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A new species of the myrmecophilous genus *Cryptocephalomorpha* Ritsema, 1875, from the Indochinese Peninsula (Coleoptera, Carabidae, Pseudomorphini)

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Abstract

Based on specimens collected in southern Cambodia and western Thailand, *Cryptocephalomorpha thom* **sp. nov.**, a new species of the genus *Cryptocephalomorpha* Ritsema, 1875 (Coleoptera, Carabidae, Pseudomorphini), is described. This study provides the first confirmed Cambodian record of the tribe and documents the occurrence of the new species in Cambodia and Thailand. A key to the Oriental genera of Pseudomorphini and an updated key to the Oriental species of the genus are provided, together with a description and illustrations of the new species.

Key Words

Cambodia, Carabidae, *Cryptocephalomorpha*, new species, Pseudomorphini, Thailand

Introduction

The concept of a biodiversity hotspot aims to promote the effective preservation of biodiversity by identifying areas that harbor exceptional concentrations of endemic species and are experiencing significant habitat loss (Myers et al. 2000; Choi et al. 2022). Cambodia, situated within the Indo-Burma biodiversity hotspot region, remains poorly studied in terms of its faunal diversity compared with neighboring countries such as Thailand, Vietnam, and Laos. Additional taxonomic and faunistic surveys in this region are therefore essential to establish a more complete understanding of the Oriental fauna.

Members of the tribe Pseudomorphini are highly distinctive ground beetles, easily recognized by their strongly convex, nearly oval bodies and by their concealed mouthparts and legs, which make them superficially resemble aquatic or bark-dwelling beetles such as members of the families Dytiscidae or Colydiidae (Baehr 2009, 2013). Their morphology represents a major deviation from the typical carabid body plan, showing features that have been interpreted as adaptations to life within ant colonies. Baehr (1997, 2009, 2013) emphasized that the unusual external structure and often soft integument, together with the reduced flight ability and larviparous or ovoviviparous reproduction observed in several genera, likely reflect a myrmecophilous lifestyle, in which both larvae and adults live in close association with ants. This reproductive strategy, which is extremely rare among carabid beetles, is considered an adaptation to a protected, nest-dwelling life inside ant colonies (Baehr 2013).

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Within this distinctive tribe, the genus *Cryptocephalomorpha* Ritsema, 1875, is especially remarkable for its very convex, smooth body, with the appendages almost entirely hidden beneath the body, a condition interpreted as protective in confined or ant-nest environments (Baehr 2009). Most species of the genus are distributed in South and Southeast Asia, New Guinea, and northeastern Australia, with a single relict species occurring in South Africa. Within Southeast Asia and the Indochinese Peninsula, the genus has previously been recorded from Thailand (three species: *C. collaris*, *C. gaverei*, and *C. siamensis*), Laos (four species: *C. gaverei*, *C. laosensis*, *C. maior*, and *C. maxima*), Vietnam (one species: *C. maior*), and Malaysia (two species: *C. gaverei* and *C. ovalis*), whereas no species has previously been recorded from Cambodia or Myanmar. Early notes mentioned that several specimens of *C. papua* were collected "in association with ants," suggesting a myrmecophilous habit (Baehr 2013). Later, *C. gaverei* was recorded under bark within an ant nest, providing the first confirmed field evidence of this behavior (Baehr 2013). The most definitive confirmation came from Maruyama et al. (2016), who described *C. siamensis* from Thailand based on specimens collected directly from a nest of *Pheidole singaporensis*, establishing the first exact host record for the genus. This finding provided clear biological proof that *Cryptocephalomorpha* species are indeed ant-associated, supporting the long-standing assumption of their myrmecophilous adaptation.

Despite these advances, the Pseudomorphini fauna of the Indochinese Peninsula remains poorly known, and no member of the tribe has previously been recorded from Cambodia. The discovery reported here therefore significantly extends the known distribution of the tribe within the peninsula.

Materials and methods

The holotype was collected in Cambodia under permits issued pursuant to the bilateral agreement on academic research between the Republic of Korea and the Kingdom of Cambodia and in compliance with national wildlife research and export regulations. The paratype was collected in 2012 under the permission and supervision of the Thai National Park Authority. The survey was conducted lawfully under the responsibility of Dr. Watana Sakchoowong, a co-author of Nomura et al. (2013), and the specimen was therefore not illegally exported. All specimens will be deposited separately in their respective institutional collections.

An Olympus SZ61 stereomicroscope (Olympus, Japan) was used to examine the external morphological characteristics of each specimen. All photographs were taken using a Fine Adjustment Stand Industry microscope (Lapsun, China) equipped with a BigEye 10000KPA C-mount camera (Korticam, China), WeMacro microphotographic hardware, and a Sony A7R IV camera (Sony, Japan). A Canon Macro Lens EF 100 mm f/2.8 USM or a Canon Macro Photo Lens MP-E 65 mm f/2.8 1–5× (Canon, Japan) was mounted on the camera to capture high-quality images of each specimen. High-quality photographs were focus-stacked using Zerene Stacker 1.04 (Zerene Systems, USA) and edited using Adobe Photoshop CC 2018 (Adobe, USA).

After habitus photography, all type specimens were rehydrated and subsequently dissected for genital examination. Consequently, slight differences in posture or external appearance may exist between the figured specimens and their present condition.

Length measurements were taken separately for the holotype and paratype, using two definitions of body length and the maximum lengths and widths of each body part. Body length including abdomen (BLA) was measured from the anterior margin of the head to the apex of the exposed abdominal segment, and body length excluding abdomen (BLE) was measured from the anterior margin of the head to the elytral apex. Head length (HL) was measured as the maximum longitudinal length of the exposed head in dorsal view and head width (HW) as the maximum width of the exposed head. Pronotal length (PL) was measured as the maximum longitudinal length of the pronotum, and pronotal width (PW) as its maximum width. Elytral length (EL) was measured as the maximum longitudinal length of the elytra, and elytral width (EW) as the maximum combined width of the elytra.

Results

Tribe Pseudomorphini Hope, 1838: 108. Type genus: *Pseudomorpha* Kirby, 1823.

Key to genera of the tribe Pseudomorphini from Oriental region

Remarks. Key reconstructed from Baehr (1997: 40, 51–58, 374–377).

1 Compound eye not extended ventrally and with distinct lateral border forming cephalic disc. Prosternal process short or moderate. Male abdominal sternite VI asymmetric..... *Adelotopus*

– Compound eye extended ventrally and without lateral border as above. Prosternal process narrowly elongate. Male abdominal sternite VI symmetric..... *Cryptocephalomorpha*

Genus *Cryptocephalomorpha* Ritsema, 1875: XCII.

Type species. *Cryptocephalomorpha gaverei* Ritsema, 1875.

***Cryptocephalomorpha thom* Choi, Nomura & Park, sp. nov.**

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Type material. ***Holotype.*** Cambodia • ♂; Kep National Park, Prey Thom Commune, Krong Keb District, Kep Province; 10°30'31.45"N, 104°18'18.86"E; 71 m; "UV fluorescent lamp"; 6 May 2018; J.K. Park leg.; Kyungpook National University, Sangju-si, Republic of Korea. ***Paratype.*** Thailand • ♀; Kaeng Krachan National Park, 17 km point; 313 m; "NLT (5 m × 3)"; 21 Mar 2012; S. Nomura leg.; National Museum of Nature and Science, Tsukuba, Japan (Fig. 1).

Differential diagnosis. Large species for the genus, body length more than 6 mm from head to visible abdominal segment. Mandible normal, without lateral excision and spine. Ground color almost uniformly dark brown, with small, narrow reddish patch on each of elytral subapex. Pronotal lateral margin distinctly explanate laterally; lateral margin visible from above. Elytral longer; length/width ratio of 1.22–1.25, lateral margin incurved below; lateral margin not distinctly visible from above, narrowed toward the apex, without a lateral seta of apical series and with a small elytral light patch on each side. Male abdominal sternite VI with dense pubescent pad at middle. Female abdominal sternite VI with four setae.

This is a large species within the genus *Cryptocephalomorpha*, readily recognized by its distinctive form of the elytral lateral margin and coloration. Among known congeners, it is most similar to *C. maxima*. However, this new species is distinguished from *C. maxima* by the incurved elytral lateral margin, small elytral patches, absence of the elytral lateroapical seta, and female gonocoxite II setation. The species is also remarkable in combining the large body size of *C. maxima* and *C. gigantea* with the reduced elytral chaetotaxy characteristic of smaller Oriental congeners.

Neither the holotype nor the paratype matches any known Oriental species of the genus in external morphology. Although collected from geographically separated localities and representing opposite sexes, the two specimens agree closely in all major external diagnostic characters, including body shape, coloration, elytral lateral structure, chaetotaxy, and the absence of the elytral lateroapical seta. Furthermore, in previously described Oriental species of the genus represented by both sexes, the external diagnostic characters used in species identification have not been observed to vary sexually. The observed differences between the present specimens are therefore interpreted as attributable to sexual dimorphism, and the two specimens are regarded as conspecific, representing a distinct new species. In contrast, the Australasian and Afrotropical species of the genus possess unicolored elytra, and the Australasian species are also readily distinguished by the presence of a sharp lateral mandibular excision and spine.

Description. General habitus as Fig. 2; body elongate-oval, with overall outline subparallel-sided; dorsal surface strongly convex; ventral surface flat. Cephalic, pronotal, and elytral discs forming an almost continuous dorsal and lateral outline, without distinct depressions or interruptions between them; mouthparts, appendages, and legs concealed beneath the body and largely not visible in dorsal view.

Color. Ground color dark reddish brown to dark brown; palpi, antenna, prosterna, procoxa, mesocoxa and abdominal sterna lighter; elytron with a small, narrow reddish patch at subapex.

Measurement. Holotype. BLA 6.3 mm, BLE 5.9 mm; HL 0.7 mm, HW 2.0 mm; PL 1.9 mm, PW 2.7 mm; EL 3.4 mm, EW 2.9 mm. Paratype. BLA 6.7 mm, BLE 6.6 mm; HL 0.7 mm, HW 2.0 mm; PL 2.0 mm, PW 2.9 mm; EL 4.0 mm, EW 3.2 mm.

Microsculpture. Dorsal surface of head, pronotum and elytron with very fine but distinct isodiametric reticulate microsculpture and shallowly punctate with fine and irregularly scattered punctures.

Head. Smooth, small, transverse and orthognathous; anterior margin rather convex, mouthparts reduced, narrow, and concealed by the anterior margin in dorsal view. Clypeus not recognizable; labrum reduced. Mandibles very small, without lateral excision or process. Maxillary palpi very short, cylindrical, with terminal palpomere longer than the combined length of the preceding palpomeres. Labial ligula short, apically rounded, bearing several short setae. Labial palpi rather short; terminal palpomere enlarged and strongly dilated, remaining palpomeres reduced. Mentum with median tooth nearly acute and with a rather long lateral lobe on each side; lateral lobes subquadrate apically. Compound eyes slightly depressed from the anterior margin of the head, subtriangularly expanded ventrally. Tempora enclosing the posterolateral margins of the compound eyes, weakly protruding laterally and bearing several short setae. Antennae short, nearly filiform; flagellar antennomeres slightly flattened and pubescent from antennomere IV onward. Head with a deep antennal groove between compound eyes and mouthparts. Submentum fused with mentum, with suture only faintly impressed. Gular suture present.

Prothorax. Pronotum smooth and convex; lateral portions entirely incurved ventrally, but lateral margins visible from above; lateral margins abruptly curved posteriorly, nearly subparallel-sided behind the point of curvature; without lateral seta. Proepisternum bearing very short, stout pubescence. Prosternal process elongate, faintly margined, acute at apex. Ventral surface convex as a result of the incurved dorsolateral portions.

Figure 1. General view of the area near the holotype collecting site of *Cryptocephalomorpha thom* sp. nov. in Kep National Park, Kep Province, southern Cambodia; photograph taken approximately 300 m northwest of the collecting site.

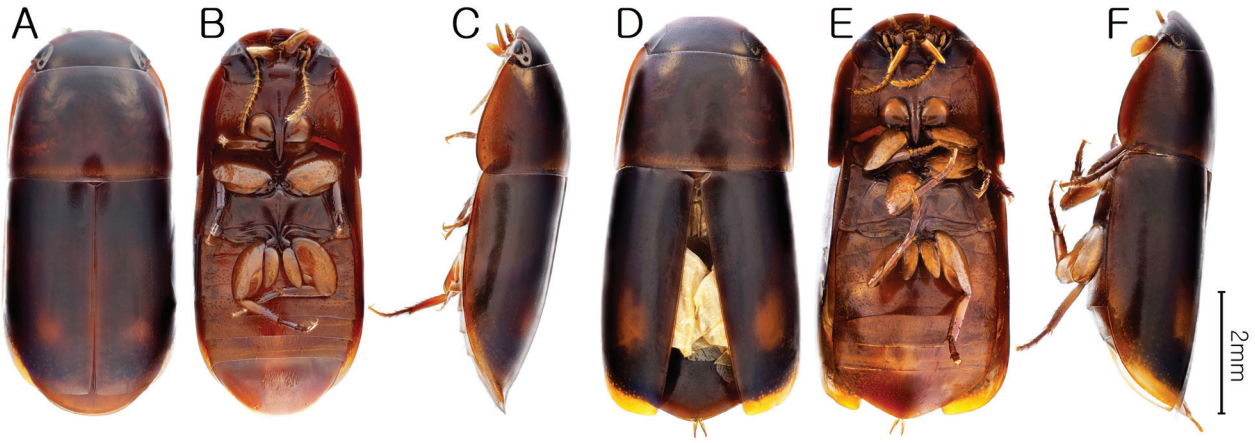

Figure 2. Habitus of the holotype and paratype of *Cryptocephalomorpha thom* sp. nov. **A–C.** Holotype, male; **D–F.** Paratype, female; **A, D.** Dorsal aspect; **B, E.** Ventral aspect; **C, F.** Left lateral aspect.

***Pterothorax*.** Scutellum small, nearly concealed by the basal margin of the pronotum. Elytra smooth, very convex, nearly subparallel-sided; lateral margins barely visible from above at the humeral region and widest posteriorly. Striae barely impressed, indicated by irregular impressions or shallow strial punctures. Elytron with no discal setigerous puncture, two to three marginal setigerous punctures; only humeral marginal series of setigerous punctures present; subapical marginal series of setigerous puncture absent; central part of the humeral margin bearing a few very short, stout pubescence. Metasternum and metepisternum bearing some very short, stout pubescence (Fig. 3).

***Abdomen*.** Abdominal sterna I–III fused, with sutures only faintly impressed; abdominal sterna I–IV bearing short, stout pubescence, more concentrated along the lateral portions; abdominal sterna III and IV each with two setae.

***Legs*.** Short and rather flattened; coxae and trochanters bearing a few very short, stout setae or pubescence. Femora and the metatrochanter enlarged and flattened, each femur with a deep tibial cavity-like groove. Tibiae and tarsi short, stout, and slightly flattened. Tibial spurs short and very stout.

***Sexual dimorphism*.** Male pro- and mesotarsomeres II–III each with two rows of very transverse adhesive setae; tarsomere IV of all legs bearing spatulate adhesive setae. Female pro- and mesotarsomeres II–IV and metatarsomeres III–IV bearing spatulate adhesive setae. Male abdominal sternite V with a horizontal row of rather long pubescence medially except for usual fixed setae and short pubescence, and sternite VI with two setae and a dense pubescent pad medially as in Fig. 4A; female abdominal sternite V bearing only short, stout pubescence and sternite VI with four setae as in Fig. 4B.

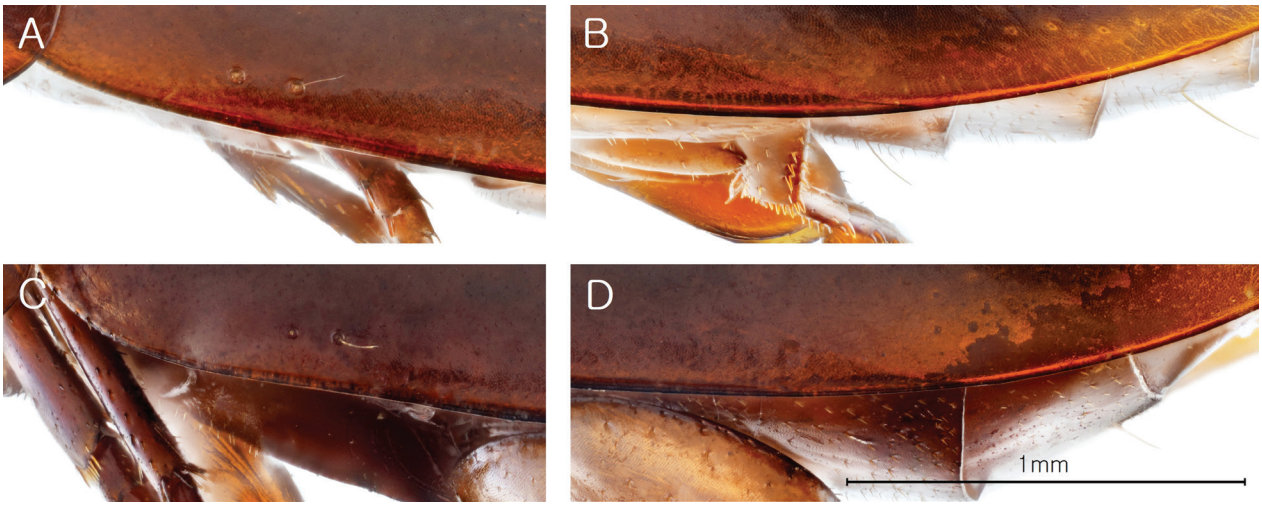

Figure 3. Elytral marginal setigerous punctures of *Cryptocephalomorpha thom* sp. nov. **A–B.** Holotype, male; **C–D.** Paratype, female; **A, C.** Humeral series of elytral marginal setigerous punctures; **B, D.** Elytral subapex, without a subapical setigerous puncture.

Figure 4. Abdominal sternites of *Cryptocephalomorpha thom* sp. nov. **A.** Holotype, male; **B.** Paratype, female.

Male genitalia. As in Fig. 5; ring sclerite entirely narrow to the base, without distinct basal plate, almost symmetrical; aedeagus relatively short, transversely flattened just behind base, gently curved ventrally, not tapered in dorsal view and apex widely rounded; endophallic structure as Fig. 5A–C; parameres asymmetrical; left one markedly larger than right one, widely rounded at apex and without apical seta.

Female genitalia. As in Fig. 6; female abdominal sternite VIII with four long setae on each lateral side and two groups of densely arranged fine setae near apex, as in Fig. 6B; gonocoxites I–II elongate, gonocoxite II with two long setae at apex, as in Fig. 6E.

Distribution. Cambodia, Thailand

Etymology. The new species is named after the Khmer word *thom*, meaning “large” or “big” (Khmer: ធំ).

Figure 5. Male genitalia of *Cryptocephalomorpha thom* sp. nov. **A–E.** Aedeagus; **F.** Right paramere; **G.** Left paramere; **H–I.** Genital ring sclerite; **A.** Aedeagal apex, dorsal aspect; **B, H.** Dorsal aspect; **C, I.** Ventral aspect; **D, F.** Right lateral aspect; **E, G.** Left lateral aspect.

The epithet is treated as a noun in apposition and refers to the comparatively large size of the species within the genus.

Collecting circumstances. The holotype was collected at night using a 15 W UV fluorescent lamp trap placed on the ground along a narrow forest path regularly used by walkers and motorbikes in Kep National Park, southern Cambodia. The paratype was collected at night at the 17 km point in Kaeng Krachan National Park, western Thailand, using a portable Nakase-system light trap (NLT) equipped with a 4 W UV fluorescent lamp, which was fixed or hooked on a tree at approximately 5 m above the ground, lit in the evening, and recovered the following morning. Host ant association could not be confirmed for either the holotype or the paratype.

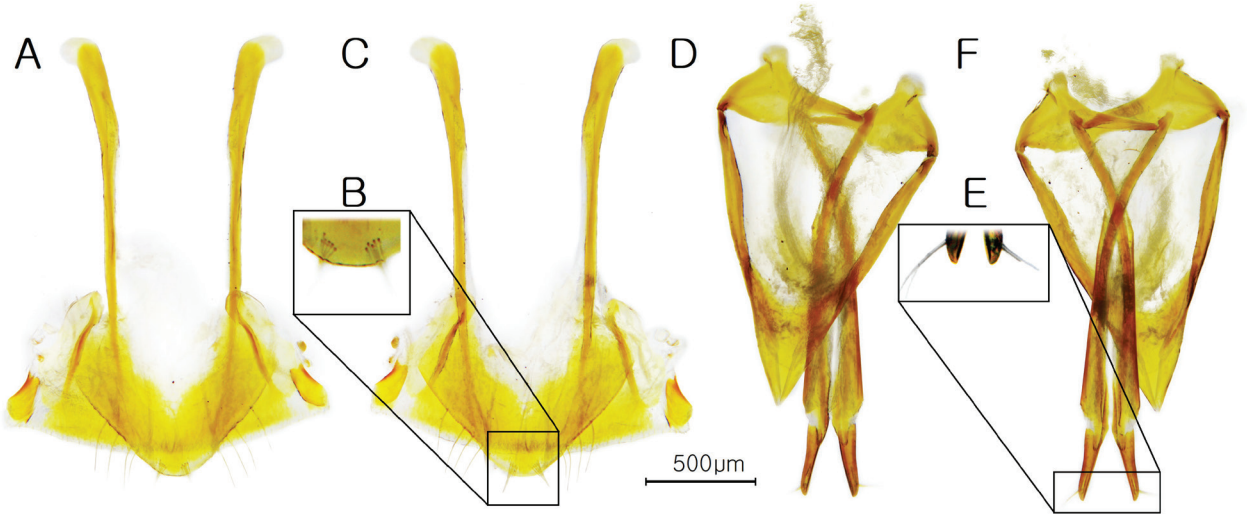

Figure 6. Female genitalia of *Cryptocephalomorpha thom* sp. nov. **A–C.** Abdominal sternite VIII and tergum VII; **D–F.** Gonocoxites I–II and tergite VIII; **A, D.** Dorsal aspect; **C, F.** Ventral aspect; **B.** Enlarged view of abdominal sternite VIII apex; **E.** Enlarged view of gonocoxite II apex.

Key to the oriental species of the genus *Cryptocephalomorpha*

Remarks. Key reconstructed and updated from Baehr (1997: 377–391, 2002: 124–128, 2009: 196–198, 2013: 62–72) and Maruyama et al. (2016: 448–450).

1 Mandible normal and without lateral spine. Elytron with a distinct light patch 2
– Mandible excised and with a sharp lateral spine. Elytron without distinct light patch ..... [Australasian species]
2 Size very large, body length 6 mm or more. Elytral light patch almost circular and pronotum blackish brown 3
– Size smaller, body length less than 5.5 mm. Either elytral light patch clearly trapezoidal or oblique oblong, or pronotum contrastingly red 5
3 Pronotal lateral margin distinctly explanate laterally; lateral margin visible from above. Elytra shorter, length/width ratio of 1.22–1.25 and with at least one lateral seta of humeral series on each side. Female abdominal sternite VI with four fixed setae on each side 4
– Pronotal lateral margin incurved below; lateral margin not visible from above. Elytra longer, length/width ratio of 1.30, without lateral setae of both humeral and apical series on each side. Female abdominal sternite VI without a fixed seta. Borneo: Brunei ..... *C. gigantea*
4 Elytral lateral margin strongly explanate laterally; lateral margin distinctly visible from above, narrowed toward the apex, with a lateral seta of apical series, and with a large elytral light patch on each side. Female gonocoxite II with one seta at apex ..... *C. maxima*
– Elytral lateral margin incurved below; lateral margin not distinctly visible from above, subparallel sided, without seta of apical series, and with a small elytral light patch on each side. Female gonocoxite II with two setae at apex ..... *C. thom* sp. nov.
5 Dorsum without reticulate microsculpture. Elytral light patch trapezoidal. Malaysia, Thailand, Laos, Sumatra, Java, Borneo 6
– Dorsum with fine though distinct reticulate microsculpture. Elytral light patch circular, triangular, or transverse. Southern China, Southern India, Thailand, Laos, Vietnam, Philippines 9
6 Elytral lateral margin explanate laterally; lateral margin visible from above and light patch separated from suture and apex by ground color. Malaysia, Thailand, Laos, Sumatra, Java, Borneo 7
– Elytral lateral margin incurved below; lateral margin not distinctly visible from above and light patch reaching suture and apex. Laos ..... *C. laosensis*
7 Elytra subparallel sided; body shape subrectangular and with three to four lateral setae on each side, except for humeral lateral setae series. Male aedeagus with markedly spatulate apex in dorsal view ..... *C. gaverei*
– Elytra distinctly narrowed distally, body shape markedly oviform and with two to three lateral setae on each side, except for humeral lateral setae series. Male aedeagus with tapered apex in dorsal view 8

8 Pronotum blackish brown, almost same with head. Elytra longer, length/width ratio of 1.21 to 1.23 and with small light patch on each side. Male abdominal sternite VI with dense pubescent pad and aedeagus with relatively short, rather wide, and subtruncate apex in dorsal view. Thailand ..... *C. siamensis*

– Pronotum contrastingly red, distinctly lighter than head. Elytra longer, length/width ratio of 1.27 and with rather large light patch on each side. Male abdominal sternite VI without dense pubescent pad and aedeagus with relatively long, narrow, and rounded apex in dorsal view. Malaysia ..... *C. ovalis*

9 Elytral light patch separated from suture by ground color and widest vertically near lateral margin. Dorsum with very fine but distinct reticulate microsculpture. Male aedeagus with narrow, slightly asymmetrical, widely rounded apex, or unknown. Thailand, Laos, Vietnam, Philippines 10

– Elytral light patch reaching suture and widest vertically along suture. Dorsum with very superficial reticulate microsculpture, visible only at high magnification (> 60×). Male aedeagus with symmetrical, wide, convexly triangular apex. Southern India ..... *C. indica*

10 Body length less than 4.2 mm. Elytra longer, length/width ratio of more than 1.28 and with regularly circular elytral light patch. Southern Thailand, Philippines ..... *C. collaris*

– Body length more than 4.2 mm. Elytra shorter, length/width ratio of less than 1.28 and with subtriangular elytral light patch. Northern Thailand, Laos, Vietnam ..... *C. maior*

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Additional information

Conflict of interest

The authors have declared that no competing interests exist.

Ethical statement

No ethical statement was reported.

Artificial Intelligence (AI) use

The authors accept full responsibility for the content of the manuscript, including the disclosure of any use of AI.
Regarding the use of AI in the preparation of this manuscript, the authors declare the following: GPT, o3
Used for: Language, style and writing

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Author contributions

Jong Bong Choi conceived and conducted the study, examined the specimens, prepared the descriptions, figures, and other taxonomic data, and drafted the manuscript. Shuhei Nomura, Taeyeong Kwon, Eunyoung Choi, and Jong Kyun Park contributed comments and improvements to the manuscript. All authors read and approved the final version of the manuscript.

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Data availability

All of the data that support the findings of this study are available in the main text.