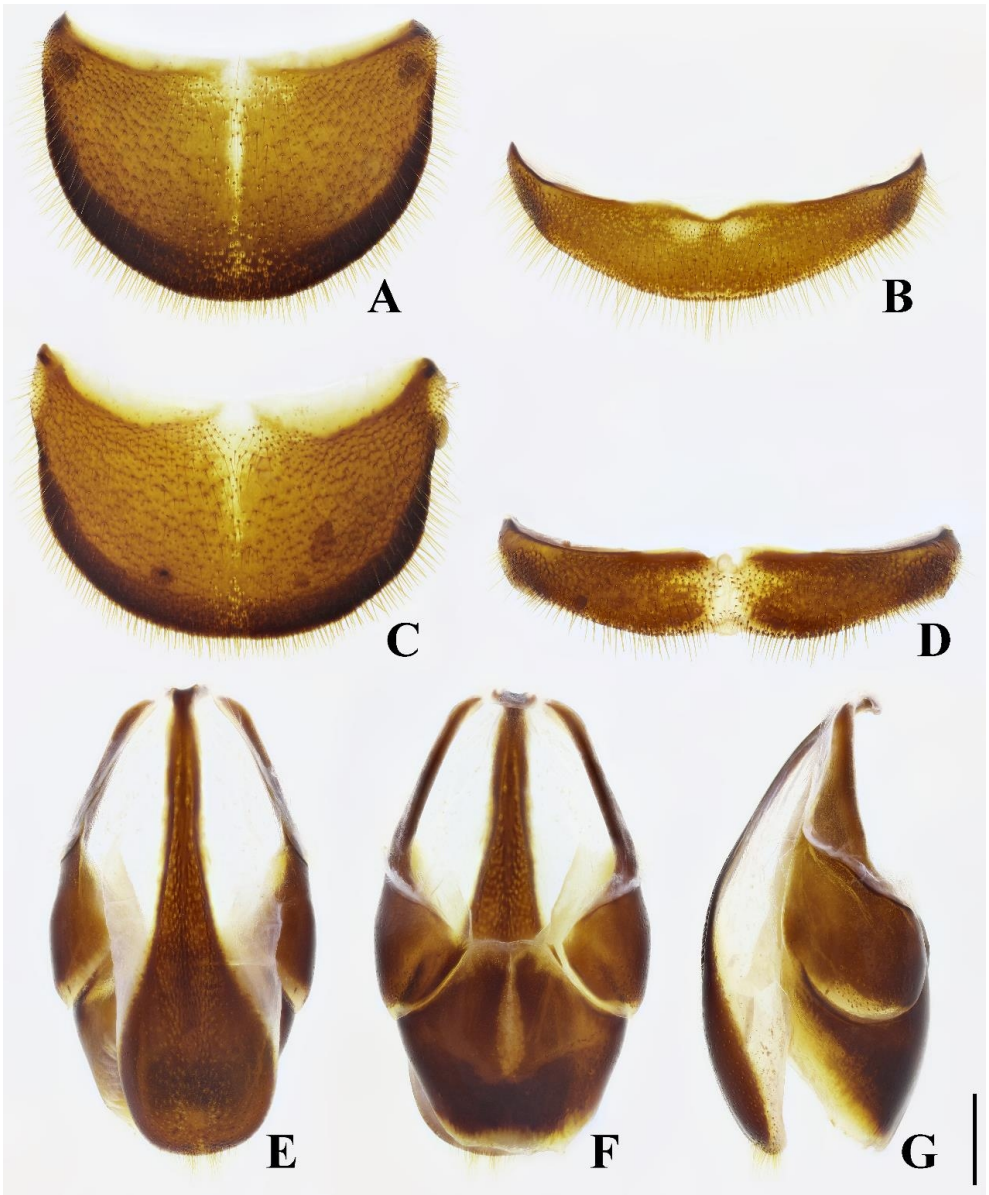


Fig. 6. Abdominal segments of *Aulacostethus zenghuai* sp. nov. A male 8th tergite in dorsal view, holotype B male 8th sternite in ventral view, holotype C female 8th tergite in dorsal view, paratype D female 8th sternite in ventral view, paratype E-G male 9th segment in ventral (E), dorsal (F) and lateral (G) view, holotype. Scale bar = 1.0 mm.

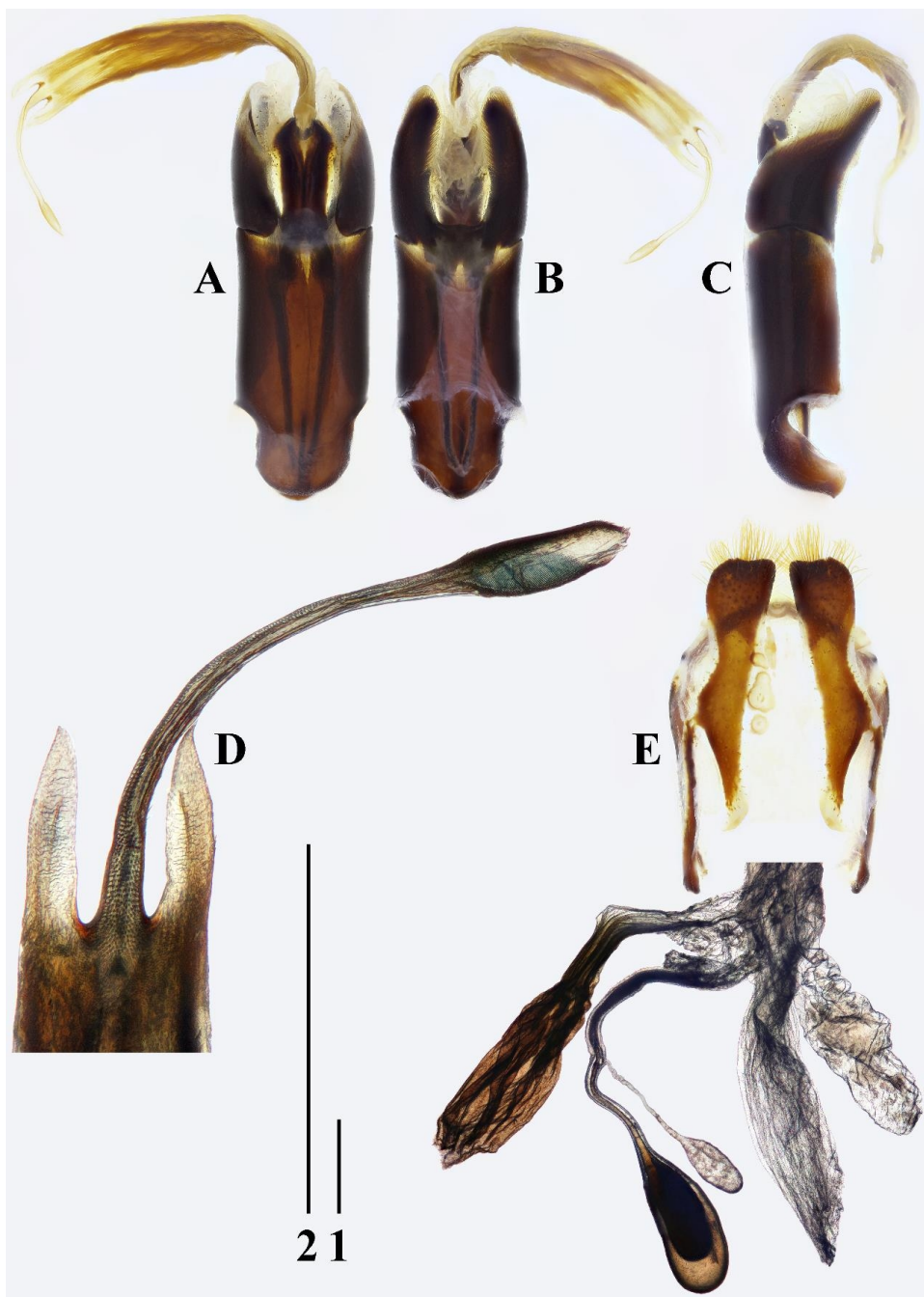


Fig. 7. Male and female genitalia of *Aulacostethus zenghuai* sp. nov. A-C aedeagus in ventral (A), dorsal (B) and lateral (C) view D apical part of aedeagus in ventral view E female genitalia in ventral view. Scale bars 1 (A-C, E) and 2 (D) = 1.0 mm.

ACKNOWLEDGEMENTS. We would like to express our sincere gratitude to Chang-Chin Chen (Tianjin, China) for his help to the community of insect amateurs from China. The first author thanks to Jian-Yue Qiu, Hao Xu and other colleagues from Mianyang Normal University, Mianyang, China, for their accompanying in the way of learning taxonomy. The first author appreciates some scholar-tyrants of Chinese entomologists or taxonomists, letting him like studying more and more, to destroy their monopoly and arrogance. Our appreciation is also due to Yu-Yan Cao (Anhui University, Hefei, China), Wen-I Chou (Taitung, China), Li He (Chengdu, China), Bo-Yan Li (Guizhou University, Guiyang, China), Ye-Jie Lin (Institute of Zoology, Chinese Academy of Sciences, Beijing, China), Bin Liu (Beijing, China), Lu Qiu (Southwest University, Chongqing, China), Jan Růžicka (Czech University of Life Sciences, Prague, Czech Republic), Xia Wan (Anhui University, Hefei, China), Fa-Lei Wang (Chongqing, China), Jin Wang (Chengdu, China), Peng Wang (Kunming, China), Ping Wang (Yangtze University, Jingzhou, China), Guang-Lin Xie (Yangtze University, Jingzhou, China), Qiao-Zhi Yang (University College London, UK), Mao Ye (Xiangyang, China), Bi-Sheng Zhan (Jiangsu University, Zhenjiang, China), Hong-Zhang Zhou (Institute of Zoology, Chinese Academy of Sciences, Beijing, China) and Xiang Zhu (Beijing, China) for their considerable help in our study. This study was supported by the Natural Science Foundation of Huaguoshan (NSFH-2020), and a start-up fund from Mianyang Normal University (QD2019A05).

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Published: 30. 11. 2020