



Description of a new species of *Anomala* Samouelle, 1819 (Coleoptera: Scarabaeidae: Rutelinae) from the Nanling Mountains (China) and remarks on three related species

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Abstract

Anomala calceiformis Huang & Lu, **sp. nov.** is described as a new species based on specimens collected from Mangshan National Nature Reserve, Hunan Province, China. *Anomala calceiformis* **sp. nov.**, which has an elongate, red-brown body, a strongly reflected clypeus, and convex elytral intervals, is similar to *Anomala fukiensis* Machatschke, 1955, *Anomala longicarcara* Lin, 2002, and *Anomala spatuliformis* Lin, 2002. Here we provide a key to these species, describe and diagnose each of them, and compile a distribution map. In addition, the Cytochrome oxidase I (COI) DNA sequence of *Anomala calceiformis* **sp. nov.** is provided. The morphological features that distinguish *Anomala calceiformis* **sp. nov.** from related species are discussed.

Key words: *Anomala*, taxonomy, key, *Anomala calceiformis* **sp. nov.**

Introduction

Anomala Samouelle, 1819 (Coleoptera: Scarabaeidae: Rutelinae) is considered to be the most speciose genus of Rutelinae and is distributed worldwide (Arrow 1917; Machatschke 1972; Krajčik 2007; Allsopp *et al.* 2024). Prior to the current investigation, over 210 species belonging to the genus *Anomala* had already been documented in China (Filippini 2016; Krajčik 2007, 2012; Lu *et al.* 2023). *Anomala fukiensis* Machatschke was described by Machatschke in 1955 and characterized by red-brown body, strongly reflected clypeus and convex elytral intervals. Then, in 2002, during the preparation of a monographic book on the fauna of Fujian Province, Lin (2002) described two other similar species, *Anomala longicarcara* Lin and *Anomala spatuliformis* Lin.

During our recent taxonomic study on *Anomala* from the Nanling Mountains (China), one new species is discovered. Herein, we describe this new species based on morphological aspects. In addition, we provide its COI gene, and revise the other three most similar species: *Anomala fukiensis*, *Anomala longicarcara* and *Anomala spatuliformis*.

Material and methods

The morphological terminology largely follows Lu *et al.* (2018, 2019). The body length was measured starting from the clypeus to the apex of the elytra. The pronotum length was measured in the middle in dorsal view, its width at the place of greatest width. In dorsal view, the ratio of interocular width to head width was measured at the widest point of the head and the shortest distance between the eyes.

The new species described in this paper have type specimens labeled as follows: 1) a red label with ‘Name of taxon **sp. nov.**, Holotype [or] Paratype, Huang & Lu’; 2) labels indicating the collecting data. The collecting data from the type material are directly quoted from the labels, with individual labels separated by a double vertical bar (||), and individual lines of each label separated by a single vertical bar (|).

The Olympus SZ61 stereomicroscope was used to conduct observations and dissections. The Canon 5D digital camera, combined with a Canon MP-E 65mm f/2.8 1-5X Macro Lens, was employed to capture the digital images. The initial images were then stacked in Helicon Focus v.7.0.2 and processed in Adobe Photoshop. The distribution map was made by QGIS 3.12 software.

Anomala calceuiformis **sp. nov.** dry-preserved beetles specimen collected in 2018 were used for DNA extractions. Specimens collected in flight interception trap with the solution of a mixture of 2% SDS (sodium dodecyl sulfate) and EDTA (ethylene diamine tetraacetic acid, 0.1mol/L, PH=8) which effectively controls the degradation of DNA. The Cytochrome oxidase I (COI) DNA was extracted from thorax muscle of dried specimens using DNeasy® Blood and Tissue kit (QIAGEN) according to the manufacturer’s protocol. PCR amplifications were performed with 20 µl volume DNA amplification system, included 10 µl Premix Taq (TaKaRa Taq™), 0.5 µl of 10 µM of each primer (LCO1490: GGTCAACAAATCATAAAGATATTGG (5’ to 3’); HCO2198: TAAACTTCAGGGTGACCAAAAAATCA (5’ to 3’)), 2 µl DNA template and 7 µl ddH₂O. The PCR conditions involved an initial denaturation step of 5 min at 94 °C; 35 cycles with a denaturation step of 30s at 94 °C, an annealing step of 1 min at 55 °C, and an extension step of 1min at 72 °C; the final extension step of 10 min at 72 °C. Using the genomic DNA as the template, the portion of the COI was amplified by the internal primers. The forward and reverse Sanger sequencing was performed by Tsingke Company (Beijing, China).

The material examined is housed in the following collections (curators in parenthesis):

CZPC Carsten Zorn private collection, Gnoien, Germany (Carsten Zorn);

IZCAS Institute of Zoology, Chinese Academy of Sciences, Beijing, China (Ming Bai);

IZGAS Institute of Zoology, Guangdong Academy of Sciences, Guangzhou, Guangdong, China (name used from 1972–2015: GEI, Guangdong Entomological Institute) (Jianxiong Li, Ping Yang);

NHMB Naturhistorisches Museum (Museum Frey, Tutzing), Basel, Switzerland (Isabelle Zürcher-Pfander, Eva Sprecher).

Taxonomy

Anomala fukiensis Machatschke, 1955

Chinese common name: 福建异丽金龟

(Fig. 1)

Anomala fukiensis Machatschke, 1955: 501, Fig. 1 (original description).

Anomala fukiensis: Zorn 2006: 260 (catalogue); Lin 2002: 397 (brief description); Krajčik 2007: 35 (catalogue); Krajčik 2012: 23 (catalogue); Zorn & Bezděk 2016: 334 (catalogue); Lu & Bai 2020: 105, Fig. X-1 (description).

Type material examined. Holotype (HT) (Fig. 1A–I). 1♂ “KUATUN, FUKIEN | China, 15.6.46 | leg. Tschung. Sen || Typus | *Anomala* | *fukiensis* | n. sp. [Machatschke’s handwritten label] | Dr. Machatschke det.” (NHMB).

Additional material examined. 1♂ Kuantun (2300m) 27.40n. Br., 117.40ö., leg. L. J. Klapperich., 11.5.1938 (Fukien) (CZPC); 1♂ Fujian, Wuyi Mountain, Tongmu Town, Sangang, Light Trap, 2018-V-26, 736 m, 27°44’58” (N), 117°40’44” (E), leg. Lu Yuanyuan & Chen Yandong, IOZ (E) 2080211 (IZCAS).

Description of holotype (male). Length 14.6 mm, greatest width 7.6 mm; body shape elongate ovoid, weakly convex.

Color. Ground color reddish brown with weak luster; legs yellowish brown except for tarsus; the setae pale yellow.

Head (Fig. 1A, D). Clypeus subrectangular, approximately 2.5 times wider than long, densely and shallowly punctate; anterior corners broadly rounded, anterior margin strongly reflexed, the disc of clypeus depressed; frontoclypeal suture curved backward weakly; frons and vertex densely punctate, the disc of frons depressed like clypeus; ratio interocular width/width of head approximately 0.6; antennal club slightly longer than antennomeres 2–6 combined (ratio antennae club length/length of antennomeres 1–5 combined 1.08, follows simplified Club L/Ante L).

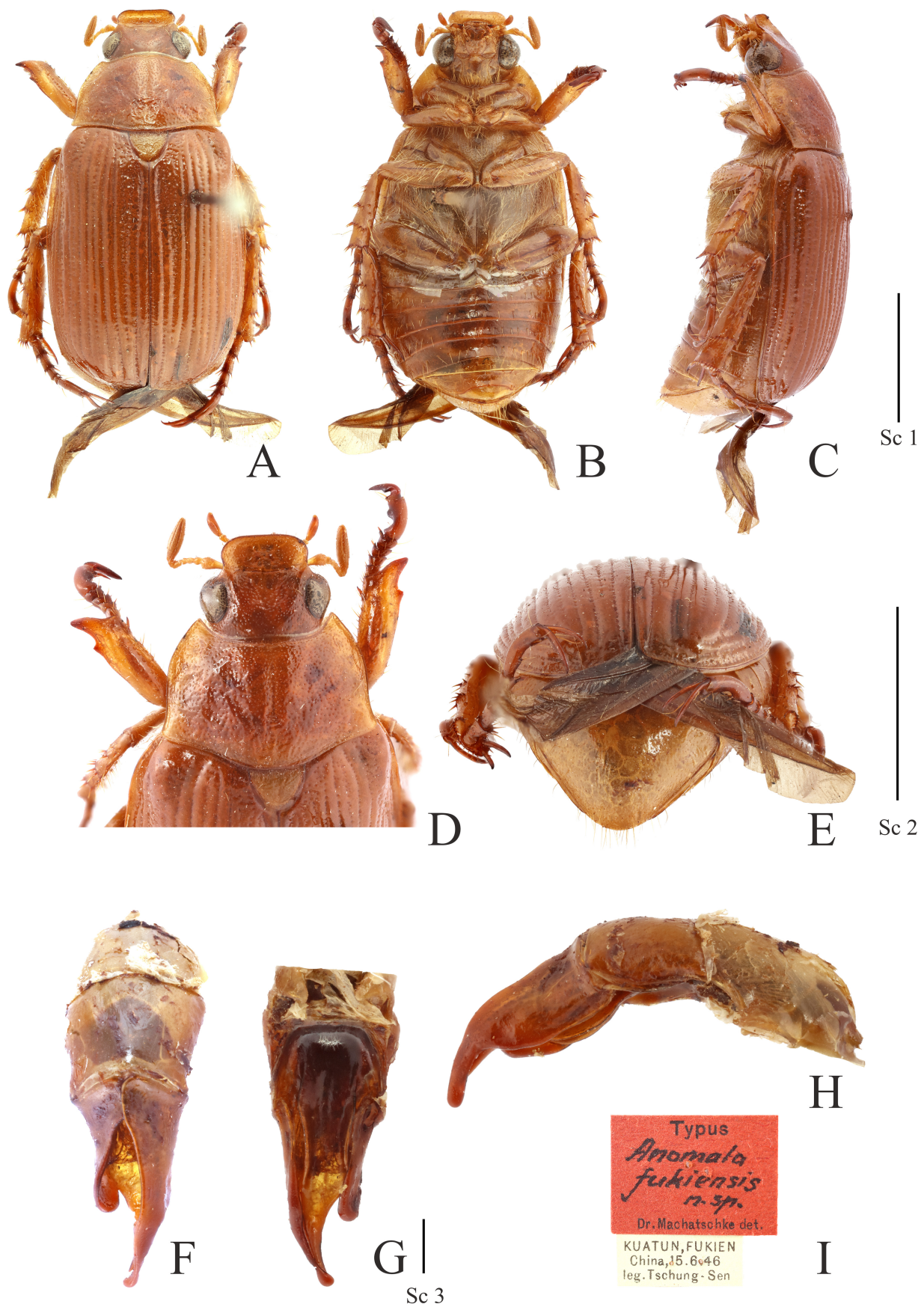


FIGURE 1. Holotype of *Anomala fukiensis* ♂ A–C. Habitus. A. Dorsal view. B. Ventral view. C. Left lateral view. D. Head and pronotum. E. Propygidium and pygidium. F–H. Aedeagus. F. Dorsal view. G. Ventral view. H. Right lateral view. I. Holotype label. Sc. 1: scale for A–C = 5 mm. Sc. 2: scale for D–E = 5 mm. Sc. 3: scale for F–H = 1 mm.

Pronotum. Approximately 1.9 times as wide as long, with a distinct median longitudinal furrow, not reaching the posterior margin; disc densely punctate, surface with additional finely micropunctures; lateral margin of pronotum distinctly converging anteriorly in the middle, slightly curved in anterior half, and slightly curved concave in posterior half; posterior corners acute; basal marginal line complete, shallower in front of scutellum.

Scutellum. Subtriangular, the width is 1.3 times the length, densely and finely punctate.

Elytra. Regularly striate; all costal intervals and interstices strongly convex; stria punctures distinct; striatepunctates distinct, large, moderately dense; subsutural interstice 2 with a secondary stria irregularly doubled, scattered placed at the base; elytral surface with micropunctuation; humeral umbone and apical protuberance prominent; epipleuron broad near humerus, ending slightly posteriorly of elytral midlength; posterior margins rounded; marginal membrane complete; apico-sutural angle without setae.

Pygidium (Fig. 1E). Strongly convex; apex narrowly rounded; punctation shallowly, moderately dense; apex with several long, erect yellow setae.

Ventral thorax (Fig. 1B). The anterior margin of prosternum with dense, long, yellow setae; mesosternum strongly punctate, with dense short setae; metasternum densely, weakly large punctate, with dense, long setae.

Abdominal ventrites (Fig. 1B). Ventrites 2–5 with small punctures, coalescently punctate in ventrite 6; ventrites 2–5 each with a transverse row of sparse and moderately long yellow setae.

Legs. Protibia bidentate, broadened, proximal tooth short, situated close to the rather short, weakly outwards curved apical tooth; inner spur short. Protarsomere 1–4 strongly compressed, length/widen is 3.9 (the length of 1–4 combined/the widest of protarsomere 1), the protarsomere 5 (without claws) widened, concave in inner side; inner protarsal claw strongly widened and deeply incised apically; outer mesotarsal claw long, curved, deeply incised at apex, upper branch spiniform; metatarsal claws unequal, outer claw longer and thicker than inner.

Aedeagus (Fig. 1F–H). Parameres asymmetric, right paramere distinctly longer; basal piece developed and the ends narrowed.

Measurements. Body length 12.0–15.0 mm (HT 14.6 mm), body width 6.0–8.0 mm (HT 7.6 mm).

Morphological variability. Abdominal ventrites vary slightly in color, from yellowish brown to brown. Shape of parameres very consistent.

Distribution. This species is only found in Fujian Province, China.

***Anomala longicarcarata* Lin, 2002**

Chinese common name: 长距异丽金龟
(Fig. 2)

Anomala longicarcarata Lin, 2002: 401, 424, Fig. 27–569 (original description)

Anomala longicarcarata: Krajčič 2007: 39 (catalogue); Krajčič 2012: 24 (catalogue); Zorn & Bezděk 2016: 335 (catalogue).

Type material examined. Holotype (Fig. 2A–F). 1♂ “214 | 福建华安仙都 [= Fujian, Hua’an, Xiandu] | 1981.4.14 | 土敏采集 [= leg. Tu Min] || HOLOTYPE || *Anomala* | *longicarcarata* | Lin [Lin’s handwritten label] | 鉴定者 [= Identified by] || 省林厅 [= Provincial Forestry Department] ” (IZGAS). Paratypes. 1♂ “广东乳源天井山 陈振 [= Guangdong, Ruyuan, Tianjing Mountain, leg. Chen Zhen] | 1974.5.26 || *Anomala* | *longicarcarata* | Lin | det. Lin || PARATYPE || 27 ||” (IZGAS); 1♂ and 1♀ “Kwangtung, S. China. | Taam Yuen Tung. | Lin-hsien (District) | May 28, 1934. | F. K. To || *Anomala* | *longicarcarata* | Lin | det. Lin || PARATYPE ||” (IZCAS, currently in IZGAS); 1♂ “Kwangtung, S. China. | Taam Yuen Tung. | Lin-hsien (District) | May 26–27, 1934 | F. K. To || *Anomala* | *longicarcarata* | Lin | det. Lin || PARATYPE || 14 ||” (IZCAS, currently in IZGAS); 1♂ “Kwangtung, S. China. | Taam Yuen Tung. | Lin-hsien (District) | May 26–27, 1934 | F. K. To || *Anomala* | *longicarcarata* | Lin | det. Lin || PARATYPE ||” (IZCAS, currently in IZGAS); 2♂ “Kwangtung, S. China. | Taam Yuen Tung. | Lin-hsien (District) | May 25, 1934 | F. K. To || *Anomala* | *longicarcarata* | Lin | det. Lin || PARATYPE ||” (IZCAS, currently in IZGAS); 1♂ “Kwangtung, S. China. | Kau-Lin san. | 700–900 m | Lienpling Distr. | April 24, 1940 | J. L. Gressitt and F. K. To || *Anomala* | *longicarcarata* | Lin | det. Lin || PARATYPE ||” (IZCAS, currently in IZGAS); 1♂ “June 4.1935 | L. Campus Canton China | H. Au Youa || *Anomala* | *longicarcarata* | Lin | det. Lin || PARATYPE ||” (IZCAS, currently in IZGAS); 1♂ “江西宜丰院前 [= Jiangxi, Yifeng Academy of Forestry] | 59-VI-30 || *Anomala* | *longicarcarata* | Lin | det. Lin || PARATYPE || 63 || a34 ||” (IZGAS); 1♂ “Kwangtung, S. China. | Taam Yuen Tung. | Lin-hsien (District) | June 1, 1934 | F. K. To || *Anomala* | *longicarcarata* | Lin | det. Lin || PARATYPE || 3 ||” (IZCAS, currently

in IZGAS); 1♂ “江西宜丰院前 [= Jiangxi, Yifeng Academy of Forestry] | 59-VII-10 || *Anomala* | *longicarcarata* | Lin | det. Lin || PARATYPE || 36 || 275 ||” (IZGAS); 1♂ “寄主 杂树 [= Host Copse] | 地点 南昆 [=Collected in Nankun Mountain] | 1980.5.18 || *Anomala* | *longicarcarata* | Lin | det. Lin || PARATYPE || 67 ||” (IZGAS) (Fig. 2G–K); 1♀ “福建南平西芹 [= Fujian, Nanping, Xiqin] | 1981.4.19 || *Anomala* | *longicarcarata* | Lin | det. Lin || ALLOTYPE || 地鞘839 || a34 ||” (IZGAS) (Fig. 2L–O); 1♀ “Kwangtung, S. China. | Taam Yuen Tung. | Lin-hsien (District) | May 25, 1934 | F. K. To || *Anomala* | *longicarcarata* | Lin | det. Lin || PARATYPE || 14 ||” (IZCAS, currently in IZGAS); 1♀ “福建南靖和溪 [= Fujian, Nanjing, Hexi] | 1965.4.18 刘胜利 [=leg. Liu Shengli] | 天津自然博物馆 [= Tianjin Museum of Natural History] || *Anomala* | *longicarcarata* | Lin | det. Lin || PARATYPE || 2 ||” (IZGAS); 1♀ “Kwangtung, S. China. | Kan-lin Sun. | 700–900m | Lienpling Distri | April 23, 1940 | J. L. Gressitt and F. K. To || *Anomala* | *longicarcarata* | Lin | det. Lin || PARATYPE || 3 ||” (IZCAS, currently in IZGAS); 1♀, “Kwangtung, S. China. | Kan-lin Sun. | 700–900m | Lienpling Distri. | April 19, 1940 | J. L. Gressitt and F. K. To || *Anomala* | *longicarcarata* | Lin | det. Lin || PARATYPE || 3 ||” (IZCAS, currently in IZGAS); 1♀ “江西石城 80-V [= Jiangxi, Shicheng, 80-V] || *Anomala* | *longicarcarata* | Lin | det. Lin || PARATYPE || 3 ||” (IZGAS); 1♀ “江西宜丰院前 [= Jiangxi, Yifeng Academy of Forestry] || *Anomala* | *longicarcarata* | Lin | det. Lin || PARATYPE || 36 || 208 ||” (IZGAS); 1♀ “福建建阳黄坑桂林 [= Fujian, Jianyang, Huangkeng, Guilin] | 270–390公尺 [= 270–390 m] | 中国科学院 [= Chinese Academy of Sciences] || 1960.IV.27 | 采集人 左永 [= leg. Zuo Yong] || *Anomala* | *longicarcarata* | Lin | det. Lin || PARATYPE || 54 ||” (IZGAS); 1♀ “Kwangtung, S. China. | Kan-lin Sun. | 700–900 m | Lienpling Distri | April 20, 1940 | J. L. Gressitt and F. K. To || *Anomala* | *longicarcarata* | Lin | det. Lin || PARATYPE || 20 || 14A” (IZCAS, currently in IZGAS).

Additional material examined. 1♂ Guangdong, Ruyuan, Luoyang, Gongshe, 1974.V.26-27, leg. Liu Daju (IZCAS); 1♂ Guangxi, Jinxiu, Huawang Town, 600 m, 1999.V.20, leg. Liu Daju, IOZ (E) 2083508 (IZCAS); 1♂ Fujian, Wuyi Mountain, Guadun, 900 m, 2001.VI.2, leg. Ge Siqin, IOZ (E) 20835089 (IZCAS).

Description of holotype (male). Length 14.4 mm, greatest width 7.9 mm; body shape elongate ovoid, weakly convex.

Color. Body with yellowish brown to brown; the setae pale yellow.

Head (Fig. 2A, D). Clypeus broad and nearly trapezoidal, approximately 2.9 times wider than long, densely and shallowly punctate; anterior corners nearly rectangular, anterior margin strongly reflexed; frontoclypeal suture curved backward weakly; frons and vertex densely punctate; ratio interocular width/width of head approximately 0.62; antennal club longer than antennomeres 2–6 combined (Club L/Ante L 1.2).

Pronotum. Approximately 1.5 times as wide as long, with a moderately distinct median longitudinal furrow, not reaching the posterior margin; disc densely punctate, surface with additional finely micropunctures; lateral margin of pronotum distinctly converging anteriorly in the middle, slightly curved in anterior half, and nearly straight in posterior half; posterior corners rectangular; basal marginal line complete, shallower in front of scutellum.

Scutellum. Subtriangular, the width is 1.1 times the length, densely and largely punctate.

Elytra. Regularly striate; all costal intervals and interstices strongly convex; striae punctures distinct, striate punctures distinct, large, moderately dense; subsutural interstice 2 with a secondary stria irregularly doubled, scattered placed at the base; elytral surface with micropunctuation; humeral umbone and apical protuberance prominent; epipleuron slightly broad near humerus; posterior margins rounded; marginal membrane complete; apico-sutural angle without setae.

Propygidium (Fig. 2E). The surface of posterior part neared pygidium glabrous.

Pygidium (Fig. 2E). Strongly convex; apex narrowly rounded; punctation dense, largely, transverse; apex with several long, erect yellow setae.

Ventral thorax (Fig. 2B). The anterior margin of prosternum with dense, long, yellow setae; mesosternum weakly punctate, with sparse short setae; metasternum densely, weakly large punctate, with dense, long setae.

Abdominal ventrites (Fig. 2B). Ventrites 2–5 with small punctures, coalescently punctate in ventrite 6. Ventrites 2–5 each with a transverse row of sparse and moderately long yellow setae.

Legs. Protibia bidentate, broadened, proximal tooth short, situated close to the rather short, weakly outwards curved apical tooth; inner spur short. Protarsomere 1–4 length/widen is 5.3. Inner protarsal claw strongly widened and deeply incised apically; outer mesotarsal claw long, curved, deeply incised at apex, upper branch spiniform; metatarsal claws unequal, outer claw longer than inner.

Aedeagus (Fig. 2H–J, paratype). Parameres nearly symmetric, right paramere slightly longer, the outer side of left paramere with one denticle at apex; basal piece narrow, apex rounded when viewed from the side.

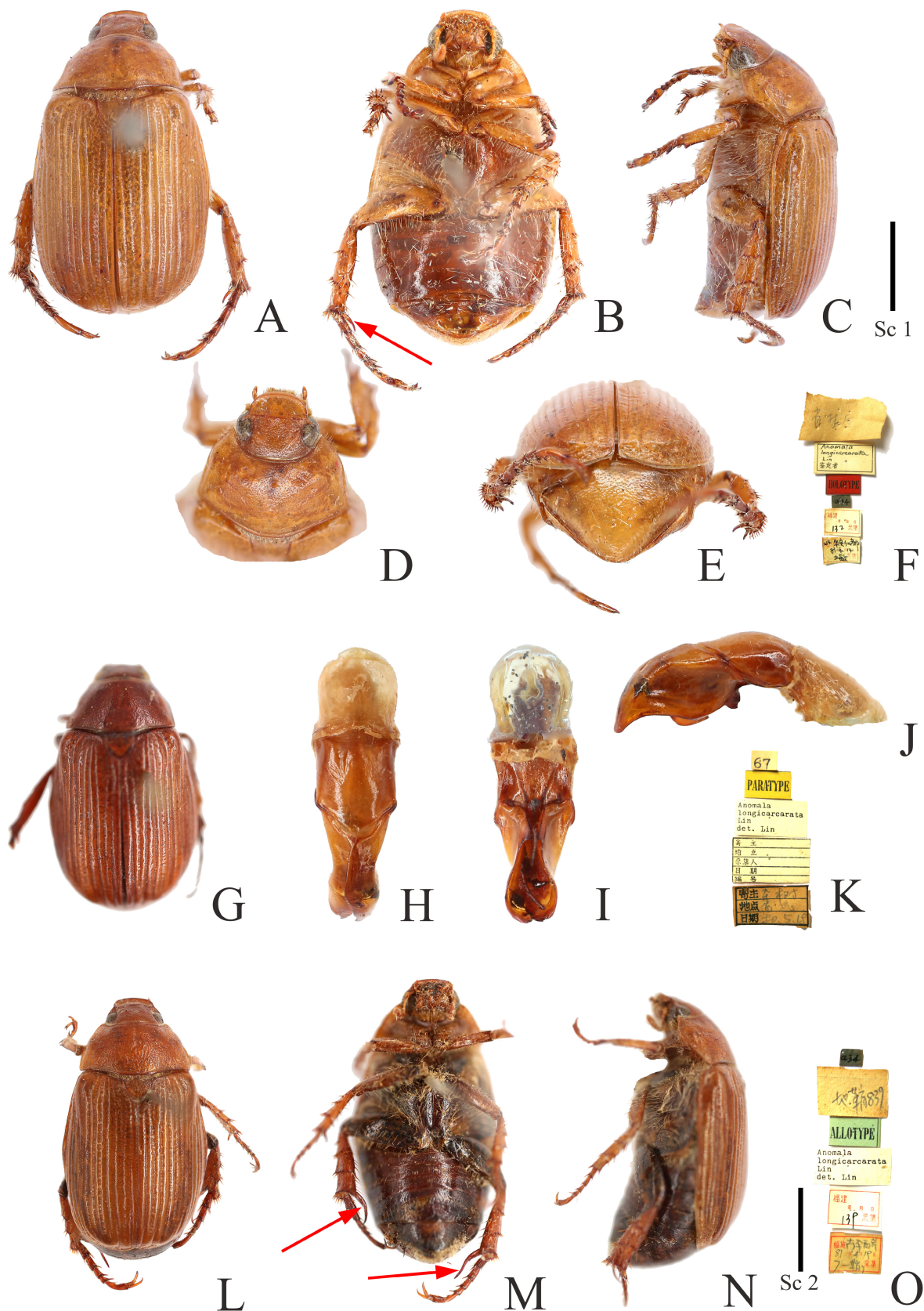


FIGURE 2. Holotype of *Anomala longicarcarata* ♂ **A–C.** Habitus. **A.** Dorsal view. **B.** Ventral view (The red arrow indicated the short spur in male). **C.** Left lateral view. **D.** Head and pronotum. **E.** Propygidium and pygidium. **F.** Holotype label. Sc. 1: scale for **A–C** = 5 mm. Paratype of *Anomala longicarcarata* ♂ **G.** Dorsal view. **H–J.** Aedeagus, **H.** Dorsal view. **I.** Ventral view. **J.** Right lateral view. **K.** Paratype label. Paratype of *Anomala longicarcarata* ♀ **L.** Dorsal view. **M.** Ventral view (The red arrows indicated the long spur in female). **N.** Left lateral view. **O.** Paratype label. Sc. 2: scale for **L–N** = 5 mm.

Female (Fig. 2L–N, paratype). Antennae club almost as long as antennomeres 1–5 combined (Club L/Ante L 1.02); elytral epipleura broader; protibial and protarsus slender; the inner spur in the end of metatibia well developed, almost equal to the length of metatarsomeres 1–3 combined (Fig. 2M); pygidium weakly convex.

Measurements. Body length 13.5–15 mm (HT 14.4 mm), body width 7.5–9.0 mm (HT 7.9 mm).

Morphological variability. Body color vary distinctly, from yellowish brown to dark brown; color in abdominal ventrites vary, darker or lighter. In some specimens mesofemur with two bands of long yellow setae. Shape of parameres very consistent.

Differential diagnosis. This species is different from the previously described *A. fukiensis* by the following characters: anterior corners of clypeus nearly rectangular, not broadly rounded; the disc of clypeus and frons not depressed; the scutellum largely punctate; posterior corners of pronotum rectangular, not acute; epipleuron in elytra not so broad; punctures of pygidium largely and transverse; the parameres of aedeagus nearly symmetric.

Distribution. This species is found in several provinces of southern China (Jiangxi, Fujian, Guangdong, Guangxi).

Anomala spatuliformis Lin, 2002

Chinese common name: 窝唇异丽金龟

(Fig. 3, 4)

Anomala spatuliformis Lin, 2002: 397–398, 422–423, Fig. 27–564 (original description).

Anomala spatuliformis: Krajčik 2007: 48 (catalogue); Krajčik 2012: 26 (catalogue); Zorn & Bezděk 2016: 339 (catalogue); Lu & Bai 2020: 111 (description).

Type material examined. Holotype (HT) (Fig. 3A–F). 1♂ “福建武夷山 [= Fujian Wuyishan] | 广东昆虫研究所 [= Guangdong Institute of Entomology] || 1985.VI. | 曾虹 [= leg. Zeng Hong] || *Anomala* | *hedonophasa* | Lin | det. Lin || HOLOTYPE || a35 || Holotype | 窝唇异丽金龟 | *Anomala spatuliformis* Lin, 2002 | Written by Lu Y-Y | & Huang Z-H, 2024 ||” (IZGAS). Paratypes (4♂7♀). 1♀ “福建三港 [= Fujian, Sangang] | 1981.6.15 | 柳晶莹 采集 [= leg. Liu Jingying] || ALLOTYPE || *Anomala* | *hedonophasa* | Lin | det. Lin || 43 || Paratype | 窝唇异丽金龟 | *Anomala spatuliformis* Lin, 2002 | Written by Lu Y-Y | & Huang Z-H, 2024 ||” (IZGAS) (Fig. 3L); 1♂ “福建崇安星村三港 [= Fujian, Chong’an, Xingcun, San’gang] | 720–850公尺 [= 720–850m] | 中国科学院 [= Chinese Academy of Sciences] || 1960.VI.4 | 采集人 姜胜巧 [= leg. Jiang Shengqiao] || *Anomala* | *hedonophasa* | Lin | det. Lin || PARATYPE || Paratype | 窝唇异丽金龟 | *Anomala spatuliformis* Lin, 2002 | Written by Lu Y-Y | & Huang Z-H, 2024 ||” (IZCAS, currently in IZGAS); 1♂ “福建三港 [= Fujian, San’gang] | 1981.6.10 | 汪江采集 [= leg. Wang Jiang] || *Anomala* | *hedonophasa* | Lin | det. Lin || PARATYPE || a35 || Paratype | 窝唇异丽金龟 | *Anomala spatuliformis* Lin, 2002 | Written by Lu Y-Y | & Huang Z-H, 2024 ||” (IZGAS) (Fig. 3G–K); 1♂ “福建建阳黄坑坳头 [= Fujian, Jianyang, Huangkeng, Aotou] | 650–950公尺 [= 650–950 m] | 中国科学院 [= Chinese Academy of Sciences] || 1966.V.6 | 采集人 蒲富基 [= leg. Pu Fuji] || *Anomala* | *hedonophasa* | Lin | det. Lin || PARATYPE || Paratype | 窝唇异丽金龟 | *Anomala spatuliformis* Lin, 2002 | Written by Lu Y-Y | & Huang Z-H, 2024 ||” (IZCAS, currently in IZGAS); 1♂ “浙江平阳 [= Zhejiang Pingyang] | 油桐 [= Youtong] | 中国科学院 [= Chinese Academy of Sciences] || 1973.5.11 || *Anomala* | *hedonophasa* | Lin | det. Lin || PARATYPE || Paratype | 窝唇异丽金龟 | *Anomala spatuliformis* Lin, 2002 | Written by Lu Y-Y | & Huang Z-H, 2024 ||” (IZCAS, currently in IZGAS); 6 ♀ Paratypes from Fujian (IZGAS).

Note: After comprehensive study on the collections in IZGAS and IZCAS, type specimens labeled as *Anomala spatuliformis* were not found. At the same time, we found specimens labeled by Ping Lin as holotype and paratypes of “*Anomala hedonophasa*” that is an unpublished name. According to the original description of *Anomala spatuliformis* in 2002, we could confidently assess that these types labeled “*Anomala hedonophasa*” were published finally with the name of “*Anomala spatuliformis*”, so we added one more label in the type series as the follows: “Holotype or Paratype | 窝唇异丽金龟 | *Anomala spatuliformis* Lin, 2002 | Written by Lu Y-Y | & Huang Z-H, 2024 ||”. In original description (Lin, 2002), except the holotype and “allotype”, no details about the paratypes’ locality, and here we found one paratype were collected from Zhejiang, therefore, the distribution of this species expanded to two provinces.

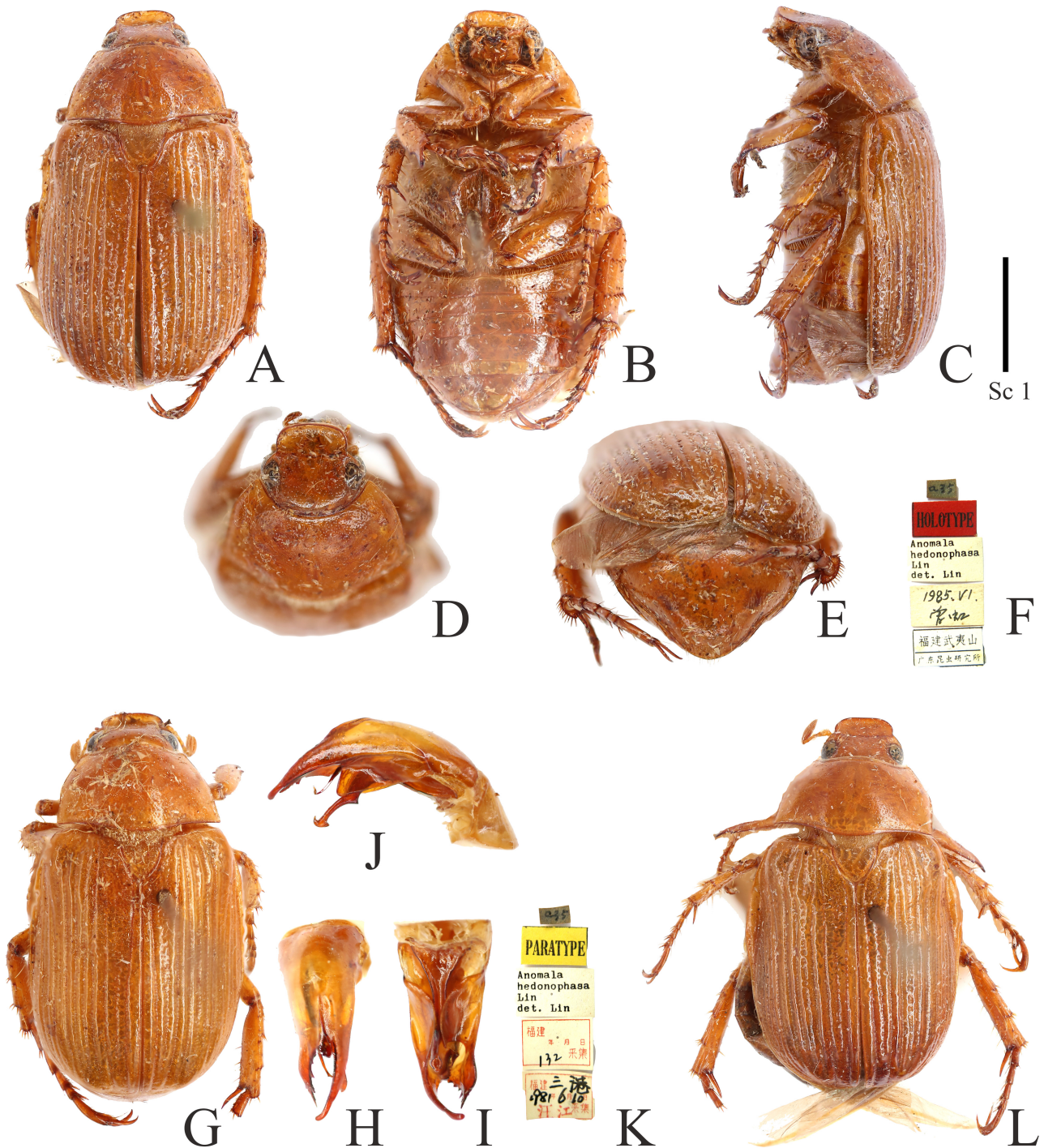


FIGURE 3. Holotype of *Anomala spatuliformis* ♂ A–C. Habitus. A. Dorsal view. B. Ventral view. C. Left lateral view. D. Head and pronotum. E. Propygidium and pygidium. F. Holotype label. Sc. 1: scale for A–C = 5 mm. Paratype of *Anomala spatuliformis* ♂ G. Dorsal view. H–J. Aedeagus. H. Dorsal view. I. Ventral view. J. Right lateral view. K. Paratype label. Paratype of *Anomala spatuliformis* ♀ L. Dorsal view.

Additional material examined. 1♂ Fujian, Wuyi Mountain, Tongmu Town, Guadun, 2018.V.25, Light Trap, leg. Lu Yuanyuan & Chen Yandong, 1204 m, 27°44'4.03''(N), 112°38'27''(E), IOZ (E) 2080222 (IZCAS) (Fig. 4A–I).

Description of holotype (male). Length 15.0 mm, greatest width 7.9 mm; body shape elongate ovoid, weakly convex.

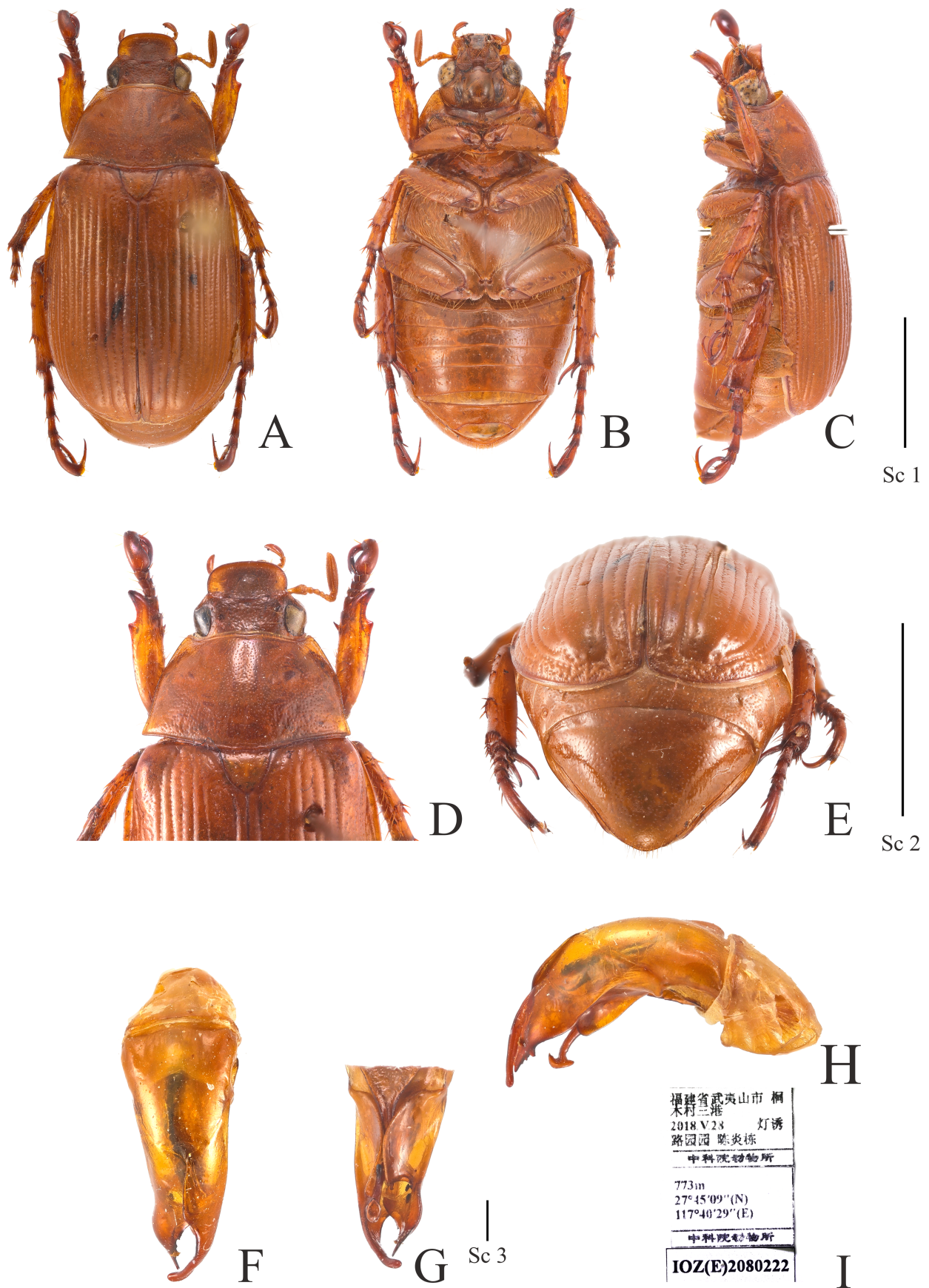


FIGURE 4. Additional specimen of *Anomala spatuliformis* ♂ A–C. Habitus. A. Dorsal view. B. Ventral view. C. Left lateral view. D. Head and pronotum. E. Propygidium and pygidium. F–H. Aedeagus. F. Dorsal view. G. Ventral view. H. Right lateral view. I. Specimen label. Sc. 1: scale for A–C = 5 mm. Sc. 2: scale for D–E = 5 mm. Sc. 3: scale for F–H = 1 mm.

Color. Ground color with light brown and metallic luster; legs yellowish brown, apical part of tibia, and apical part of meso- and metatarsomeres 1–5 dark brown; antennae yellowish brown, frons and vertex of head brown; pygidium dark brown; ventral thoracic surface and abdomen dark brown or yellowish brown, the setae pale yellow.

Head (Fig. 3A, D). Clypeus subrectangular, approximately 2.1 times wider than long, densely punctate; anterior corners broadly rounded; anterior margin strongly reflexed, the disc of clypeus strongly depressed; frontoclypeal suture curved backward weakly; frons and vertex densely punctate, the disc of frons and part of vertex depressed like clypeus; ratio interocular width/width of head approximately 0.65; antennal club slightly longer than antennomeres 2–6 combined (Club L/Ante L 1.07).

Pronotum. Approximately 2.1 times as wide as long, with a weak median longitudinal furrow, not reached the posterior sides; disc densely punctate, surface with additional finely micropunctures; lateral margin of pronotum distinctly converging anteriorly in the middle, slightly curved in anterior half, and slightly curved concave in posterior half; posterior corners acute; basal marginal line complete, shallower in front of scutellum.

Scutellum. Nearly semicircular, the width is 1.2 times the length, densely and finely punctate.

Elytra. Regularly striate; all costal intervals and interstices strongly convex; striae punctures distinct; striate punctures distinct, large, moderately dense; subsutural interstice 2 with a secondary stria irregularly doubled, scattered placed at the base; elytral surface with micropunctuation; humeral umbone and apical protuberance prominent; epipleuron strongly broad near humerus, ending slightly posteriorly of elytral midlength; posterior margins rounded; marginal membrane complete; apico-sutural angle without setae.

Propygidium (Fig. 3E). The surface of posterior part near pygidium glabrous.

Pygidium (Fig. 3E). Strongly convex; apex narrowly rounded; punctation shallowly, dense; slightly transverse; apex with several long, erect yellow setae.

Ventral thorax (Fig. 3B). The anterior margin of prosternum with dense, long, yellow setae; mesosternum weakly punctate, with dense short setae; metasternum densely, weakly large punctate, with dense, long setae.

Abdominal ventrites (Fig. 3B). Ventrites 2–5 with small punctures, coalescently punctate in ventrite 6. Ventrites 2–5 each with a transverse row of sparse and moderately long yellow setae.

Legs. Protibia bidentate, broadened, proximal tooth short, situated close to the rather short, weakly outwards curved apical tooth; inner spur short. Protarsomere 1–4 strongly compressed, length/widen is 3.7; the protarsomere 5 (without claws) widened, concave in inner side; inner protarsal claw strongly widened and deeply incised apically; outer mesotarsal claw long, curved, deeply incised at apex, upper branch spiniform; metatarsal claws unequal, outer claw longer than inner.

Aedeagus (Fig. 3H–J). Parameres asymmetric, right paramere slightly longer, inner margin of the left paramere with sharp denticles; basal piece slender and long, apex expand with an upward curved hook when viewed from the side.

Female. Anterior margin of clypeus reflexed weaker than male, antennal club almost equal to antennomeres 2–6 combined (Club L/Ante L 1.02); protibia and protarsus slender; elytral epipleura broader; the pygidium weakly convex.

Measurements. Body length 13.5–15 mm (HT 15 mm), body width 7.0–8.5 mm (HT 7.9 mm).

Morphological variability. Frons and vertex punctate shallow and fine. Meso- and metafemur with two bands of long yellow setae. Shape of parameres very consistent.

Differential diagnosis. This species is most similar to the previously described *A. fukiensis*, and it is different from it by the following characters: pronotum with a weak median longitudinal furrow; punctation of pygidium slightly transverse; the parameres of aedeagus with denticles.

This species is different from previous *A. longicarcarata* by the following characters: anterior corners of clypeus broadly rounded; the disc of clypeus and frons strongly depressed; the posterior corners of pronotum acute, not subrectangular; the medial and lateral margins of left paramere's inner side with sharply denticles.

Distribution. This species is found in Fujian and Zhejiang provinces of southern China.

***Anomala calceiformis* Huang & Lu, sp. nov.**

Chinese common name: 靴端异丽金龟

(Fig. 5, 6)

Type locality. China, Hunan, Chenzhou, Yichang, Mangshan, 24°58'57.43"N, 112°55'9.94"E, 598m.

Type material. HOLOTYPE (Fig. 5A–H): **CHINA:** ♂ “中国湖南省郴州市宜章县莽山 | 飞行阻隔器 | 采集人 石天琪 || 24°58'57.43"N, 112°55'9.94"E | 10 May 2020 | 中科院动物所 || China, Hunan Province, Chenzhou City, Yizhang County, Mangshan | Flight interception trap | leg. Shi Tianqi || 24°58'57.43"N, 112°57'9.94"E | 10 May 2020 || IOZ (E) 2083501” (IZCAS). **PARATYPES** (2♂2♀): **CHINA:** 1♂ “中国湖南省郴州市宜章县莽山 | 飞行阻隔器 | 采集人 石天琪 || 24°58'53.35"N, 112°54'39.82"E | 10 May 2019 | 中科院动物所 || China, Hunan Province, Chenzhou City, Yizhang County, Mangshan | Flight interception trap | leg. Shi Tianqi || 24°58'53.35"N, 112°54'39.82"E | 10 May 2019 || IOZ (E) 2083502” (IZCAS); 1♀ “中国湖南省郴州市宜章县莽山 | 飞行阻隔器 | 采集人 石天琪 || 24°56'52.58"N, 112°56'33.6"E | 10 May 2019 | 中科院动物所 || China, Hunan Province, Chenzhou City, Yizhang County, Mangshan | Flight interception trap | leg. Shi Tianqi || 24°56'52.58"N, 112°56'33.6"E | 10 May 2019 || IOZ (E) 2083503” (IZCAS) (Fig. 5A–H); 1♀ “中国湖南省郴州市宜章县莽山 | 飞行阻隔器 | 采集人 石天琪 || 24°57'1.71"N, 112°58'42.43"E | 10 May 2019 | 中科院动物所 || China, Hunan Province, Chenzhou City, Yizhang County, Mangshan | Flight interception trap | leg. Shi Tianqi || 24°57'1.71"N, 112°58'42.43"E | 10 May 2019 || IOZ (E) 2083506” (IZCAS); 1♂ “中国湖南省郴州市宜章县莽山 | 飞行阻隔器 | 采集人 石天琪 | 10 May 2020 | 中科院动物所 || China, Hunan Province, Chenzhou City, Yizhang County, Mangshan | Flight interception trap | leg. Shi Tianqi | 10 May 2019 || IOZ (E) 2083507” (IZCAS).

Additional material examined. 1♂ China, Hunan Province, Chenzhou City, Yizhang County, Mangshan, Flight interception trap, leg. Shi Tianqi, 24°57'4.13"N, 112°57'31.72"E, 2019.V.10, IOZ(E)2083504 (IZCAS).

Description of holotype (male). Length 15.8 mm, greatest width 7.6 mm; body shape elongate ovoid, weakly convex.

Color. Ground color reddish brown with weak luster; legs yellowish brown except for protarsus, apical part of tibia, and apical part of meso- and metatarsomeres 1–5 dark brown; antennae yellowish brown, frons and vertex of head yellowish brown; disc of pronotum brown, medial area darker; pygidium yellowish brown; ventral thoracic surface and abdomen yellowish brown, setae pale yellow.

Head (Fig. 5A, D). Clypeus broad and nearly trapezoidal, approximately 2.5 times wider than long, densely and shallowly punctate; anterior corners broadly rounded, anterior margin straight and strongly reflexed, the disc of clypeus depressed; frontoclypeal suture nearly straight; frons and vertex densely punctate, the disc of frons depressed like clypeus; ratio interocular width/width of head approximately 0.65; antennal club slightly longer than antennomeres 2–6 combined (Club L/Ante L 1.1).

Pronotum. Approximately 1.8 times as wide as long, with a distinct median longitudinal furrow, nearly reaching the posterior sides; disc densely punctate, punctures becoming gradually larger and sparser laterally, surface with additional fine micropunctures; anterior corners sub-rectangular, posterior corners acute; lateral margin of pronotum distinctly converging anteriorly in the middle, slightly curved in anterior half, and slightly curved concave in posterior half; basal marginal line almost complete; all other marginal lines complete.

Scutellum (Fig. 5D). Subtriangular, the width is 1.1 times the length, apex corner rounded; surface densely and largely punctate.

Elytra. Regularly striate; all costal intervals and interstices strongly convex; striae punctures distinct; striate punctures distinct, large, moderately dense; subsutural interstice 2 with a secondary stria irregularly doubled, scattered placed at the base; elytral surface with micropunctuation; humeral umbone and apical protuberance prominent; epipleuron strongly broad near humerus, ending slightly posteriorly of elytral midlength; posterior margins rounded; marginal membrane complete; apico-sutural angle without setae.

Propygidium (Fig. 5E). The surface of posterior part neared pygidium glabrous, with dense, transverse punctures.

Pygidium (Fig. 5E). Strongly convex; apex narrowly rounded; punctation shallowly, moderately dense; apex with several long, erect yellow setae.

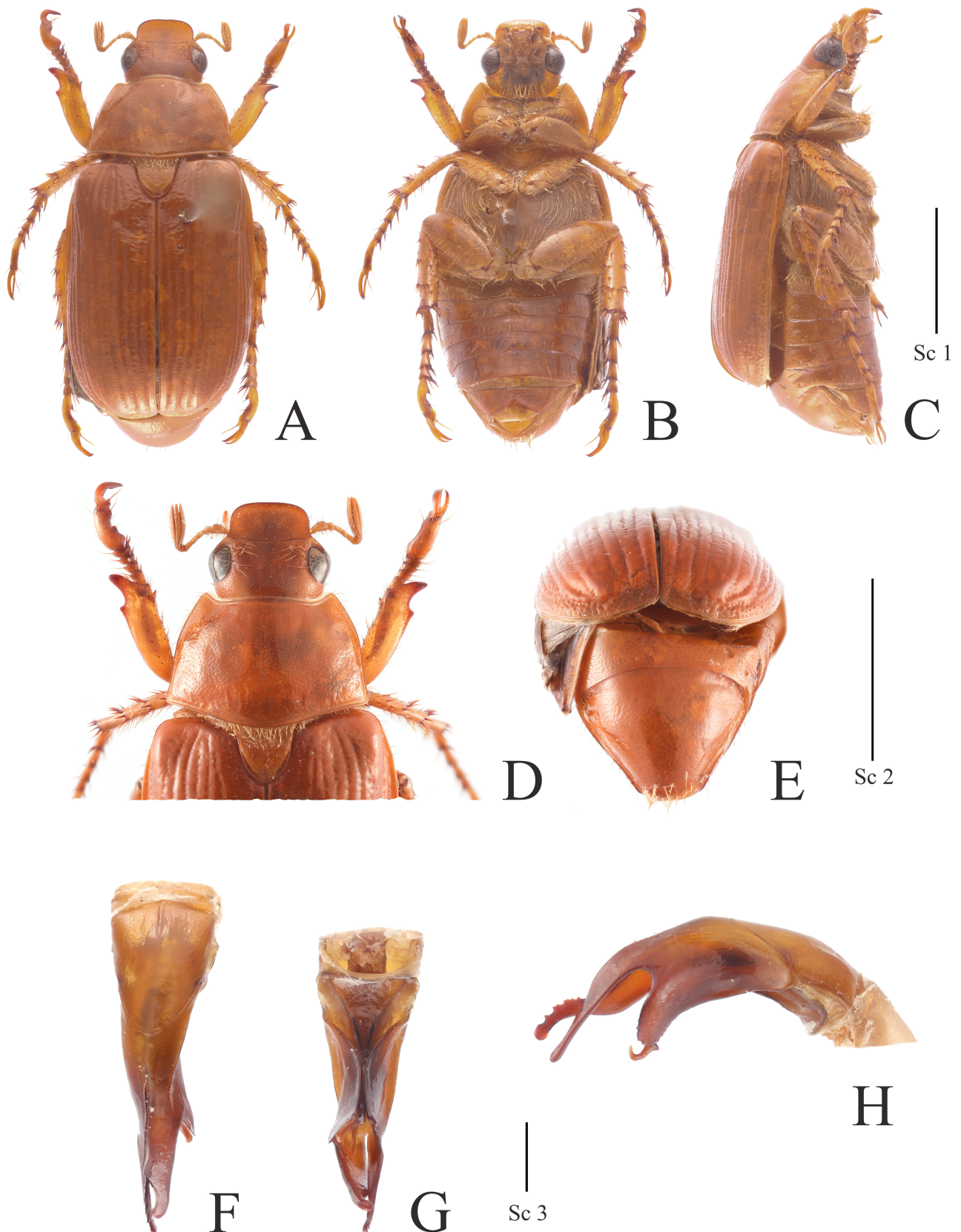


FIGURE 5. Holotype of *Anomala calceiformis* sp. nov. ♂ A–C. Habitus. A. Dorsal view. B. Ventral view. C. Right lateral view. D. Head and pronotum. E. Propygidium and pygidium. F–H. Aedeagus. F. Dorsal view. G. Ventral view. H. Right lateral view. Sc. 1: scale for A–C = 5 mm. Sc. 2: scale for D–E = 5 mm. Sc. 3: scale for F–H = 1 mm.

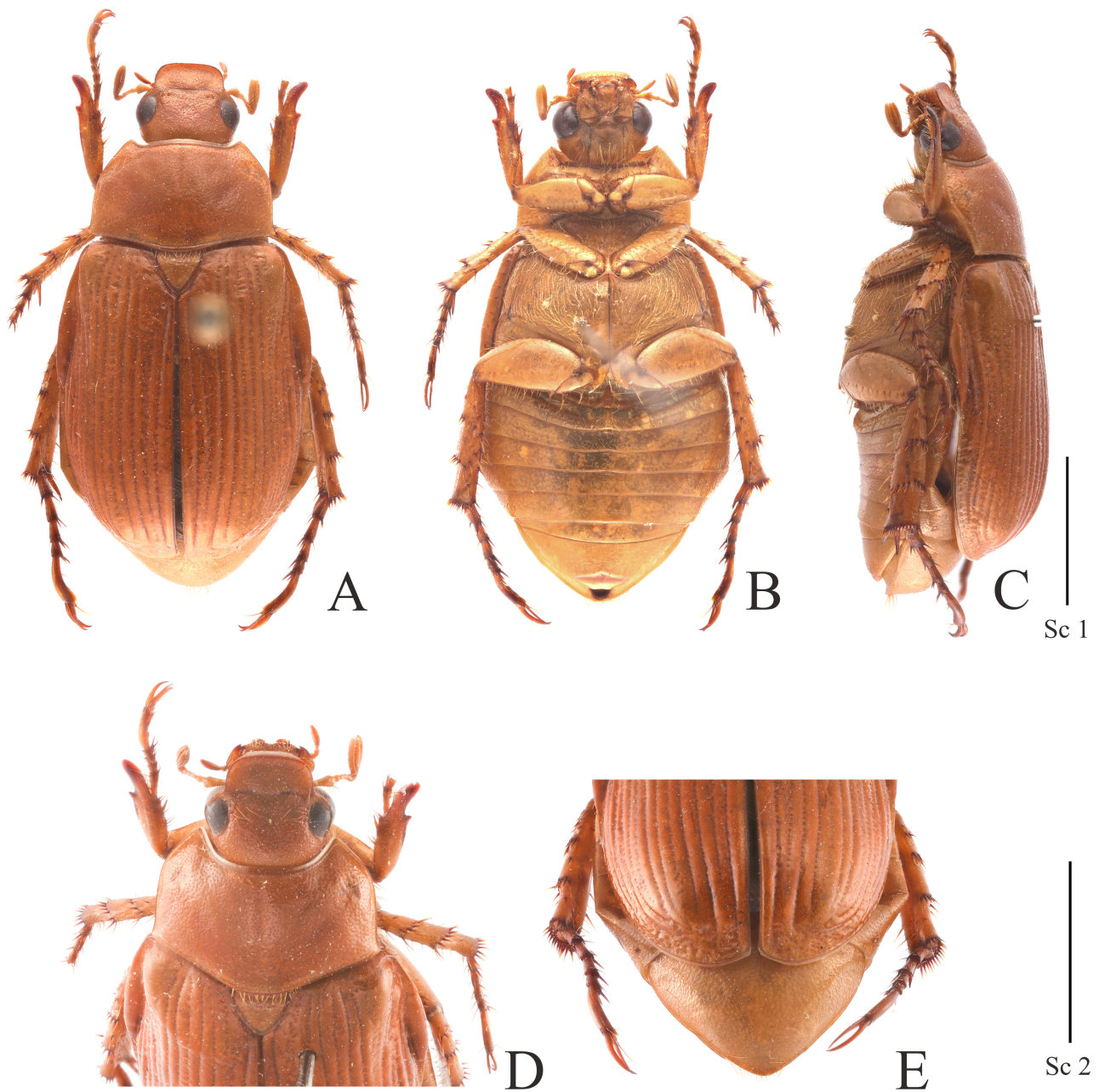


FIGURE 6. Paratype of *Anomala calceuiformis* sp. nov. ♀ **A–C.** Habitus. **A.** Dorsal view. **B.** Ventral view. **C.** Left lateral view. **D.** Head and pronotum. **E.** Propygidium and pygidium. Sc. 1: scale for **A–C** = 5 mm. Sc. 2: scale for **D–E** = 5 mm.

Ventral thorax (Fig. 5B). The anterior margin of prosternum with dense, long, yellow setae; mesosternum weakly punctate, with dense short setae; metasternum densely, large punctate, with dense, long setae.

Abdominal ventrites (Fig. 5B). Ventrites 2–5 with small punctures, coalescently punctate in ventrite 6. Ventrites 2–5 each with a transverse row of sparse and moderately long yellow setae.

Legs. Mesofemur with two bands of long yellow setae: one along anterior margin; another on a transverse row of punctures parallel to posterior margin; metafemur with one band of long yellow setae, emerging from a transverse row of punctures parallel to posterior margin. Protibia bidentate, broadened, approximately 2.7 times longer than wide; proximal tooth short, situated close to the rather short, weakly outwards curved apical tooth; inner spur short, articulated in opposite to proximal tooth. Protarsomere 1–4 strongly compressed, length/widen is 4.0, the protarsomere 5 (without claws) strongly widened, concave in inner side; inner protarsal claw strongly widened and deeply incised apically, lower margin with obtuse angle basally, upper branch spiniform; outer mesotarsal claw

long, curved, deeply incised at apex, upper branch spiniform; metatarsal claws unequal, outer claw longer than inner.

Aedeagus (Fig. 5F–H). Parameres asymmetric, right paramere slightly longer, the inner side of left paramere dentated at apex; apex of the ventral branch of the right paramere with denticles; basal piece slender, apex with a boot-like structure when viewed from the side.

Female (Fig. 6A–E). Antennal club short, slightly longer than antennomeres 2–6 combined; sides of pronotum slightly straight in posterior half; elytral epipleura broader; pygidium weakly convex. Protibia slender, apical tooth of protibia long and spatulate; protarsus articulated slightly basally of level of proximal tooth; inner spur long, articulated between 1/2 and 2/3 of tibial length; protarsus very slender, protarsomere 5 (without claws) longer than tarsomeres 1–4 combined; modified claws of protarsus shorter, apical branches more equal than in males.

Measurements. Body length 14.3–15.8 mm (HT 15.8 mm), body width 7.3–7.9 mm (HT 7.6 mm).

Morphological variability. Shape of parameres very consistent.

Differential diagnosis. This species is different from the previously described *A. longicarcara* by the following characters: anterior corners of clypeus broadly rounded; the disc of clypeus and frons strongly depressed; the posterior corners of pronotum acute, not subrectangular; the slender aedeagus.

The new species is most similar to *A. fukiensis* and *A. spatuliformis*. It is different from *A. fukiensis* by the following characters: pronotum with a weak median longitudinal furrow; punction of pygidium transverse. *A. calceiformis* **sp. nov.** is different from *A. spatuliformis* by the the inner spur in the end of metatibia well developed.

Etymology. The specific epithet refers to the boot-like shape of the basal piece in aedeagus of the *A. calceiformis* **sp. nov.**

Distribution. This species is found only in Hunan.

COI sequence

COI sequence of the *Anomala calceiformis* **sp. nov.** resulted in a 658 base pair alignment. The sequence is as follows: ACTCCTTATTTTCTATTTGGTAGTTGAGCTGGAATAGTAGGAACATCCCTAAGATTA-TATTTCGAG-CAGAACTAGGAAACCCAGGATCTCTTATTGGAGATGACCAAATTTATAATGTAATTGTAACAGCACAT-GCTTTTATTATGATTTTCTTTATAGTGATACCTATTATAATTGGTGGATTTGGAAATTGACTTGTACCTC-TAATACTAGGAGCCCTGATATAGCATTTCCTCGAATAAATAATATGAGATTTTGGCTTCTTCCCCCT-CACTAACTCTTCTTTAATAAGAAGACTAGTAGAGAATGGAGCAGGAACTGGTTGAACAGTC-TATCCCCACTGTCAGCTAATATTGCCATAGAGGTGCCTCTGTTGATTTAGCTATTTTTAGACTTCATC-TAGCAGGTATTAGATCTATTCTTGGAGCAGTAAATTTTACTACTACAGTAATCAATATAACGATCAA-CAGGAATAACCTTTGATCGCATAACCTTTATTTGTTGATCAGTAGTATTAACGGCTCTTTTACTTCTTT-TATCTTTACCAGTATTAGCTGGTGCTATTACCATATTATTAACCGACCGTAATATTAATACTTCCCTTTTTT-GATCCTGCAGGAGGAGGAGATCCTATTTTATACCAACACTTATT

Key to *A. calceiformis* sp. nov. and similar species

- 1 Anterior corners of clypeus broadly rounded; the disc of clypeus and frons depressed; shape of parameres asymmetric 2
- Anterior corners of clypeus nearly rectangular; the disc of clypeus and frons not depressed; shape of parameres nearly symmetric *Anomala longicarcara*
- 2 Pronotum with a distinct median longitudinal furrow, the posterior half of lateral margin slightly concaved; the surface of pronotum more smoothly; the left paramere of aedeagus with denticles 3
- Pronotum with a weak median longitudinal furrow, the posterior half of lateral margin more concaved; the surface of pronotum with some wrinkled area; the parameres of aedeagus without denticle *Anomala fukiensis*
- 3 The disc of clypeus and frons depressed; the protarsomere 5 (without claws) strongly widened, especially in outer side; the parameres slender, basal piece with a boot-like apex. *Anomala calceiformis* **sp. nov.**
- The disc of clypeus, frons and part of vertex strongly depressed; the protarsomere 5 (without claws) widened; the parameres wide, basal piece with a hook-like apex. *Anomala spatuliformis*

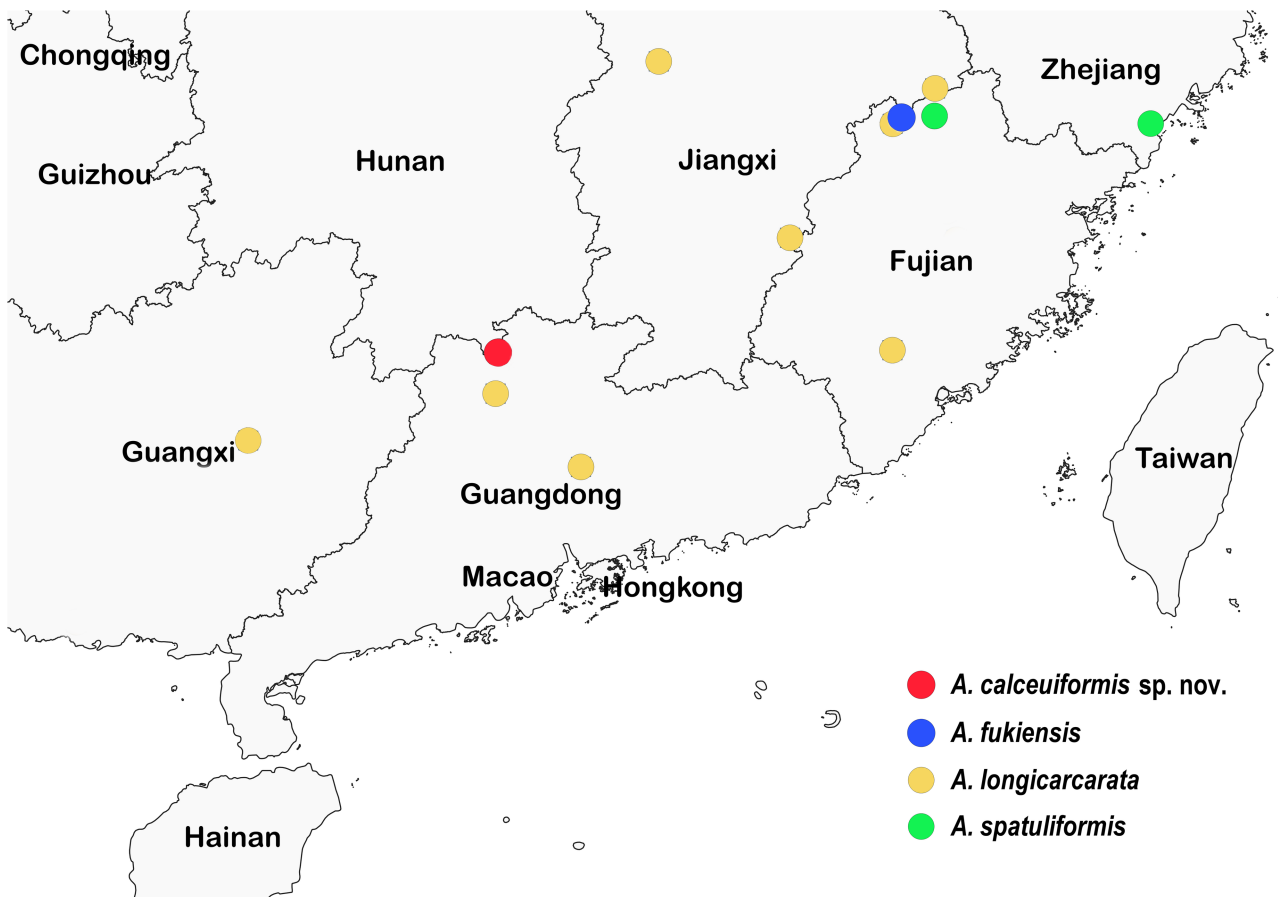


FIGURE 7. Sketch map of the South China with marked distribution of four *Anomala* species.

TABLE 1. List of know localities of four *Anomala* species with their geographic coordinates and altitude data.

Species	Country	Locality	N	E	Altitude
<i>A. fukiensis</i>	China	Fujian, Wuyi Mountain, Kuatun	27°44'21.7''	117°38'52.7''	2300 m
<i>A. longicarcarata</i>	China	Fujian, Wuyi Mountain, Guadun	28°4'49.08''	118°2'29.7''	900 m
<i>A. longicarcarata</i>	China	Fujian, Nanping, Jianyang, Huangkeng Town	26°38'30.00''	118°10'38.99''	270–390 m
<i>A. longicarcarata</i>	China	Fujian, Hua'an, Xiandu Town	25°1'47.99''	117°39'30.83''	\
<i>A. longicarcarata</i>	China	Guangdong, Ruyuan County	24°30'1.00''	112°53'10''	\
<i>A. longicarcarata</i>	China	Jiangxi, Yifeng County	28°23'51''	114°47'54''	\
<i>A. longicarcarata</i>	China	Jiangxi, Nankun Mountain	23°36'0''	113°48'0''	\
<i>A. longicarcarata</i>	China	Guangdong, Huizhou, Nankun Mountain	23°38'27.34''	113°53'6.81''	\
<i>A. longicarcarata</i>	China	Guangxi, Jinxiu Town	24°8'9.54''	110°11'43.10''	600 m
<i>A. spatuliformis</i>	China	Fujian, Wuyi Mountain, Guadun	27°24'0''	117°24'0''	2300 m
<i>A. spatuliformis</i>	China	Zhejiang, Pingyang County	27°40'4.88''	120°34'20.87''	\
<i>A. calceiformis</i> sp. nov.	China	Hunan, Mangshan	24°58'57.43''	112°55'9.94''	598 m

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南岭地区异丽金龟属 *Anomala* 一新种及近似种评述 (鞘翅目: 金龟科: 丽金龟亚科)


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摘要: 描述湖南省莽山国家级自然保护区异丽金龟属 *Anomala* 一新种, 即靴端异丽金龟 *A. calceiformis* **sp. nov.**; 给出了该物种详细描述和COI序列; 提供了新种的图版及其近缘种特征照片, 并绘制了分布图。靴端异丽金龟在形态上与福建异丽金龟 *A. fukiensis*、长距异丽金龟 *A. longicarcara* 和窝唇异丽金龟 *A. spatuliformis* 相近, 讨论了这些种的区别特征。

关键词: 异丽金龟属; 分类; 检索表; 靴端异丽金龟