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Taxonomic notes of the genus *Ripiphorus* Bosc d'Antic (Coleoptera: Ripiphoridae: Ripiphorinae) from China, with description of a new species

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Abstract

The Chinese species of the ripiphoride genus *Ripiphorus* Bosc d'Antic, 1791 are taxonomically reviewed. A new species, *R. curvispinus* Pan, **sp. nov**., is discovered from Beijing and distinguished from its congeners by the distinctly curved metatibial inner spur. The difference between *R. curvispinus* Pan **sp. nov.** and *R. chalcidoides* (Gressitt, 1941) is confirmed using phylogenetic analysis and molecular species definition based on mtDNA *COI* sequences. Furthermore, *Ripiphorus subdipterus* Fabricius, 1792 is newly recorded for China. All *Ripiphorus* species occurring in China are described, illustrated and keyed.

Key words: wedge-shaped beetle, taxonomy, new species, new record, *COI*, China

Introduction

The wedge-shaped beetle genus *Ripiphorus* Bosc d'Antic, 1791 belonging to Ripiphorinae Laporte, 1840 of the family Ripiphoridae Laporte, 1840 includes approximately 70 species (Batelka 2009; Batelka & Straka 2011) mostly occurring in the Nearctic Region (Falin 2002). The genus is widely distributed across continents (excluding Antarctica and Australia) and commonly found in temperate and arid regions (Lawrence *et al*. 2010). Unfortunately, the short adult lifespan of many ripiphorid species has complicated collection efforts, resulting in a scarcity of specimens in collections. This scarcity has hindered comprehensive taxonomic revisions, with limited works focusing only on the Nearctic and Eastern Mediterranean species (Rivnay 1929; Linsley & MacSwain 1951; Batelka 2007).

Ripiphorus is poorly known from China, though Gressitt (1941) provided a revision of the family from China but only four species have been documented and recorded endemic to the central and southern regions, with no new Chinese species having been recorded since 1941. However, the above four species have been described based on a single sex, with limited knowledge of the opposite sex.

In recent years, we have obtained and examined some *Ripiphorus* specimens in China, especially from the northern territory. After comparing the adults with known *Ripiphorus* species, we concluded that there is one new species, *R. curvispinus* Pan **sp. nov.**, from Beijing and a newly recorded species, *R. subdipterus* Fabricius, 1792, from Xinjiang, China. Meanwhile, the male of *R. davidis* (Fairmaire, 1878) and *R. minor* (Gressitt, 1941) were discovered and described for the first time. Furthermore, phylogenetic analysis and molecular species definition were used to confirm the validity of the new species *R. curvispinus* Pan **sp. nov.** based on mtDNA *COI* sequences. The primary objective of this paper is to compile existing information and provide new data regarding the *Ripiphorus* species from China.

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Material and methods

Morphological examination

Sixteen specimens (including four types, see below) of six species were examined and have been deposited at the Entomological Museum of China Agricultural University, Beijing, China (CAU), Museum of Hebei University, Baoding, China (MHBU), Museum of Biology, Sun Yat-sen University, Guangzhou, China (MSYU), and National Animal Collection Resource Center, Beijing, China (NACRC), respectively.

The photos were taken by Canon EOS 5D Mark III (Canon Inc., Tokyo, Japan) connected to a Laowa EF 100 mm F2.8 CA-Dreamer Macro 2× or Laowa EF 25 mm F2.8 Ultra Macro 2.5–5× (Anhui Changgeng Optics Technology Co., Ltd, Hefei, China). Images were edited using Adobe Photoshop to form the final figure plates.

Most of the terms in the descriptions are from previous introductions (e.g., Batelka 2009; Batelka & Straka 2011; Lawrence & Ślipiński 2013).

Molecular analyses

To resolve species identity, especially the difference between *R. chalcidoides* and *R. curvispinus* Pan **sp. nov.**, 16 mitochondrial cytochrome c oxidase subunit I (*COI*) fragment sequences associated with 6 species level identifications were selected and sequenced or downloaded from GenBank. Additionally, *Macrosiagon bimaculata* (Fabricius, 1787) was selected as outgroup, which was positioned in the sister groups of *Ripiphorus* in the previous molecular phylogenetics by Batelka *et al*. (2016).

For our samples, total genomic DNA was extracted from the leg muscles using the Insect gDNA Isolation Kit (Biomiga, Hangzhou, China). Fragments of the mitochondrial molecular marker *COI* were amplified with the primer pair: C1-J-2183 (Jerry) and TL2-N-3014 (Pat) (Simon *et al.* 1994). Polymerase chain reaction (PCR) amplifications were performed following the settings described in Erasmus *et al.* (2006). The PCR products were examined using 1.0% agarose gel electrophoresis and purified and sequenced by General Biol (Chuzhou, China).

DNA sequences were edited in DNASTAR SeqMan Pro v.7.1.0 (DNASTAR, Inc., Madison, WI, USA) and aligned in batches with MAFFT (Katoh & Standley 2013) using codon alignment mode. All newly generated sequences were deposited in GenBank (Table 1)

Genetic distances were calculated using the Kimura 2-parameter model with MEGA v10.2.6 (Kumar *et al*. 2018). Phylogenetic analyses were performed under the assumptions of Bayesian Inference (BI). ModelFinder (Kalyaanamoorthy *et al*. 2017) was used to select the best-fit partition model using the corrected Akaike's Information Criterion (AICc). The best-fit partition model yielded a scheme of three partitions: GTR+F+I, GTR+F+I, and HKY+F+G4. The BI analysis was inferred using MrBayes v3.2.6 (Ronquist *et al*. 2012) for 40 million generations. The consensus tree was generated with a 25% burn-in, and Bayesian posterior probabilities (bpp) were used to assess nodal support. Lastly, the phylogenetic consensus tree was visualized in FigTree v1.4.4 and chiplot on the online web (www.chiplot.online, Xie *et al*. 2023).

For molecular species delimitation analyses that were advocated to use in a complementary way to better assess species boundaries, species boundaries within *Ripiphorus* were assessed using three separate methods: assumable species by automatic partitioning (ASAP; Puillandre *et al*. 2021), generalized mixed Yule coalescent approach (GMYC; Fujisawa & Barraclough 2013), and Bayesian implementation of the poisson-tree-processes model (bPTP; Zhang *et al*. 2013). ASAP was implemented on the online web application (https://bioinfo.mnhn.fr/abi/public/asap/asapweb.html) with Kimura (K80) distance. The GMYC analysis was conducted in R using the GMYC package with default setting, based on a ultrametric tree that was built by BEAST v2.6.7 (Bouckaert *et al*. 2019). bPTP analysis was carried out on the web server of the Exelixis Lab (species.h-its.org/ptp/), using default settings, based on a BI tree from MrBayes.

TABLE 1. Species, codes, and sampling locality for the molecular analyses based on *COI* sequences.

Taxon	Sample Code	Locality/Region	GenBank Accession	Source of Data
Ripiphorus chalcidoides (Gressitt, 1941)	R1A8	China, Shanxi, Yangcheng, Mt. Lishan, 35°22′8.08″N, 112°3′11.95″E, elev. 955 m	PQ299820	Current study
Ripiphorus chalcidoides (Gressitt, 1941)	R1A9	China, Beijing, Haidian, National Botanical Garden North Area	PQ299821	Current study
Ripiphorus chalcidoides (Gressitt, 1941)	R1A10	China, Hubei, Chongyang, Maojing, 29.624117°N, 114.050563°E, elev. 200 m	PQ299822	Current study
Ripiphorus curvispinus Pan, **sp. nov.**	R1A3	China, Beijing, Haidian, Xishan, elev. 300 m	PQ299819	Current study
Ripiphorus arabiafelix arabiafelix Batelka, 2009	n/a	Yemen	KT447432	Batelka *et al.* 2016
Ripiphorus arabiafelix arabiafelix Batelka, 2009	n/a	Yemen	KT447433	Batelka *et al.* 2016
Ripiphorus arabiafelix arabiafelix Batelka, 2009	n/a	Yemen	KT447434	Batelka *et al.* 2016
Ripiphorus arabiafelix caboverdianus Batelka & Straka, 2011	n/a	Cape Verde	KT447422	Batelka *et al.* 2016
Ripiphorus diadasiae Linsley & MacSwain, 1950	MNCN_Ent 331115	USA, California, Mono Co., 2 km N Mono Mills, Old Bodie Railroad Grade, 37°54’23”N 118°57’40”W, elev. 2222 m	OR535305	Jurado-Angulo *et al*. 2023
Ripiphorus flaviventris (Champion, 1891)	n/a	Costa Rica	FJ904015	Levkaničová 2009
Ripiphorus subdipterus Fabricius, 1792	MNCN_Ent 331099	Spain, Castilla y León, Burgos, Pardilla, 41°32’51”N 3°43’01”W, elev. 911 m	OR535299	Jurado-Angulo *et al*. 2023
Ripiphorus subdipterus Fabricius, 1792	MNCN_Ent 331100	Spain, Andalucía, Granada, 1 km al NE de Capileira, 36°57’58”N 3°22’16”W, elev. 1510 m	OR535301	Jurado-Angulo *et al*. 2023
Ripiphorus subdipterus Fabricius, 1792	MNCN_Ent 331101	Spain, Castilla-La Mancha, Guadalajara, 2.3 km al SE de Uceda, 40°49’42”N 3°26’35”W, elev. 873 m	OR535302	Jurado-Angulo *et al*. 2023
Ripiphorus subdipterus Fabricius, 1792	MNCN_Ent 331102	Spain, Castilla-La Mancha, Toledo, Villacañas, Laguna de Tirez, 39°32’39”N 3°20’58”W, elev. 651 m	OR535303	Jurado-Angulo *et al*. 2023
Ripiphorus subdipterus Fabricius, 1792	MNCN_Ent 331107	Spain, Comunidad de Madrid, 3 km al E de Villamanrique de Tajo, Cueva de Vara, 40°04’21”N 3°16’31”W, elev. 598 m	OR535300	Jurado-Angulo *et al*. 2023
Ripiphorus subdipterus Fabricius, 1792	MNCN_Ent 331108	Spain, Castilla-La Mancha, Toledo, Villacañas, Laguna de Peña Hueca, 39°31’14”N 3°20’12”W, elev. 917 m	OR535304	Jurado-Angulo *et al*. 2023
Macrosiagon bimaculata (Fabricius, 1787)	n/a	Hungary	KT447429	Batelka *et al.* 2016

Taxonomy

Genus *Ripiphorus* Bosc d'Antic, 1791

Chinese common name: 大花蚤属

Ripiphorus Bosc d'Antic 1791: 327. Type species: *Ripiphorus subdipterus* Fabricius, 1792.
Myodes Latreille 1818: 130 [homonym, nec Pallas, 1811]. Type species: *Myodes dorthesii* Latreille, 1818 (= *Riphiphorus subdipterus* Fabricius, 1792).
Myodites Latreille 1819: 303 [replacement name for *Myodes* Latreille, 1818].
Dorthesia Say 1824: 274. Type species: *Dorthesia fasciata* Say, 1824.
Rhipiphorus Duméril 1827: 374; Agassiz 1846: 324 [unjustified emendation].
Rhipidophorus Perty 1831: xix [unjustified emendation].
Polychroma Gistel 1848: x. Type species: *Ripiphorus subdipterus* Bosc d'Antic, 1792 (= *Riphiphorus subdipterus* Fabricius, 1792).
Myiodites Fabre 1886: 221 [unjustified emendation].
Myiodes Heyden *et al*. 1891: 520 [unjustified emendation].

Description. Body small to medium size, yellowish brown to black, occasionally brown or yellow on abdomen, elytra, and antennae; setation varied. Head large, distinctly downturned, elliptical or flattened antero-posteriorly; vertex distinctly raised to a protuberance; antennal sockets located on posterior side of compound eyes. Compound eyes large. Labrum broad, bilobed, slightly protruding; mandibles simple, sickle-shaped; maxillary palps 4-segmented, thread-like, truncate at apex in some cases, lacinia absent, stipes and galea fused together; labial palps 3-segmented. Antennae with 10 or 11 antennomeres, biflabellate in male, uniflabellate in female; scape and pedicel simple, scape ring-shaped. Pronotum large, bell-shaped; prosternum usually smaller, proventral process not exceeding procoxae; mesosternum extremely shortened; metasternum distinctly enlarged. Scutellum with a narrow longitudinal furrow at center, posterior margin emarginate in middle. Elytra short; hind wings not completely covered by elytra. Legs elongated; trochanter degenerate; tibial spur formula 2-2-2; claws with one row of comb-shaped teeth along ventral margin. Abdomen 8-segmented, terminal portion strongly bent ventrally.

Diagnosis. *Ripiphorus* could be easily distinguished from other genera of Ripiphorinae by its distinctly reduced elytra. However, the genus *Ripidus* Thunberg, 1806, in Ripidiinae Gerstaecker, 1855, exhibits similar characteristics to those of *Ripiphorus*. *Ripiphorus* differs from *Ripidus* by having a complete mouthpart, compound eyes widely divided in both sexes, vertex distinctly raised to a protuberance, antennae biflabellate in male and uniflabellate in female, and pronotum large and wide; while in *Ripidus*, mouthparts degenerated; compound eyes contiguous in males but small and divided in females, vertex slightly raised, antennae uniflabellate in males and filiform in females, and pronotum small.

Distribution. Worldwide, exclude Antarctica, New Zealand, and Australia.

Key to the *Ripiphorus* species from China

1. Male, i.e., antennae biflabellate; abdominal tergite VIII fan-shaped. 2
- Female, i.e., antennae uniflabellate; abdominal tergite VIII rectangular. 5
2. Pronotum with a smooth and unpunctured area on each side (Fig. 1C); body almost dark (Fig. 1A). . . . . ***R. chalcidoides***
- Pronotum without a smooth and unpunctured area on each side; body light to dark yellow. 3
3. Elytra extremely short, not reaching to posterior margin of metathorax. . . . . ***R. subdipterus***
- Elytra short, exceeded posterior margin of metathorax (Figs 3A, 5A). 4
4. Body wider, covered with grayish short setae (Fig. 3A); pronotum slightly longer than wide (Fig. 3C) . . . . . ***R. davidis***
- Body narrower, covered with pale yellow long setae (Fig. 5A); pronotum slightly wider than long (Fig. 5C) . . . . . ***R. minor***
5. Pronotum with a smooth and unpunctured area on each side (Figs 2C, 8C); abdominal tergite VIII wider than long (Figs 2E, 8E) 6
- Pronotum without a smooth and unpunctured area on each side (Fig. 7C); abdominal tergite VIII longer than wide (Fig. 7E) 7
6. Head wider than long in frontal view (Fig. 8B); aspect ratio of scutellum approximately 0.18 (Fig. 8A); metatibial inner spur straight, at most slightly curved at apex (Fig. 8D) . . . . . ***R. tenthredinoides***
- Head approximately as long as wide in frontal view (Fig. 2B); aspect ratio of scutellum approximately 0.38 (Fig. 2A); metatibial inner spur distinctly curved (Fig. 2D) . . . . . ***R. curvispinus* sp. nov.**
7. Antennae with 11 antennomeres (Fig. 7B); pronotum approximately as long as wide, with small and shallow punctures (Fig. 7C). . . . . ***R. subdipterus***

- Antennae with 10 antennomeres (Figs 4B, 6B); pronotum wider than long, with large and deep punctures (Figs 4C, 6C). . . . 8
8. Abdominal tergite VII densely punctate (Fig. 4E); aspect ratio of abdominal tergite VIII > 1.5 (Fig. 4E). . . . . ***R. davidis***
- Abdominal tergite VII sparsely punctate (Fig. 6E); aspect ratio of abdominal tergite VIII > 1.5 (Fig. 6E) . . . . . ***R. minor***

Ripiphorus chalcidoides **(Gressitt, 1941)**

Chinese common name: 平额大花蚤

(Fig. 1)

Rhipiphorus chalcidoides Gressitt 1941: 532; Hua 2002: 129.
Ripiphorus chalcidoides: Batelka 2008: 77; Barclay 2020: 65.

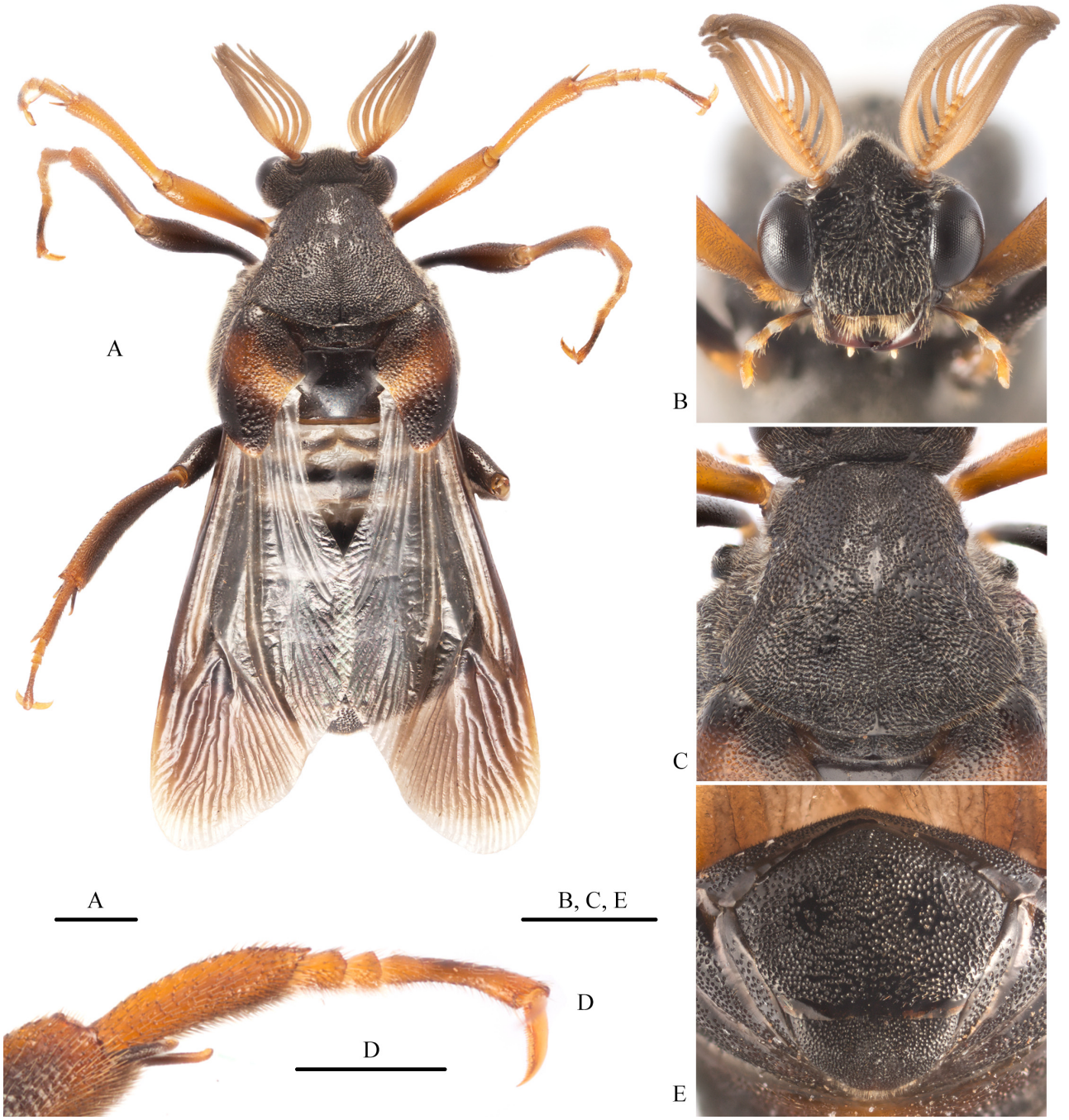

FIGURE 1. *Ripiphorus chalcidoides* (Gressitt, 1941), ♂, from Mt. Lishan, Shanxi. **A.** Habitus, dorsal view. **B.** Head, frontal view. **C.** Pronotum, dorsal view. **D.** Metatarsus, lateral view. **E.** Tergites VII and VIII, dorsal view. Scale bar: 1 mm.

Updated description. Male: Body length: 4.8–7.3 mm, width (maximum width of metathorax): 2.3–2.7 mm. Body almost dark (Fig. 1A): head and thorax dark; elytra black, or with one brown-yellow oblique fascia in middle; fore and middle legs brown-yellow, but mesofemora, base of mesotibiae, and mesotarsomere V black; hind legs almost black except tarsomeres dark brown; abdominal tergites uniformly black or brown-yellow with broad black transverse fasciae. Body covered with brown-yellow setae. Head (Fig. 1B) wider than long; protuberance of vertex sightly pointed at apex, obtusely triangular in frontal view (Fig. 1B). Compound eyes approximately 0.59× as long as head. Antennae (Fig. 1B) approximately as long as pronotum, with 11 antennomeres; flagellomeres I to VIII subequal in length, rami approximately 13.0× as long as their respective stem, IX longest without ramus. Pronotum (Fig. 1C) approximately as long as wide, punctures on disc dense and small towards borders and along median portion behind middle, sparser on remainder, with irregular impunctate areas on each side and along median line before middle. Scutellum short and wide (aspect ratio approximately 0.36). Elytra approximately 0.8× as long as pronotum, punctures on disc large but more sparsely on sides and apex. Metatarsomere I (Fig. 1D) approximately 4× as long as II. Abdominal tergite VIII (Fig. 1E) fan-shaped, densely punctate.

Female. Unknown.

Type materials. Gressitt (1941) recorded the male holotype was collected from "Iu-ling-paai, Yao Shan, Lin District, N. Kwangtung Province [广东连州 (Lianzhou, Guangdong)], S. China" and deposited at the Lingnan Natural History Museum that was the predecessor of MSYU. However, the author did not find the type from MSYU. The single paratype (sex unknown, not recorded in the original description) was collected from "Naam-fung, 10 miles S. S. W. of Nodoa, Tan District, Hainan Island" and deposited at the United States National Museum, not examined.

Materials examined. 1♂ (MHBU), Shanxi, Yangcheng, Mt. Lishan, 35°22′8.08″N, 112°3′11.95″E, elev. 955 m, 2022.VII.12, Zhao Pan leg.; 1♂ (MHBU), Beijing, Haidian, National Botanical Garden North Area, near the grave of Xue-Qin Cao, 2024.VII.12, Hao-Yang Xiong leg.; 1♂ (MHBU), Hubei, Chongyang, Maojing, 29.624117°N, 114.050563°E, elev. 200 m, Ting-Kai Zeng leg.; 1♂ (NACRC), Yunnan, Xishuangbanna, Yunjinghong, elev. 650 m, 1958.VI.19, Le-Yi Zheng leg.

Distribution. China: Beijing, Shanxi, Hubei, Yunnan, Guangdong, Hainan.

Remarks. This species is newly recorded for Beijing, Shanxi, Hubei, and Yunnan provinces of China and represents that *Ripiphorus* is discovered from Northern China for the first time. As one of the only two species found in North China, the differences between *R. chalcidoides* and *R. curvispinus* Pan **sp. nov.** were pointed out in the remarks of *R. curvispinus* Pan **sp. nov.**

***Ripiphorus curvispinus* Pan, sp. nov.**

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Chinese common name: 钩刺大花蚤
(Fig. 2)

Diagnosis. The new species is closely related to *R. tenthredinoides* (Gressitt, 1941). It can be distinguished from the latter by the following characters: metatibial inner spur distinctly curved; aspect ratio of scutellum approximately 0.38 (approximately 0.18 in *R. tenthredinoides*); abdominal tergite VII subrounded.

Description. Female: Body length: 7.69–7.97 mm; width (maximum width of metathorax): 2.28–2.37 mm. Body almost black (Fig. 2A), but pronotum reddish black in paratype, elytra brownish yellow but black basally and apically in holotype, inner sides of protibiae yellowish brown, margins of metatarsomere I brown, tibial spurs and claws reddish brown, abdominal tergites IV–VI with equal-length transverse yellow fasciae, abdominal ventrites yellowish brown. Body covered with tawny setae: erect on head and abdomen, recumbent on thorax.

Head (Fig. 2B) approximately as long as wide; frons concave and with large and dense punctures; protuberance of vertex distinctly raised and bluntly rounded at apex, semicircle-shaped in frontal view (Fig. 2B); clypeus evenly truncate, slightly and finely punctate; mandibles elongate, approximately 0.2× as long as head; palpomere III longer than IV. Compound eyes oval, approximately half length of head, interocular distance wide. Antennae (Fig. 2B) less than half length of pronotum, with 10 antennomeres; pedicel subglobose; flagellomeres subequal in length, rami of I–V approximately 7.0× as long as their respective stem, VI–VII gradually shortened, VIII without ramus.

Pronotum (Fig. 2C) wider than long, widest at base and gradually narrowed anteriorly; anterior angles obtuse and rounded; disc convex, with dense punctures, puncture at center smaller and denser than that on remainder, smooth

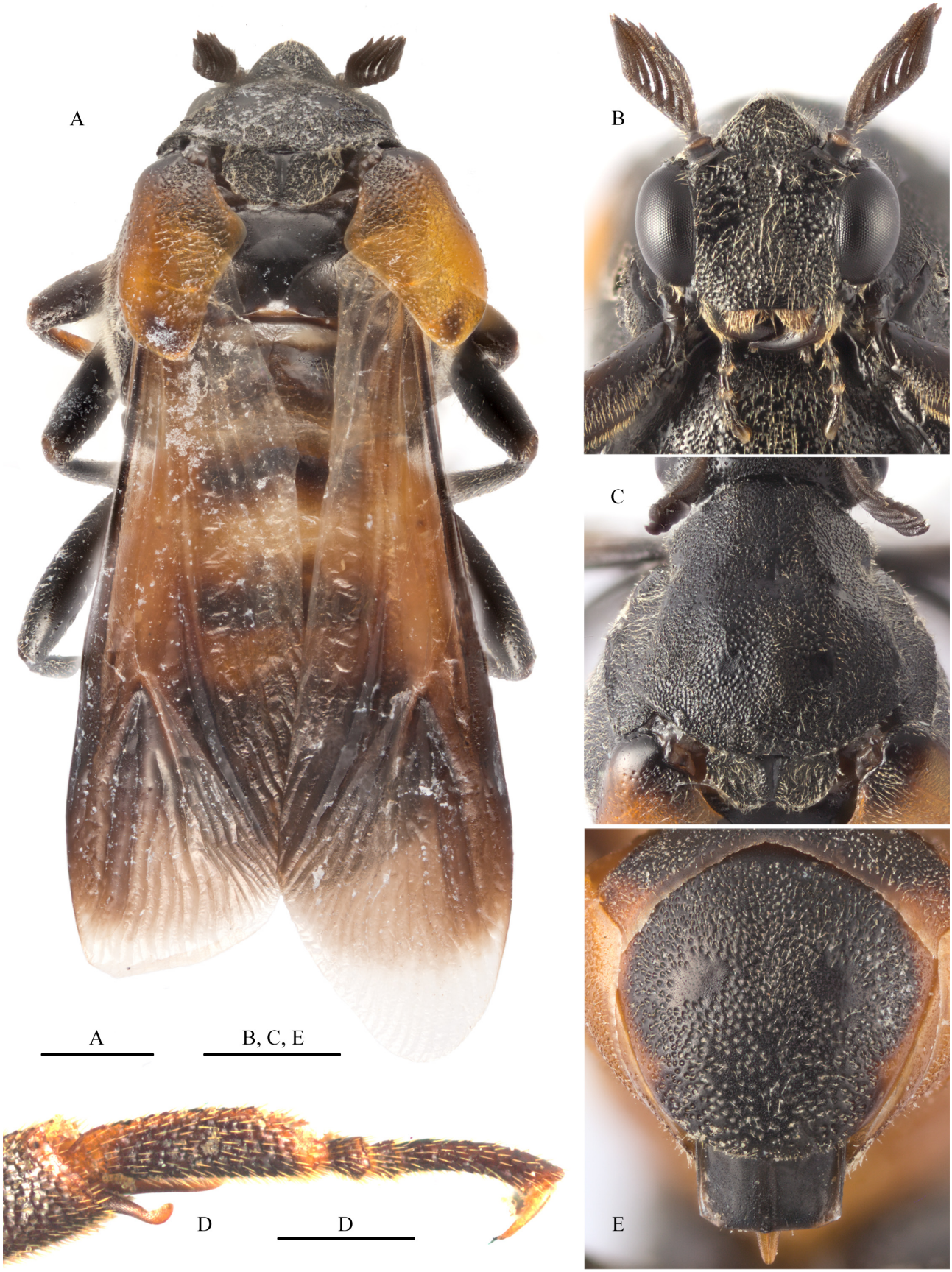

FIGURE 2. *Ripiphorus curvispinus* Pan, **sp. nov.**, ♀. **A.** Habitus, dorsal view. **B.** Head, frontal view. **C.** Pronotum, dorsal view. **D.** Metatarsus, lateral view. **E.** Tergites VII and VIII, dorsal view. **A–C, E.** Holotype. **D.** Paratype. Scale bar: 1 mm.

at approximately basal 1/4 and on each side of midline. Scutellum tongue-shaped (aspect ratio approximately 0.38), covered with fine punctures and short setae. Thoracic sternums with deep punctures that denser at center. Elytra slightly longer than half of pronotum, widest in middle, narrowed anteriorly and posteriorly, apex bluntly rounded; largely punctate, more sparsely on sides; hind wings largely exposed. Metatibiae (Fig. 2D) longer than pro- and mesotibiae, gradually widened towards apex, inner spur distinctly curved; metatarsomere I (Fig. 2D) approximately 4.5× as long as II.

Abdominal ventrites with small and dense punctures; penultimate tergite nearly rounded, densely punctate, with a subrounded smooth, impunctate region on each side; tergite VIII (Fig. 2E) rectangular-shaped (aspect ratio approximately 0.51), almost without punctures.

Male. Unknown.

Type materials. Holotype: ♀ (MHBU), labeled "2020.VII.16, 北京海淀西山 [China, Beijing, Haidian, Xishan], elev. 300 m, 吴超采&赠 [Chao Wu leg. & presented]" (white, rectangular, print), "HOLOTYPE, *Ripiphorus curvispinus* sp. n. det. Z. Pan" (red, rectangular, print and handwritten).

Paratype: 1♀ (IZCAS), labeled "1961.VI.29, 北京香山卧佛寺 [China, Beijing, Mt. Xiangshan, Wofo Temple], 葛素梅 [Su-Mei Ge leg.], 荆条 [*Vitex negundo* var. *heterophylla* (Franch.) Rehd.]" (white, rectangular, print), "IOZ(E)689148" (white, rectangular, print), "PARATYPE, *Ripiphorus curvispinus* sp. n. det. Z. Pan" (yellow, rectangular, print and handwritten).

Etymology. From the Latin root "*curvi*-" for "curved" and "*spinus*" for "spinous", in reference to the metatibial inner spur distinctly curved.

Distribution. China: Beijing.

Remarks. The type locality, Beijing, is located in North China, in which is no significant geographical barrier between it and neighboring Hebei. Therefore, it is plausible that this new species may also occur in Hebei, even Shanxi, especially in the Taihang and Yanshan Mountains.

From the North China, only two *Ripiphorus* species have been recorded so far. Unfortunately, only the male of *R. chalcidoides* and the female of *R. curvispinus* Pan, **sp. nov.** are known. On morphology, *R. chalcidoides* is characterized by the head wider than long, the antenna distinctly biflabellate with 11 antennomeres, the flagellomeres I–VIII approximately equal in length, the rami approximately 13.0× as long as their respective stem; the pronotum as long as wide; the abdominal tergite VIII fan-shaped; the metatibial inner spur straight. While in *R. curvispinus* Pan **sp. nov.**, the head is as long as wide; the antenna is uniflabellate with 10 antennomeres; the flagellomeres I–V are approximately equal in length, the rami are approximately 7.0× as long as their respective stem; the pronotum is wider than long; the abdominal tergite VIII is rectangular-shaped; the metatibial inner spur is distinctly curved.

Since there is significant sexual dimorphism and intraspecific variation in this genus, comparisons of morphological characteristics between the different sexes may not be sufficient to ensure that they are distinct species. Therefore, phylogenetic analysis and molecular species definition based on mtDNA *COI* sequences were carried out. Details see the below "molecular analyses".

Ripiphorus davidis (Fairmaire, 1878)

Chinese common name: 大卫大花蚤

(Figs 3, 4)

Myodites davidis Fairmaire in Deyrolle & Fairmaire 1878: 124.
Rhipiphorus davidis: Csiki 1913: 21; Wu 1937: 413; Gressitt 1941: 533; Hua 2002: 129.
Ripiphorus davidis: Batelka 2008: 77; Barclay 2020: 65.

Updated description. Male: Body length: 5.9–6.2 mm, width (maximum width of metathorax): 2.42–2.76 mm. Body dark yellow (Fig. 3A): head and thorax black, antennae yellowish brown, elytra ochraceous; fore legs yellowish brown, middle and hind legs brownish black; abdomen dark, base of first tergite yellow, tergite VIII reddish brown. Body covered with grayish short setae. Head (Fig. 3B) wider than long; clypeus almost straight, with big and dense punctures; frons slightly concave, with small and dense punctures, and bigger and sparser towards compound eyes; protuberance of vertex abruptly raised, blunt (Fig. 3B); palpomere II longest, IV approximately 2.4× as long as III. Compound eyes relatively large approximately 0.61× as long as head. Antennae (Fig. 3B) long, reaching base of pronotum posteriorly, with 11 antennomeres; flagellomeres subequal in length, rami approximately 13.7× as long as their respective stem, IX without ramus. Pronotum (Fig. 3C) slightly longer than wide, punctures dense, small,

and deep near midline, big on sides, midline prominently raised. Aspect ratio of scutellum approximately 0.18. Elytra approximately 0.9× as long as pronotum, scattered with regular punctures; base and inner edge of hind wings transparent. Metatarsomere I (Fig. 3D) flat and wide, approximately 5.2× as long as II. Abdominal ventrites with regular punctures; tergite VIII (Fig. 3E) semicircular, with small and dense punctures.

Female: Body length: 5.1 mm, width (maximum width of metathorax): 2.4 mm. Body brownish yellow (Fig. 4A): head and thorax brownish black, antennae yellow, elytra brown; abdominal tergites ochraceous, with unregular spots. Body covered with grayish short setae. Head (Fig. 4B) wider than long, with even punctures; protuberance of vertex abruptly raised, blunt (Fig. 4B). Compound eyes relatively large approximately 0.6× as long as head. Antennae (Fig. 4B) long, with 10 antennomeres; flagellomeres I–V subequal in length, VI–VIII gradually shortened, VIII without ramus and broadened. Thoracic sternums with deep and dense punctures. Pronotum (Fig. 4C) slightly longer than wide, punctures small and dense near midline, big and sparse on sides, midline prominently raised. Punctures of elytra dense basally and sparse apically. Metatarsomere I (Fig. 4D) thinner than male, approximately 5.2× as long as II. Abdominal tergite VIII (Fig. 4E) much longer than wide (aspect ratio approximately 1.73–2.63), with shallow punctures.

Type materials. There is no detailed record of the type specimens in the original description by Deyrolle & Fairmaire (1878). We propose the type locality is "la Chine centrale" because of the literature title. The type specimens could be deposited at the Muséum National d'Histoire Naturelle (France, Paris), but without examination.

Materials examined. 1♂ (MSYU), Tai-tsing-lam-ts'uen, back of Lai-mo-ling (Loi Mother Mountain), Ting-an Distr., Hainan Island, S. China, 1935.VI.17, F. K. To leg. (determined by J. L. Gressitt); 1♂ (CAU), Hubei, Yangri, 1984.VI.24, Xin-Li Wang leg.; 1♀ (CAU), Hubei, Yangri, 1984.VI.24, Xin-Li Wang leg.; 1♀ (NACRC), Yunnan, Jinping Mengla, elev. 600 m, 1956.V.23, Bonfilov leg.

Distribution. China: Hubei, Hainan, Yunnan.

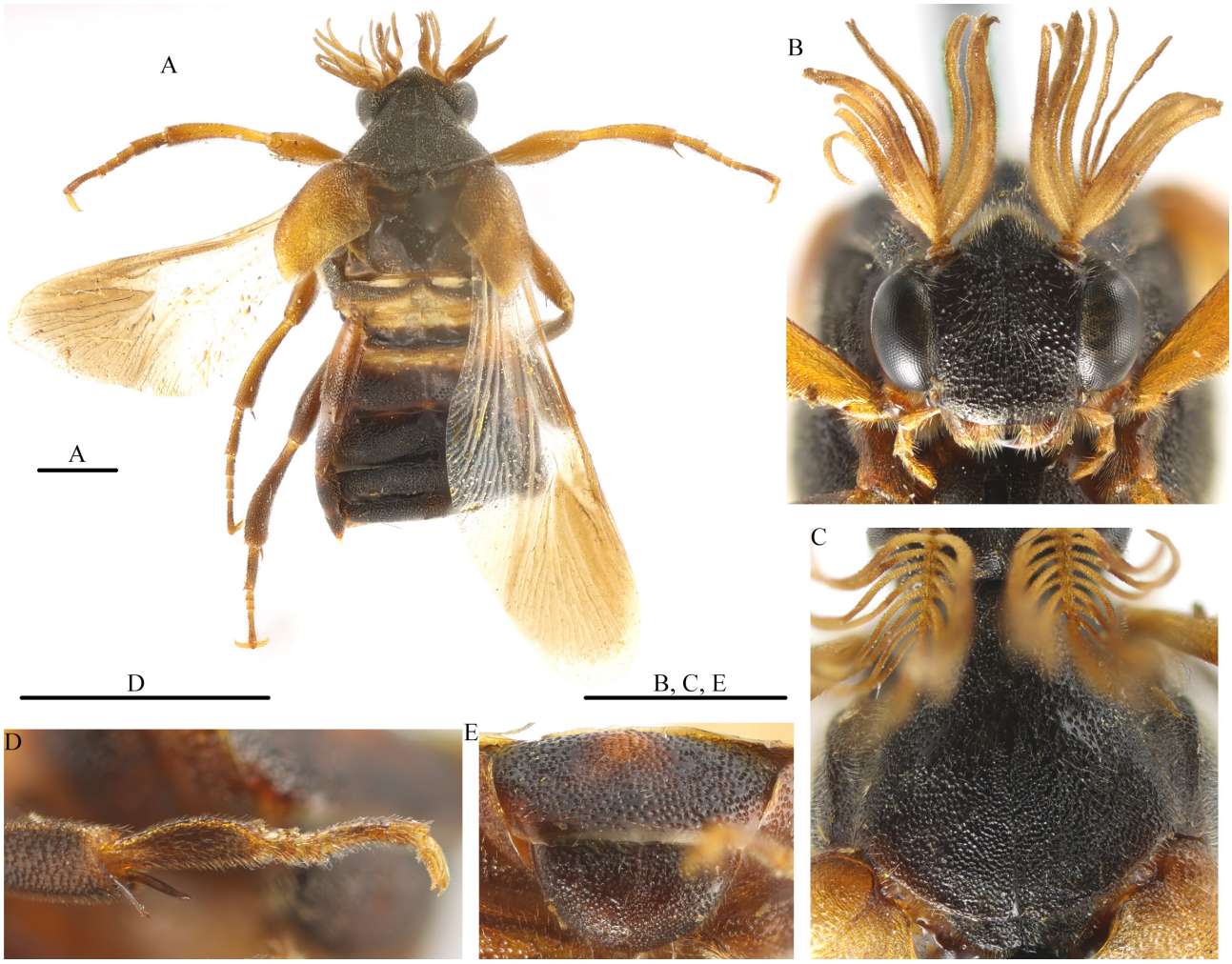

FIGURE 3. *Ripiphorus davidis* (Fairmaire, 1878), ♂, from Yangri, Hubei. **A.** Habitus, dorsal view. **B.** Head, frontal view. **C.** Pronotum, dorsal view. **D.** Metatarsus, lateral view. **E.** Tergites VII and VIII, dorsal view. Scale bar: 1 mm.

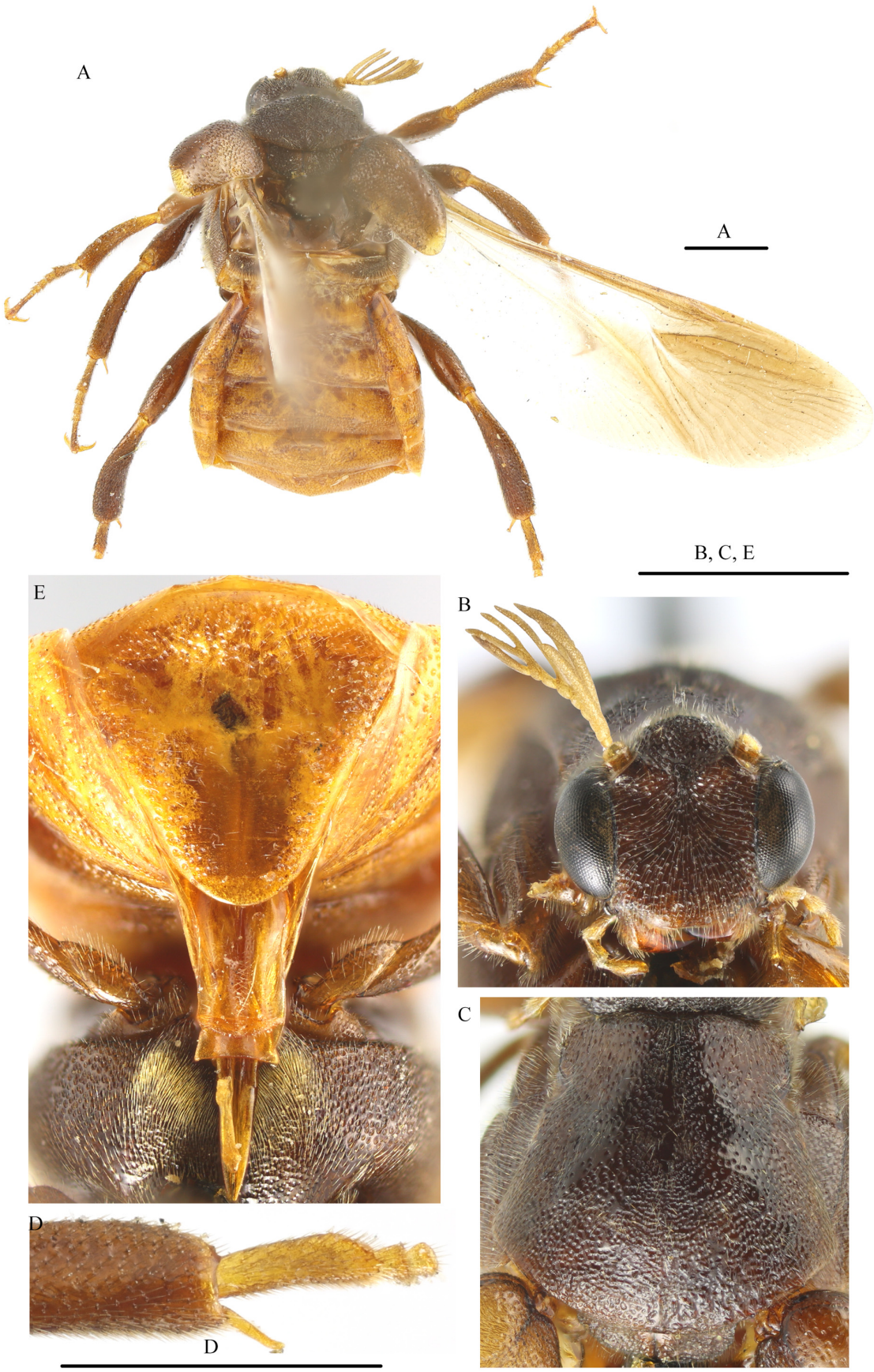

FIGURE 4. *Ripiphorus davidis* (Fairmaire, 1878), ♀, from Yangri, Hubei. **A.** Habitus, dorsal view. **B.** Head, frontal view. **C.** Pronotum, dorsal view. **D.** Metatarsomeres I–III, lateral view. **E.** Tergites VII and VIII, dorsal view. Scale bar: 1 mm.

Remarks. Only female of this species was described by Deyrolle & Fairmaire (1878). Although Gressitt (1941) provided a note of the male, not detailed enough. Therefore, an updated description of the male is presented here.

***Ripiphorus minor* (Gressitt, 1941)**
Chinese common name: 微大花蚤
(Figs 5, 6)

Rhipiphorus minor Gressitt 1941: 533; Hua 2002: 129.
Ripiphorus minor: Batelka 2008: 77; Barclay 2020: 65.

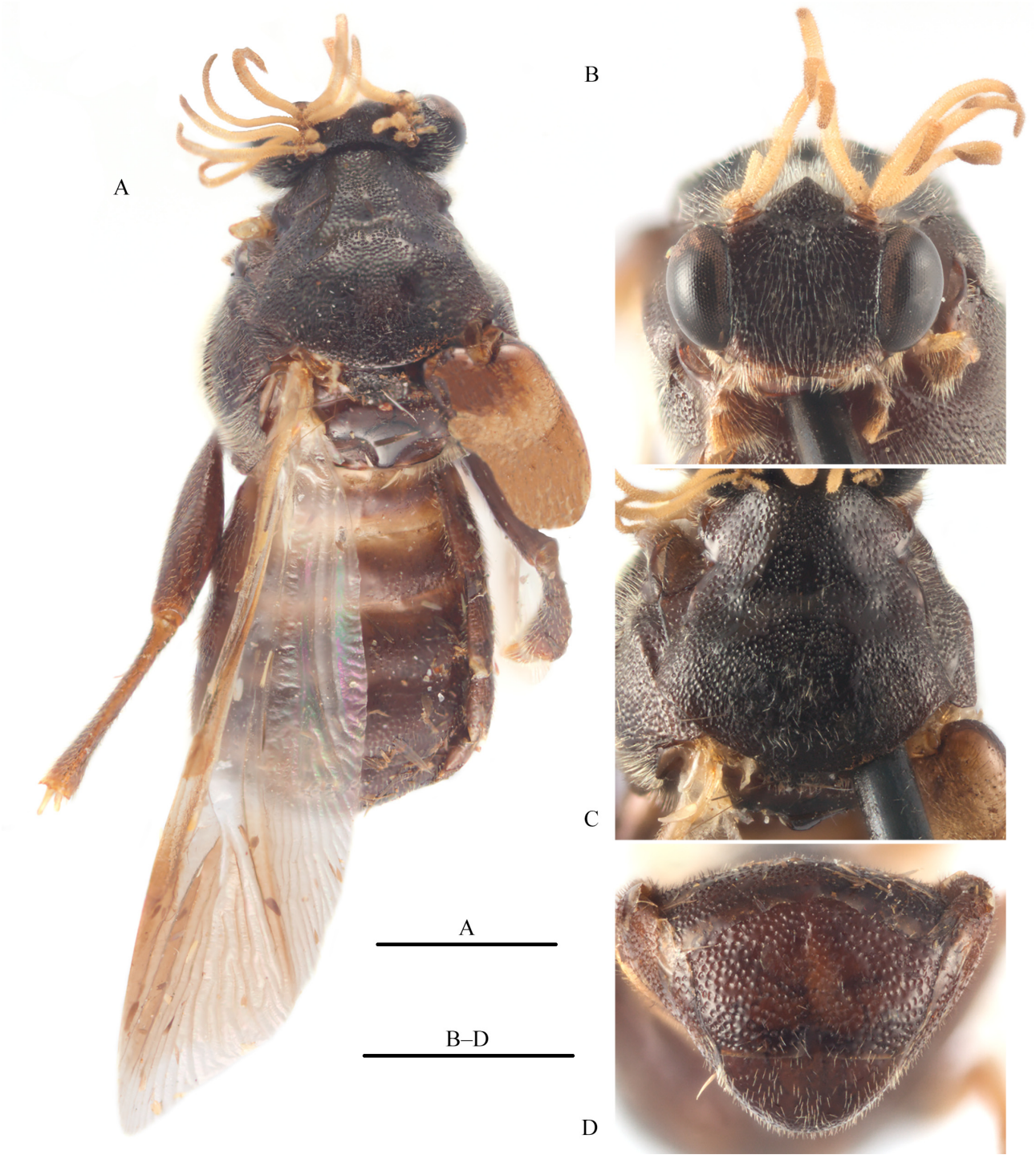

FIGURE 5. *Ripiphorus minor* (Gressitt, 1941), ♂, from southeast estuary, Yunnan. **A.** Habitus, dorsal view. **B.** Head, frontal view. **C.** Pronotum, dorsal view. **D.** Tergites VII and VIII, dorsal view. Scale bar: 1 mm.

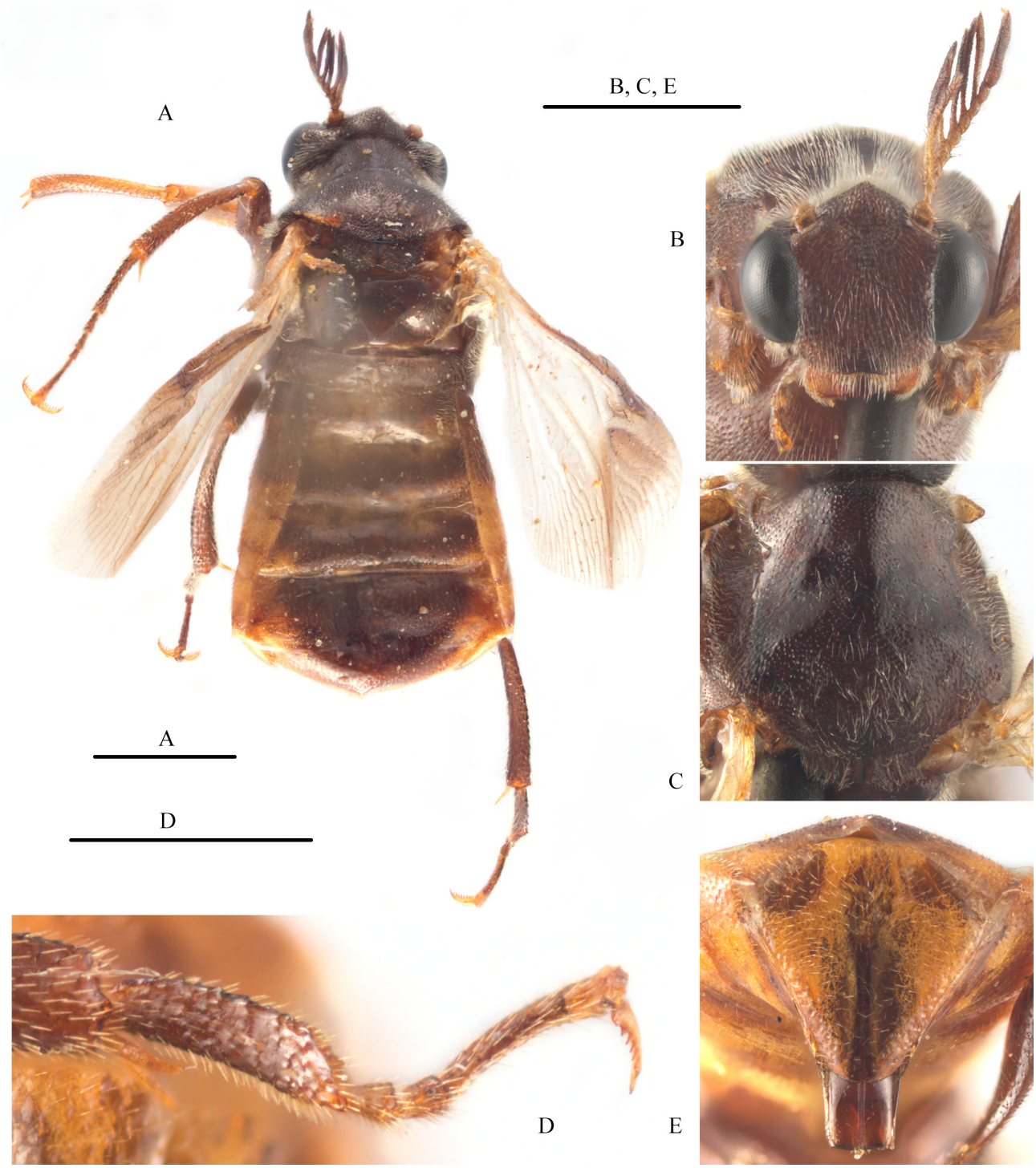

FIGURE 6. *Ripiphorus minor* (Gressitt, 1941), ♀, from Xiaomengyang, Yunnan. **A.** Habitus, dorsal view. **B.** Head, frontal view. **C.** Pronotum, dorsal view. **D.** Metatarsus, lateral view. **E.** Tergites VII and VIII, dorsal view. Scale bar: 1 mm.

Updated description. Male: Body length: 3.88 mm, width (maximum width of metathorax): 1.74 mm. Body brownish yellow (Fig. 5A): head and thorax brownish black, antennae yellow, elytra dark reddish brown; abdominal ventrites brownish yellow, tergites brown. Body covered with pale yellow, long setae. Head (Fig. 5B) much wider than long, clypeus truncate; protuberance of vertex slightly raised, apiculate (Fig. 5B). Compound eyes large, approximately 0.67× as long as head. Antennae (Fig. 5B) biflabellate, with 11 antennomeres; flagellomeres subequal in length, rami approximately 10.5× as long as their respective stem. Thoracic sternums with deep and dense punctures. Pronotum (Fig. 5C) slightly wider than long, with large, deep and regular punctures, hump-like protuberance. Elytra

scattered with small and sparse punctures. Abdominal tergite VII (Fig. 5D) trapezoid, sparsely punctate, punctures deep and even; tergite VIII (Fig. 5D) fairy semicircular.

Female: Body length: 4.0 mm, width (maximum width of metathorax): 1.43 mm. Body (Fig. 6A) brownish yellow: head and thorax brown, abdominal tergites bicolor (ochraceous and brown), ventrites ochraceous, antennae (Fig. 6B) ochraceous, but dark apically. Body covered with pale yellow, long setae. Head (Fig. 6B) much wider than long, center portion of clypeus slightly curved, protuberance of vertex slightly raised, apiculate; compound eyes approximately 0.61× as long as head. Antennae (Fig. 6B) with 10 antennomeres, flagellomeres I–VII uniflabellate with rami subequal in length, rami approximately 7.8× as long as their respective stem. Pronotum slightly wider than long, hump-like protuberance; scutellum densely punctured, slight concavity at apex, aspect ratio approximately 0.19. Metatarsomere I (Fig. 6D) approximately 4.3× as long as II. Abdominal tergite VII (Fig. 6E) nearly triangular, sparsely punctate, punctures deep on sides; tergites VIII (Fig. 6E) rectangular (aspect ratio approximately 1.17), smooth and non-punctate.

Type materials. Gressitt (1941) recorded the female holotype was collected from "Tai-pin-ts'uen, Lam-ka-heung, near Lai-mo-ling [Loi Mother Mountain], Kiung-shan District, Hainan Island [海南黎母山 (Mt. Limushan, Hainan)], S. China" and deposited at the Lingnan Natural History Museum that was the predecessor of MSYU. However, the authors did not find the type from the above Museum. The single paratype (sex unknown, not recorded in the original description) was collected from "Iu-ling-paai, Yao-Shan, Lin District, N. Kwangtung Province [广东连州 (Lianzhou, Guangdong)]" and deposited at the United States National Museum, not examined.

Materials examined. 1♂ (NACRC), Yunnan, southeast estuary, elev. 200 m, 1956.VI.8. B. Bobrov leg.; 1♀ (NACRC), Yunnan, Xiaomengyang, elev. 850 m, 1957.III.28, Ling-Chao Zang leg.

Distribution. China: Yunnan, Guangdong, Hainan.

Remarks. Before the present study, only female of this species has been known. We found a male from Yunnan that presents a new record for Yunnan Province. The male is described here for the first time. During the study of available materials, a female specimen from Hubei exhibits a notable variation in the vertex of the head, where the apex is rounded rather than acuminate, indicating potential individual variation within *R. minor*.

***Ripiphorus subdipterus* Fabricius, 1792**

Chinese common name: 短翅大花蚤

(Fig. 7)

Ripiphorus subdipterus Fabricius 1792: 109.
Ripiphorus subdipterus Bosc d'Antic 1792: 293; Batelka 2008: 77; Barclay 2020: 65 [homonym, nec Fabricius, 1792, see Bousquet & Bouchard 2018].
Mordella ambigua Giorna 1804: 216. Synonymized by Gerstaecker 1855: 16.
Myodes dorthesii Latreille 1818: 131. Synonymized by Gemminger & von Harold 1870: 2123.
Myodites subdipterus: Gerstaecker 1855: 16.
Rhipiphorus subdipterus: Gemminger & von Harold 1870: 2123; Csiki 1913: 22; Fernández-Carrillo *et al.* 2001: 114.
Rhipidophorus pallescens Solsky 1881: 57 [as variety of *R. subdipterus* by Csiki 1913: 22].
Myiodes antoniae Pic 1905: 165 [homonym, nec Reitter, 1895].
Rhipiphorus subdipterus var. *caucasicus* Reitter in Heyden *et al*. 1906: 453.
Myiodes subdipterus var. *clermonti* Chobaut 1906: 224 [replacement name for *Myiodes antoniae* Pic, 1905].
Myiodes babadjanidesi Reitter 1912: 43 [as variety of *R. subdipterus* by Csiki 1913: 22].

Updated description. Female. Body large (Fig. 7A), length: 8.7 mm; width (base of pronotum): 3.3 mm. Body light coloration: black in head and brown in mandibles, antennae yellowish brown but scape and pedicel brownish buff; pronotum dark reddish brown at base; elytra pale yellow; metafemora brown, while metatibia and metatarsus light yellow; abdomen orange but apex of last tergite black. Body covered with long white setae. Head (Fig. 7B) slightly wider than long, protuberance of vertex rounded (Fig. 7B); Compound eyes longer than half length of head, with considerable interocular distance. Antennae (Fig. 7B) shorter than head, not reaching middle of prothorax, with 11 antennomeres; flagellomeres subequal in length, rami of I–V approximately 9.3× as long as their respective stem, VI–VIII gradually shortened, IX without ramus. Pronotum (Fig. 7C) approximately as long as wide, with small and shallow punctures. Scutellum fan-shaped (aspect ratio approximately 0.44) with small and shallow punctures. Elytra extremely short, not reaching base of abdomen (Fig. 7A). Metatarsomere I (Fig. 7D) thin and long, approximately 6.0× as long as II. Abdominal tergite VIII (Fig. 7E) rectangular (aspect ratio approximately 1.29).

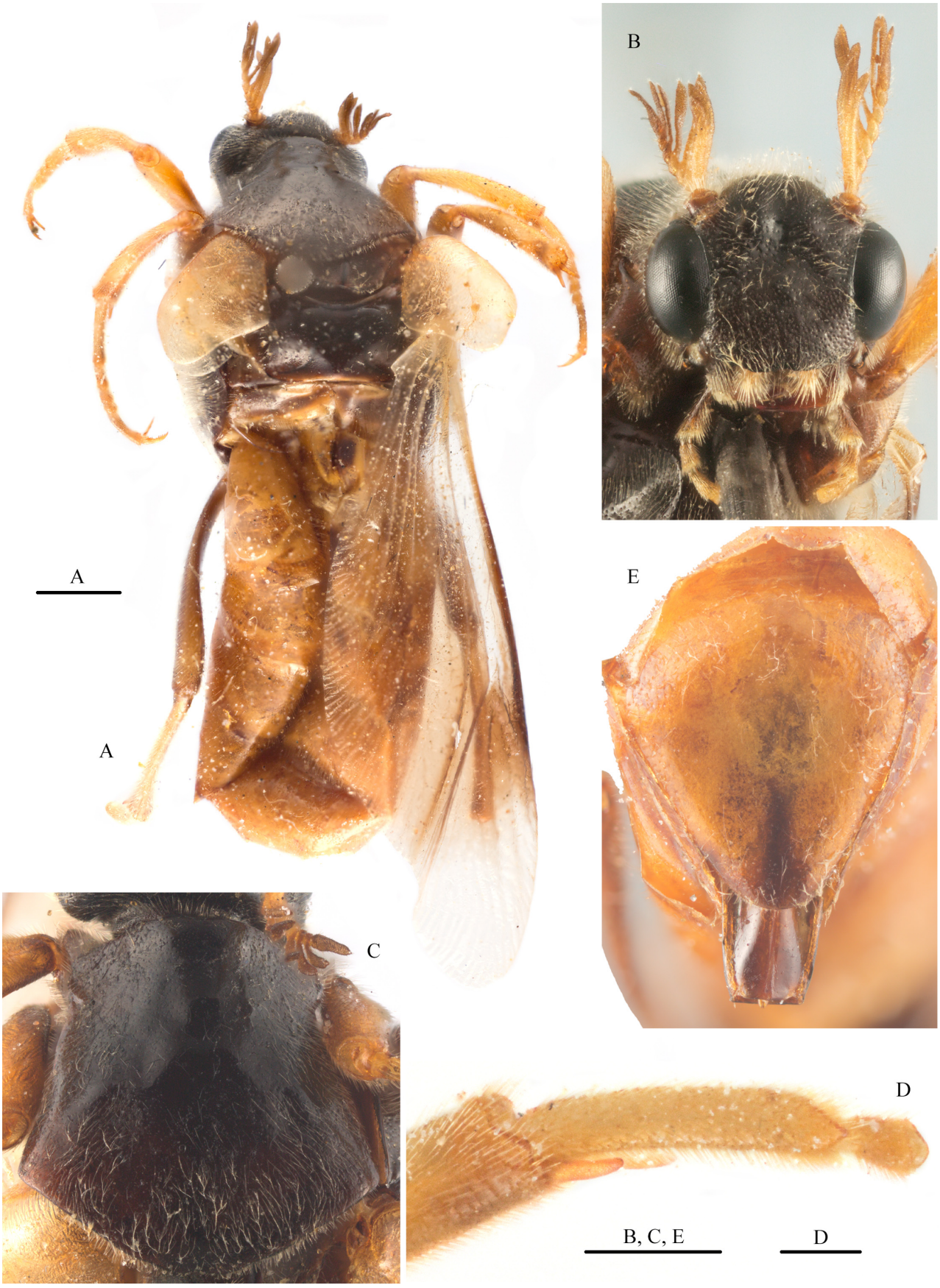

FIGURE 7. *Ripiphorus subdipterus* Fabricius, 1792, ♀, from Xinjiang. **A.** Habitus, dorsal view. **B.** Head, frontal view. **C.** Pronotum, dorsal view. **D.** Metatarsomeres I–II, lateral view. **E.** Tergites VII and VIII, dorsal view. Scale bar: 1 mm.

Male. No specimens examined, description see Bosc d'Antic (1792) and Batelka (2007).

Type materials. This species was first published by Fabricius (1792), but its syntypes have deposited at Bosc d'Antic's collections (Zimsen 1964) that not examined. The type locality is "environs de Montpellier".

Materials examined. 1♀ (NACRC), Xinjiang, Zhaosu, Wukuerqi, elev. 1120 m, 1957.VIII.7, Guang Wang leg.

Distribution. China: Xinjiang; Kazakhstan, Uzbekistan, Israel, Cyprus, Azerbaijan, Albania, Armenia, Belarus, Croatia, France, Greece, Italy, Portugal, Spain, Serbia and Montenegro, Algeria, Morocco, Tunisia. **New country record for China.**

Remarks. This species distributed in West Palaearctic region, and is discovered from China for the first time, marking the easternmost boundary of its distribution.

Ripiphorus tenthredinoides (Gressitt, 1941)

Chinese common name: 隆额大花蚤

(Fig. 8)

Rhipiphorus tenthredinoides Gressitt 1941: 534; Hua 2002: 129.
Ripiphorus tenthredinoides: Batelka 2008: 78; Barclay 2020: 66.

Updated description. Female: Body length: 7.9–8.7 mm, width (base of pronotum): 4.0–4.5 mm. Body robust (Fig. 8A), bright black to orange-yellow: head and thorax black; anterior margin of clypeus sometimes orange-yellow; pronotum sometimes with reddish or orange irregular spots; mesothorax and metathoracic pleuron reddish; abdominal tergites orange-yellow, occasionally with dark and circular spots; fore legs orange-yellow to yellow-brown, while middle and hind legs blackish brown. Body covered with long golden-yellow setae. Head (Fig. 8B) distinctly wider than long, vertex abruptly raised to a blunt protuberance (Fig. 8B). Antennae (Fig. 8B) approximately 0.6× as long as pronotum, with 10 antennomeres; rami of flagellomeres I–V approximately 7.9× as long as their respective stem, VI–VIII gradually shortened, IX shortest without rami. Pronotum (Fig. 8C) longer than wide, strongly convex apically; punctures large and deep at center, sparser on sides, with irregular impunctate areas on each side and along median line before middle. Scutellum wide (aspect ratio approximately 0.18). Elytra wide, with dense and small punctures. Metatarsomere I (Fig. 8D) approximately 7.3× as long as II. Abdominal tergite VIII (Fig. 8E) rectangular (aspect ratio approximately 0.5–0.63).

Male. Unknown.

Type materials. The type locality is "Yuet-loi-hui (16 kilom. N. W. of Ping-chuen), Mei District, N. E. Kwangtung Province, S. China". The female holotype was deposited at MSYU, according to the original description (Gressitt, 1941). However, the authors did not find the type either. Two paratypes were examined from MSYU that were collected from "Iu-ling-paai, Yao Shan, Lin Distr., N. Kwangtung [广东连州 (Lianzhou, Guangdong)]" and "Tai-tsing-lam-ts'uen, back of Lai-mo-ling (Loi Mother Mt.), Ting-an Distr., Hainan Island [海南黎母山 (Mt. Limushan, Hainan)], South China", respectively. Another paratype from the type locality is deposited at the United States National Museum, not examined.

Materials examined. 1♀ (MSYU), Guangxi, Longjin, Shuikou, elev. 650 m, 1958.IX.11, Yi-Guang Gao leg.; 1♀ (NACRC), Hubei, Wuxue, Meichuan, Gangshan Forest Park, 30.18136°N, 115.66133°E, elev. 414.51 m, 2022. VIII.02, Huan-Xi Cao leg., IOZ(E)924819, sweep netting; 1♀ (NACRC), Fujian, Fuzhou, 1961.V.06, Yan-Ru Wu leg.

Distribution. China: Hubei, Fujian, Guangxi, Guangdong, Hainan.

Remarks. This species is newly recorded in Hubei, Fujian, and Guangxi provinces of China.

Molecular species delimitation

Seventeen mitochondrial *COI* sequences were obtained, including those downloaded from GenBank, which were pruned to lengths of 723 bp, except for *R. flaviventris* (643 bp), after sequence alignment.

The maximum and mean intraspecific genetic distances for each species are listed in Table 2. The interspecific mean distances (exclude *R. curvispinus* **sp. nov.**) ranged from 12.29% to 20.62% (Table 3). The results indicate

that the distances between *R. curvispinus* **sp. nov.** and *R. chalcidoides* is 12.96% that is evidently higher than the maximum intraspecific distance and the minimum interspecific distances among other *Ripiphorus* species.

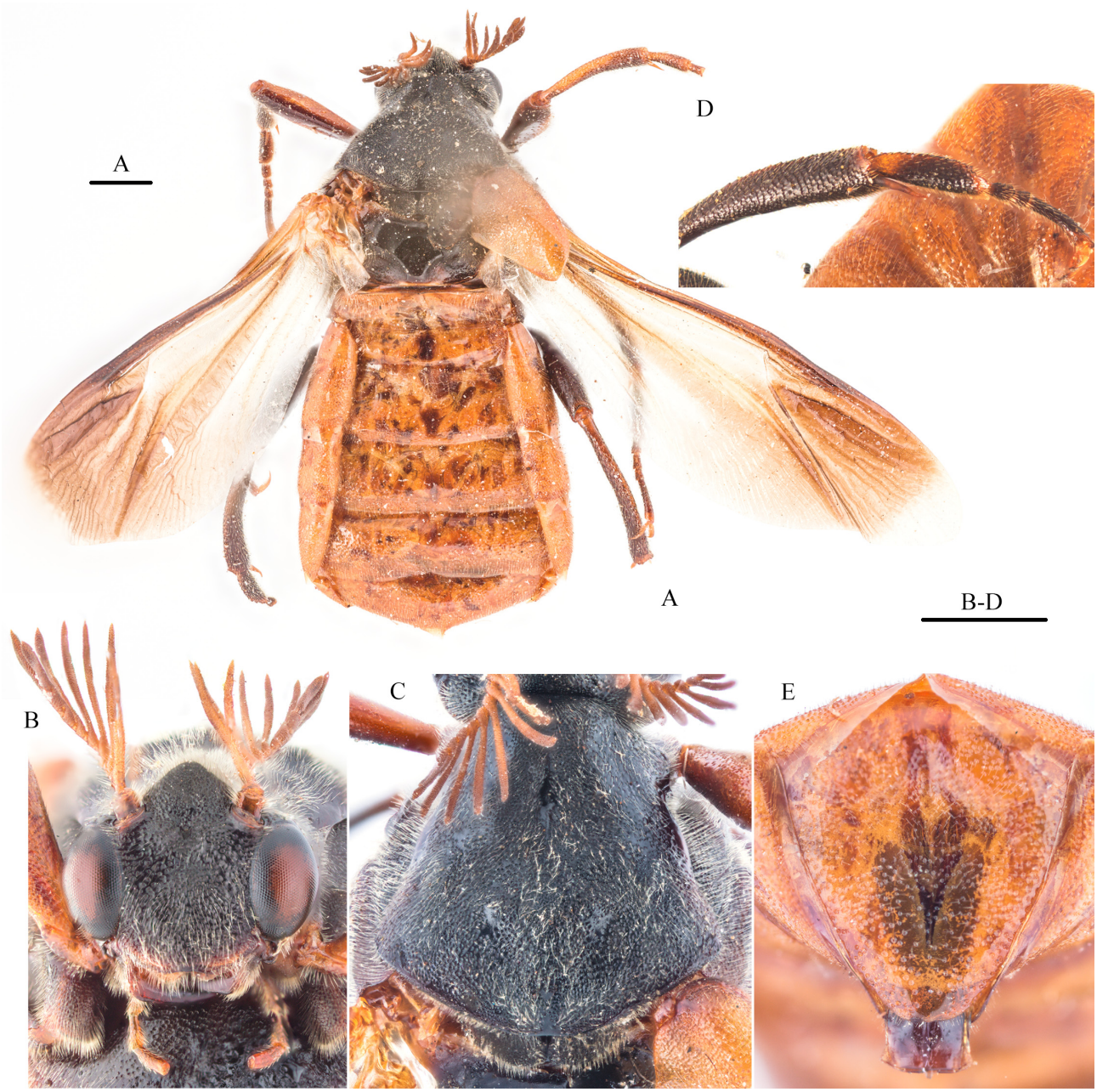

FIGURE 8. *Ripiphorus tenthredinoides* (Gressitt, 1941), ♀. **A.** Habitus, dorsal view. **B.** Head, frontal view. **C.** Pronotum, dorsal view. **D.** Metatarsus, lateral view. **E.** Tergites VII and VIII, dorsal view. **A–C, E.** From Hainan. **D.** From Guangdong. Scale bar: 1 mm.

TABLE 2. Maximum and mean intraspecific pariwise divergence of six *Ripiphorus* species.

Species	Number of Samples	Intraspecific Distance (%)	
		Maximum	Mean
R. chalcidoides	3	0.14	0.092
R. curvispinus	1	n/a	n/a
R. flaviventris	1	n/a	n/a
R. diadasiae	1	n/a	n/a
R. subdipterus	6	0.84	0.48
R. arabiafelix	4	0.70	0.37

TABLE 3. Interspecific genetic distance (%) among six *Ripiphorus* species.

	R. arabiafelix	*R. chalcidoides*	*R. curvispinus*	*R. diadasiae*	*R. flaviventris*
R. arabiafelix					
R. chalcidoides	13.83				
R. curvispinus	14.95	12.96			
R. diadasiae	16.44	17.75	17.85		
R. flaviventris	18.69	20.62	19.83	18.11	
R. subdipterus	12.29	14.64	17.04	15.63	17.08

BI tree exhibited identical topology with strong nodal supports (Fig. 9). *R. curvispinus* **sp. nov.** was the sister group to the clade of monophyletic *R. chalcidoides* (bpp = 0.99). Regarding species delimitation, six molecular species-level operational taxonomic units were inferred and consistent across the ASAP, bPTP, and GMYC methods used (Fig. 9). The present molecular species delimitation results are the same as the morphological determination, i.e., *R. curvispinus* **sp. nov.** and *R. chalcidoides* are two definite species.

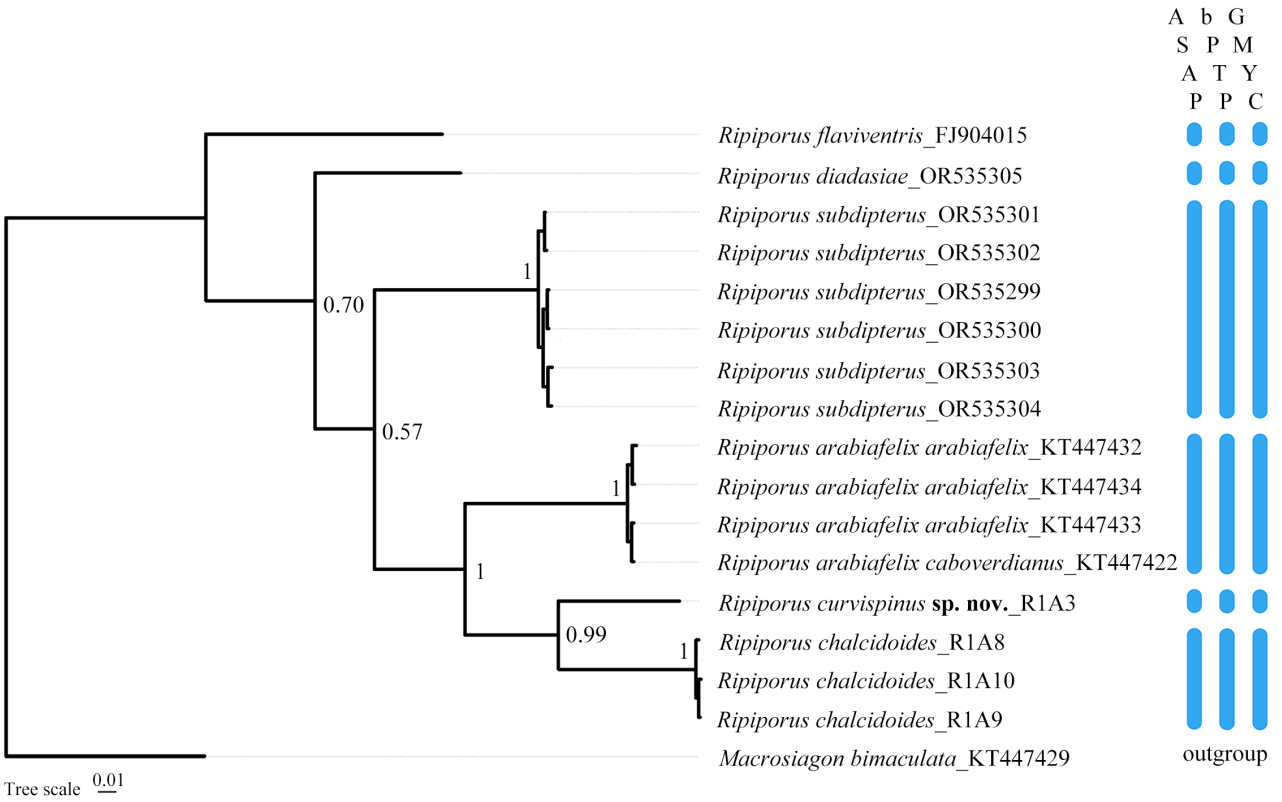

FIGURE 9. Bayesian (BI) tree based on mtDNA *COI* sequences. Support for each node is represented by Bayesian posterior probability (bpp). The color strips represent the species delimitation results of ASAP, bPTP, and GMYC, respectively.

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中国大花蚤属*Ripiphorus*分类评述及一新种（鞘翅目：大花蚤科：大花蚤亚科）

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摘要：回顾了中国大花蚤属*Ripiphorus* Bosc d'Antic, 1791分类。发现产自北京一新种，即钩刺大花蚤*Ripiphorus curvispinus* **sp. nov.**，后足胫节端距明显弯曲是其主要鉴别特征。基于线粒体*COI*片段序列的系统发育分析和分子物种界定证明该新种有别于平额大花蚤*R. chalcidoides* (Gressitt, 1941)。另报道了一中国新纪录种，即短翅大花蚤*Ripiphorus subdipterus* Fabricius, 1792。此外，给出了中国已知种的描述和特征图，并编制分种检索表。

关键词：大花蚤；分类；新种；新记录；*COI*；中国