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Original article

Taxonomic study on the subspecies of *Cyclommatus metallifer* (Boisduval, 1835) from Indonesia (Coleoptera: Lucanidae)Eunjoong Kim^a, Jinyoung Park^b, Jong Kyun Park^{a,*}^aEntomology Laboratory, Department of Ecological Science, College of Ecology and Environmental Science, Kyungpook National University, Sangju-si, Republic of Korea^bDepartment of Nature survey, National Institute of Ecology, Seocheon-gun, Republic of Korea

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ABSTRACT

The lucanid beetles of the subspecies of *Cyclommatus metallifer* from Indonesia are revised here. Five subspecies are known from Indonesia. Among them, *Cyclommatus metallifer otanii* Mizunuma and Nagai was confirmed to be a synonym of *Cyclommatus metallifer aenomicans* Parry. Moreover, a new subspecies, *Cyclommatus metallifer butonensis* ssp. nov., is described from Buton Island of Indonesia. The identification key, distributional data, photos of adults, genitalia, and figures for each subspecies are provided.

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Introduction

Species of the genus *Cyclommatus* are distributed mainly in Southeast Asia, a region characterized by tropical and subtropical climate. Most members of this genus have a strong positive phototaxis and are deeply attracted to light traps. These species are diurnal, and they feed on the sap of tall herbaceous plants or woody plants by scratching the surface with their mandibles (Ishitsuka 2011); they also gather flowers of specific genera of Theaceae (Suzuki 1996). This genus belongs to tribe Cyclomatini and was listed at Maes, 1992 but without taxonomic description; therefore, Huang and Chen (2013) described this tribe.

Cyclommatus metallifer (Boisduval 1835) is a type species of this genus, and to date five subspecies have been reported. Since Parry (1862) reported *C. aenomicans*, Jakowlew (1896) reported *C. metallifer* var. *ritsemae*, and then Mizunuma and Nagai (1991) reported *C. m. finae*, *C. m. isogaii*, *C. m. otanii*, and *C. m. sangirensis* from Indonesia. Among the subspecies, *C. m. ritsemae* has been synonymized by considering type locality Celebes, which is the

covering type locality of Celebes, Manado. Furthermore, *C. m. otanii* was synonymized in this research by considering the morphological characters based on original description and examination of materials from the north Moluccas region. A new subspecies was suggested from the population of Buton Island.

The following abbreviations are used in this paper: PCEK, private collection of Eunjoong Kim, Entomology Laboratory, Kyungpook National University, Republic of Korea; PCJK, private collection of Jinyoung Kim, Anyang-si, Republic of Korea; PCSB, private collection of Seunghoon Baek, Sacheon-si, Republic of Korea; *, indicates type locality of the subspecies.

Systematic accounts

Family Lucanidae (Latreille, 1804)

Subfamily Lucaninae (Latreille, 1804)

Tribe, Cyclomatini (Huang and Chen, 2013)

Cyclomatini (Maes, 1992), nomen nudum (Smith 2006)

Genus *Cyclommatus* (Parry, 1862)*Cyclommatus* (Parry, 1862)*Cycloptalmus* (Hope and Westwood, 1845); used by Stenberg for genus of Arachnidae (Parry 1862)*Megaloprepes* (Thomson, 1862)

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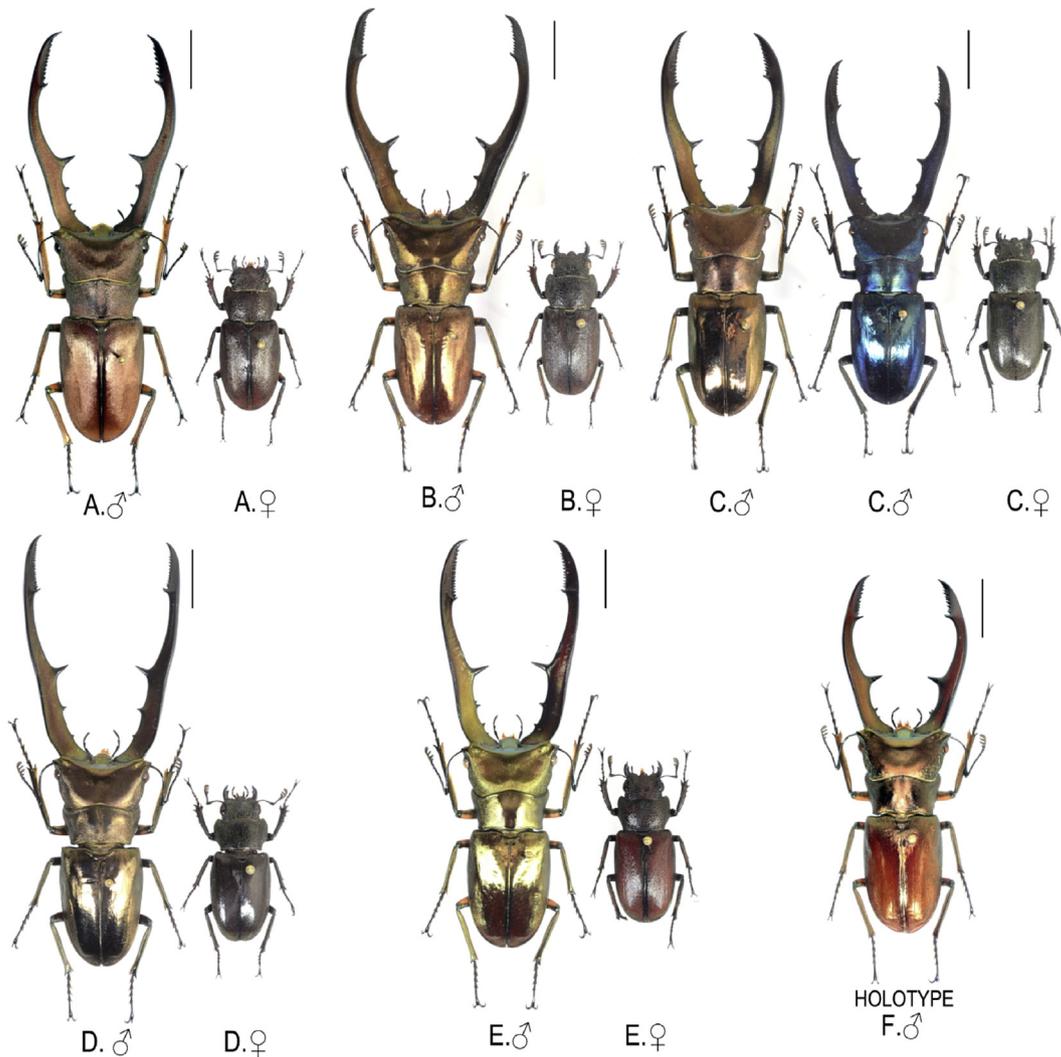


Figure 1. Subspecies of *Cyclommatus metallifer*: A, *Ssp. metallifer*; B, *Ssp. aenomicans*; C, *Ssp. finae*; D, *Ssp. isogaii*; E, *Ssp. sangirensis*; F, *Ssp. butonensis* ssp. nov. Holotype. <scale bars: 10 mm>; ♀ = male; ♂ = female.

Key to subspecies of Cyclommatus metallifer from Indonesia by male characteristics

1. Femur without yellow spot on dorsal view*ssp. finae*
- Femur with yellow spot on dorsal view2
2. Elytral shoulder with well developed process..... *ssp. isogaii*
- Elytral shoulder without process3
3. Head width distinctly broader than pronotum ...*ssp. aenomicans*
- Head width slightly broader than pronotum4
4. Body surface with strong greenish gold luster ...*ssp. sangirensis*
- Body surface without greenish gold luster5
5. Body surface with minute gloss, Elytral shoulder rounded, mandible less inclined*ssp. metallifer*
- Body surface with strong gloss, Elytral shoulder strongly angulated, mandible strongly inclined toward inside*butonensis* ssp. nov.

Key to subspecies of Cyclommatus metallifer from Indonesia by female characteristics

(*butonensis* ssp. nov. is excluded here, because of lack of collection and information on female)

1. Body dark, surface smooth, with densely punctate2
- Body bright, surface rough, with coarsely punctate3
2. Elytral shoulder with developed process, body surface with strong gloss*ssp. isogaii*
- Elytral shoulder without process, body surface with minute gloss*ssp. finae*
3. Body color brown*ssp. aenomicans*
- Body color reddish brown4
4. Body surface with strong greenish gold luster...*ssp. sangirensis*
- Body surface without greenish gold luster.....*ssp. metallifer*

1. *Cyclommatus metallifer metallifer* (Boisduval, 1835)

(Figures 1A, 2A, 4A–L)

Lucanus metallifer Boisduval, 1835: 236–237.

Cyclommatus metallifer: Deyrolle, 1866: PL. 2; Ritsema, 1892: 5;

Möllenkamp, 1904: 372; Mizunuma and Nagai, 1994: 235;

Suzuki, 1996: 16; Krajcik, 2001:31; Krajcik, 2003: 51.

Cyclommatus metallifer var. *ritsemae*: Jakowlew, 1896: 171.

Cyclommatus metallifer metallifer: Mizunuma and Nagai, 1991: 2;

Maes, 1992: 59; Fujita, 2010: 155.

Redescription. Body length: male 28–93 mm, female 22–28 mm. Male body thin and elongated. Generally copper brownish colored,

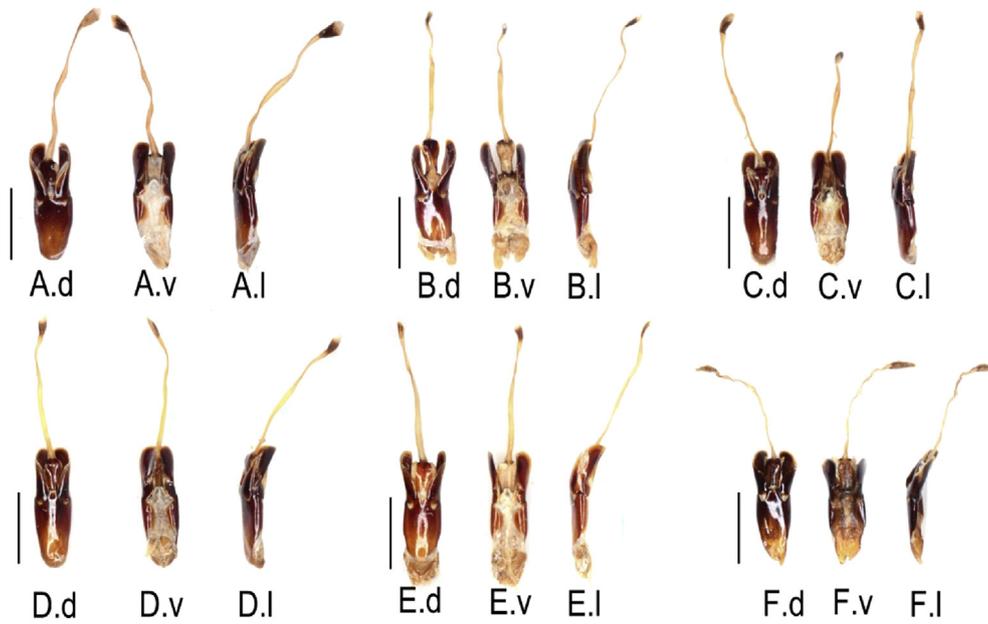


Figure 2. Male genitalia of subspecies: A, *Ssp. metallifer*; B, *Ssp. aenomicans*; C, *Ssp. finae*; D, *Ssp. isogaii*; E, *Ssp. sangirensis*; F, *Ssp. butonensis* ssp. nov. <scale bars: 2.5 mm>; d = dorsal; l = lateral; v = ventral.

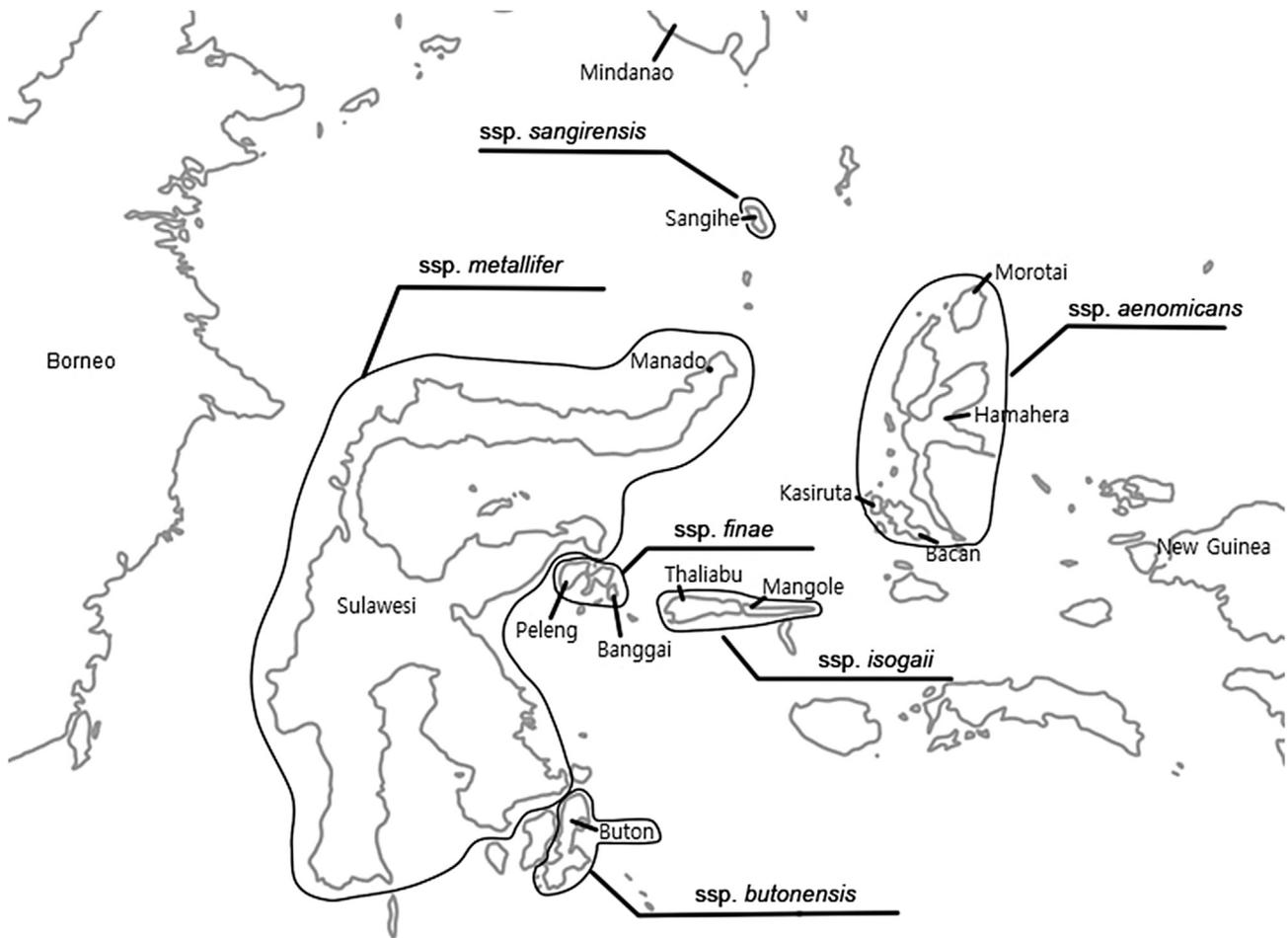


Figure 3. Distribution of *Cyclommatus metallifer* ssp. from Indonesia.

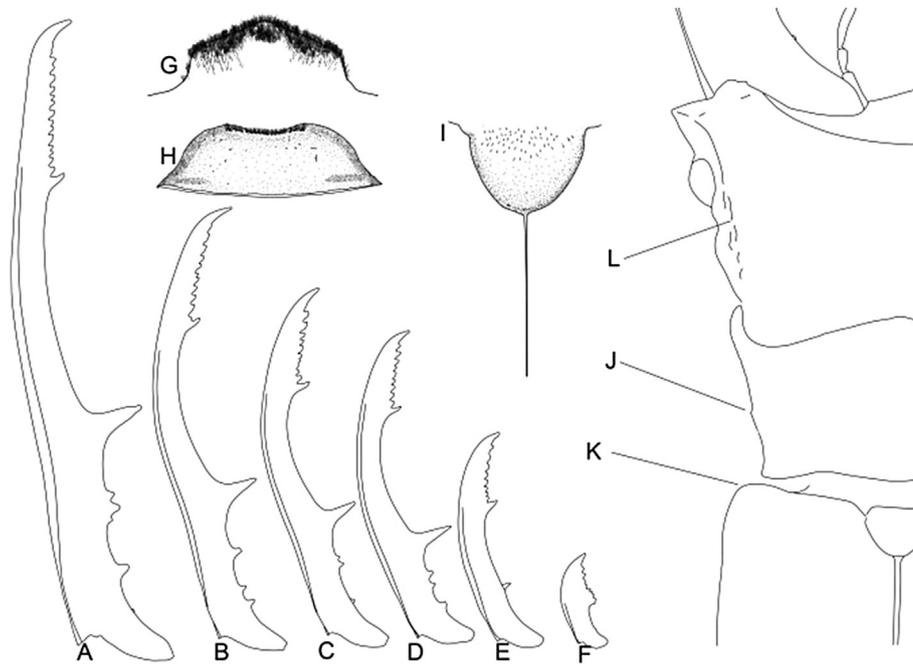


Figure 4. *Ssp. metallifer*: A–F, Male mandible; G, Clypeus of male; H, Gula of male; I, Scutellum; J, Pronotal side process; K, Shoulder of elytra; L, Wrinkle of head.

with individual color variation ranging from bright orange to blue. In major male, mandible is elongated. At apex of mandible, between apical outer tooth and apical inner tooth, teeth forming apical tooth group resembling a saw. Bold main tooth located medial part of mandible. At basal part of mandible, with zero to five small teeth, and teeth sometimes merged together. In minor male, main tooth diminished and apical tooth group remaining. Clypeus with produced triangular shape, covered with short orange hair at margin. Genuiculate antennal first segment thin and elongated, seventh segment sharply expanded and eighth, ninth, and 10th segments laterally expanded. Canthus not well developed, compound eye exposed roundly. Head angle in front of canthus strongly angulated. Head width as pronotum and slightly wider at front. Wrinkle behind compound eye minute at lateral part of head. Pronotum trapezoidal with developed minutely process at medial margin on lateral view, hind angle protruded out. Body surface with gloss of metallic particle. Near elytral suture highly glossy. Shoulder of elytron smooth, process not developed. Leg thin and straight, process of tibia not developed. Femur with yellowish spot. From femur to tarsus, with bright orange hairs cover along ventral. Female body thin and flattened. Body surface with weak gloss, reddish brown colored. Elytral shoulder rounded. Elytra surface rough, with coarsely punctate [Fig. 3](#)

Materials examined. 1 female ♂, 17 ix 2006, Sulawesi, Indonesia private collection of Eunjoong Kim, Entomology Lab, Kyungpook National University, Republic of Korea (PCEK); 2♂, 1–11 ix 2007, Ibid (PCEK); 17♂, 1 male ♀, 5–12 ix 2008, Ibid (PCEK); 3♂, 7–14 vi 2008, Ibid (PCEK); 1♂, 17 ix 2011, Ibid (PCEK); 1♂, 13 ix 2008, Ibid Private collection of Jinyeong Kim, Anyang-si, Republic of Korea (PCJK), 4♂, No data, Ibid (PCJK). All materials locality belongs to Indonesia.

Distribution. Indonesia; Sulawesi Island = Celebes Is. [*Manado, Palolo, Palopo, Mamasaj].

Remarks. By [Suzuki \(1996\)](#), both male and female gathered to flower and fresh leaf of genus *Schima* sp. (Theaceae), flower and fruit of *Melastoma* sp. (Melastomataceae), and sap of *Dyroxylum* sp. (Meliaceae). Male presents mate-guarding behavior to protect female from mating with other males.

2. *Cyclommatus metallifer aenomicans* (Parry, 1862)

([Figures 1B, 2B, 5A–K](#))

Cyclommatus aenomicans: [Parry, 1862](#): 111.

Cyclommatus metallifer var. *aenomicans*: [Geminger and Harold, 1868](#): 953.

Cyclommatus metallifer aenomicans: [Mizunuma and Nagai, 1991](#): 2–10; [Mizunuma and Nagai, 1994](#): 235; [Krajcik, 2001](#): 31; [Krajcik, 2003](#): 51; [Hujita, 2010](#): 155.

Cyclommatus metallifer otanii: [Mizunuma and Nagai, 1991](#): 2; [Mizunuma and Nagai, 1994](#): 235; [Krajcik, 2001](#): 31; [Krajcik, 2003](#): 51; [Fujita, 2010](#): 156.

Redescription. Body length: male 28–84 mm, female 22–28 mm. Male body thin, elongated. Head broader allied to *ssp. metallifer*. Body color generally bright copper brown with individual color variation from reddish to blue. In major male, mandible thin and elongated. Bold main tooth at medial part of mandible. Allied to nominotypical subspecies, mandible inclined toward inside at the point of one-third from apex, with near main tooth part broader. At the basal part of mandible, zero to five small teeth produced and teeth sometimes merged together. In minor male, main tooth diminished and apical tooth group remaining. Canthus not well developed, compound eye exposed roundly. Head angle in front of canthus strongly angulated. Head broad as pronotum and slightly wider at front. Wrinkle behind compound eye minute at lateral part of head. Pronotum trapezoidal with pronotal side process developed minutely at medial margin, hind angle protruded out. Body surface gloss with metallic particle. Elytral suture with high gloss. Elytral shoulder smooth, without process. Leg thin and straight, without process of tibia. Femur with yellowish spot on dorsal and ventral view. From femur to tarsus, bright orange hairs cover along ventral. Female body thin. Body surface with weak gloss, dark brown colored. Elytral shoulder rounded. Elytra surface rough, coarsely punctate.

Materials examined. 2♂, 1–14 ii 2008, Halmahera (PCEK); 1♂, 16–20 viii 2009, Ibid (PCEK); 1♂, 16 iv 2011, Ibid (PCEK); 2♂, 17 iv 2011, Mount Ibu, Halmahera (PCEK); 1♂, 5–12 v 2014, Ibid (PCEK); 1♂, 8 xi 2011,

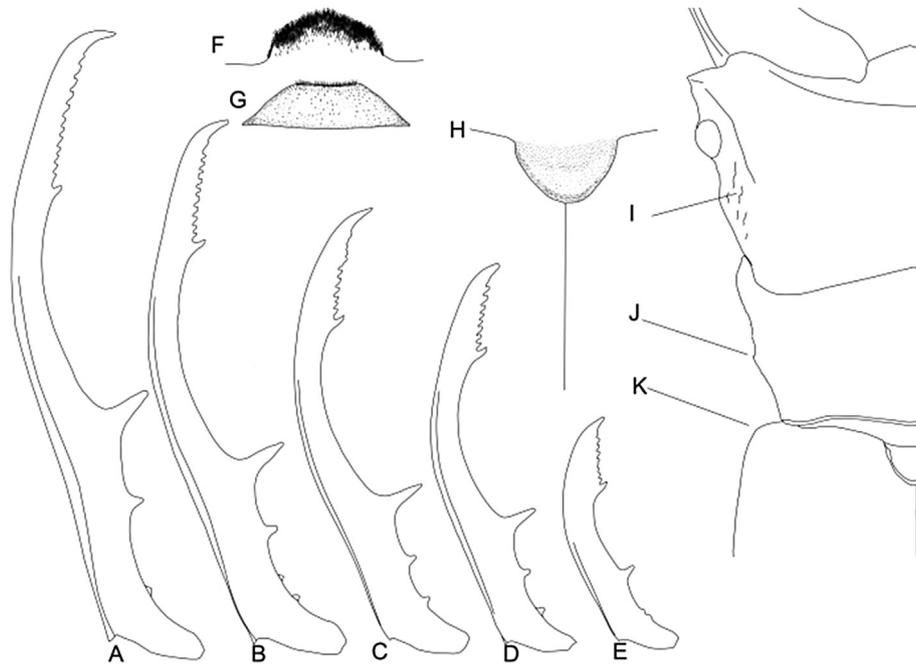


Figure 5. *Ssp. aenomicans*: A–E, Male mandible; F, Clypeus of male; G, Gula of male; H, Scutellum; I, Wrinkle of head; J, Pronotal side process; K, Shoulder of elytra.

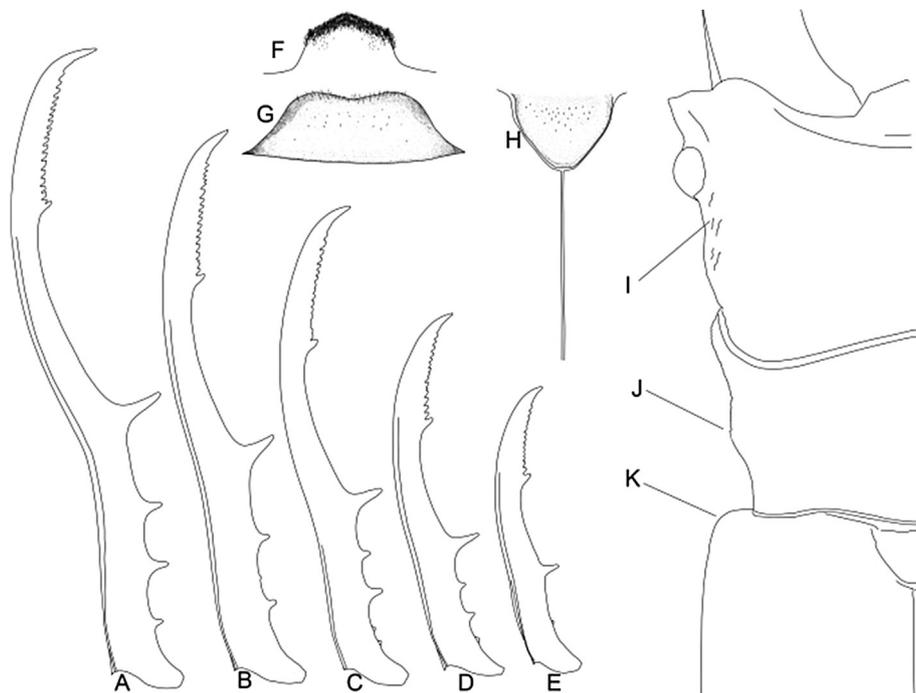


Figure 6. *Ssp. finae*: A–E, Male mandible; F, Clypeus of male; G, Gula of male; H, Scutellum; I, Wrinkle of head; J, Pronotal side process; K, Shoulder of elytra.

Kasiruta (PCEK); 2♂, 11 iv. 2011, Kasiruta (PCEK); 1♂, 7 i 2004, Morotai (PCEK); 1♂, 1♀, 8–16 x 2014, Wayabula, Morotai (PCEK); 3♂, 11–18 i 2015, Wayabula, Morotai (PCEK); 1♂, 24 iii 2010, Ibid (PCJK); 1♂, 26 vii 2013, Mount Ibu, Halmahera (PCJK); 2♂, 11 ix 2013, Mount Ibu, Ibid (PCJK); 1♂, 18 xi 2009, Kasiruta (PCJK); 5♂, 14 x 2014, Morotai (PCJK). All materials locality belongs to Indonesia.

Distribution. Indonesia; North Moluccas Archipelago [*Bachan Is. (=Batchian Is.), Halmahera Is., Kasiruta Is., Morotai Is.]

Remarks. This subspecies is similar to *ssp. metallifer* but is easily distinguished by inclined mandibular shape and head wider compared to pronotum. Mizunuma and Nagai set the population of Morotai Is. as *ssp. otanii* with development of pronotal side projection. But by considering the examination result of materials from Halmahera, Kasiruta, and Morotai Islands, this characteristic should be regarded as variation level difference. Therefore, *ssp. otanii* should be regarded as synonymy of *ssp. aenomicans* Parry.

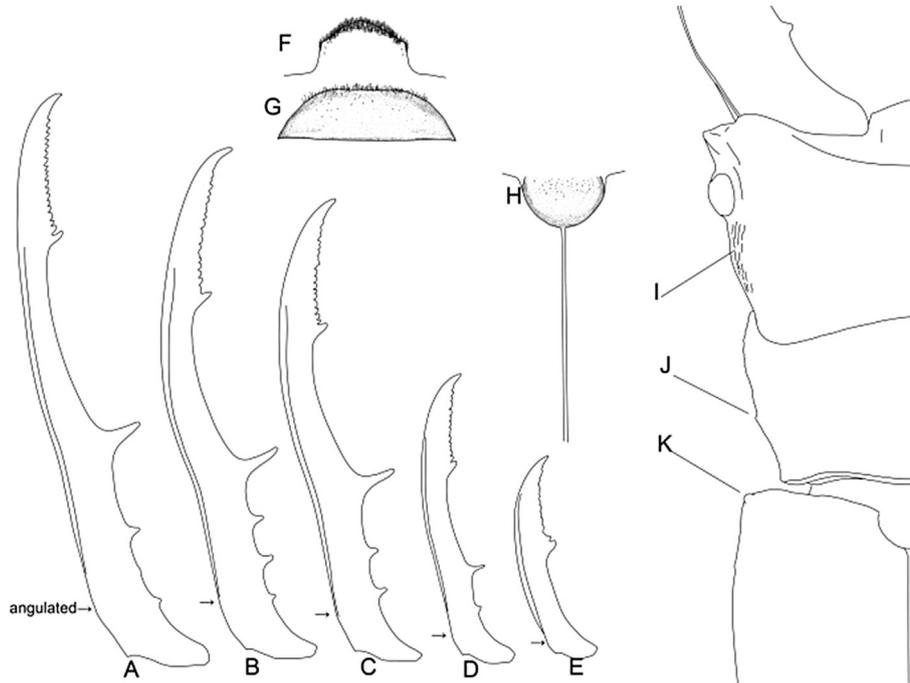


Figure 7. *Ssp. isogaii*: A–E, Male mandible; F, Clypeus of male; G, Gula of male; H, Scutellum; I, Wrinkle of head; J, Pronotal side process; K, Shoulder of elytra.

3. *Cyclommatus metallifer finae* (Mizunuma and Nagai, 1991) (Figures 1C, 2C, 6A–K)

Cyclommatus metallifer finae: Mizunuma and Nagai, 1991: 2–10; Mizunuma and Nagai, 1994: 235 pl. 47; Krajcik, 2001: 31; Krajcik, 2003: 51–52; Fujita, 2010: 155 p. pl. 93.

Redescription. Body length: male 26–100 mm, female 22–25 mm. Male body thin, elongated. Head broader allied to *ssp. metallifer*. Body color generally dark copper brown with individual color variation from black to blue. In major male, mandible is thin and elongated. Allied to other subspecies, longer apical tooth group formed. Weak main tooth located in medial part of mandible. At basal part of mandible, zero to five small teeth produced and teeth sometimes merged together. In minor male, main tooth diminished and apical tooth group remaining. Canthus not well developed with compound eye exposed roundly. Head angle in front of canthus strongly angulated. Head broad as pronotum and slightly wider at front. Wrinkle behind compound eye minute at lateral part of head. Pronotum trapezoidal with side process developed minutely at medial margin, hind angle protruded out. Body surface smooth with strong gloss, with metallic particle. Near elytral suture highly gloss. Shoulder of elytron smooth, process not developed. Leg thin and straight, process of tibia not developed. Distinguished from other subspecies by femur without yellow spot. From femur to tarsus, bright orange hairs cover along ventral. Female body thin. Body surface present gloss, reddish brown colored. Elytral shoulder angulated. Elytra surface smooth, densely punctate.

Materials examined. 5♂, 1♀, 1–12 ix 2006, Peleng (PCEK); 1♂, 15–22 viii 2007, Ibid (PCEK); 1♂, 3–12 x 2007, Ibid (PCEK); 1♂, 6 v 2009, Ibid (PCEK); 1♂, 21 viii 2010, Ibid (PCEK); 3♂, 9–12 ix 2010, Ibid (PCEK); 1♂, 8 x 2010, Ibid (PCEK); 1♂, 2–14 xii 2010, Ibid (PCEK); 8♂, 3–15 ix 2011, Ibid (PCEK); 1♂, 12 v 2009, Banggai (PCEK); 1♂, 6–13 i 2012, Ibid (PCJK); 6♂, 1–11 i 2014, Ibid (PCJK); 1♂, 4–5 iv 2011, Ibid (PCJK); 6♂, 8–11 vi 2013, Ibid (PCJK); 1♂, 6–8 vii 2013, Ibid (PCJK); 1♂, 6 viii 2010, Ibid (PCJK); 3♂, 7–8 ix 2010, Ibid (PCJK); 1♂, 4 ix 2011, Ibid (PCJK); 1♂, 27 ix 2013, Ibid (PCJK); 1♂,

22–23 ix 2014, Ibid (PCJK); 4♂, 8 xii 2010, Ibid (PCJK); 2♂, No data, Ibid (PCJK). All materials locality belong to Indonesia.

Distribution. Indonesia; Banggai Archipelago [*Peleng Is., Banggai Is., Bangkulu Is.].

Remark. This subspecies is easily distinguished by the lack of yellow spot of femur.

4. *Cyclommatus metallifer isogaii* (Mizunuma and Nagai, 1991) (Figures 1D, 2D, 7A–K)

Cyclommatus metallifer isogaii: Mizunuma and Nagai, 1991: 2–10; Mizunuma and Nagai, 1994: 235 pl. 47; Krajcik, 2001: 31; Krajcik, 2003: 51–52; Fujita, 2010: 155 pl. 93.

Redescription. Body length: male 33–75 mm, female 22–25 mm. Male body thin, elongated. Head broader allied to nominotypical subspecies. Body color generally dark copper brown, reddish or blue colored individuals occurred as variant. In major male, mandible thin, elongated. Allied to other subspecies, tooth densely formed along apical tooth group. Thin main tooth located medial part of mandible. At basal part of mandible, zero to five small teeth produced and teeth sometimes merged together. Outer angle close to basal part of mandible strongly angulated (Figures 7A–E). In minor male, main tooth diminished and apical tooth group remaining. Head broad as pronotum and slightly wider at front. Wrinkle behind compound eye minute at lateral part of head. Pronotum trapezoidal with side process developed minutely at medial margin, hind angle protruded out. Allied to other subspecies, entire body presents strong gloss with shiny smooth surface. The most distinguishing key of this subspecies, elytron process of shoulder well developed (Figure 7K). Leg thin and straight, without process of tibia. Femur with yellowish spot. From femur to tarsus, bright orange hairs cover along ventral. Female body thin. Body surface with distinguishable gloss from other subspecies, with dark black color. Elytral shoulder angulated with process developed. Elytra surface smooth with densely punctate.

Materials examined. 1♀, 4 iii 2005, Tikon, Taliabu (PCEK); 1♂, 8 iv 2010, Enggele, Taliabu (PCEK); 3♂, 11–15 xi 2010, Taliabu (PCEK);

2♂, 8–9 xii 2010, Ibid (PCEK); 1♂, 11–15 xi 2010, Ibid (private collection of Seungheon Baek, Sacheon-si, Republic of Korea); 1♂, 3 vi 2009, Ibid (PCJK); 1♂, 2–4 vii 2002, Ibid (PCJK). All materials locality belongs to Indonesia.

Distribution. Indonesia; *Sula Archipelago [Thaliabu Is. (tikon, enggele), Mangole Is.].

Remarks. This subspecies is similar to *ssp. finae* but is easily distinguished by process of elytral shoulder, femur with yellow spot, and angulated basal part of outer mandible.

5. *Cyclommatus metallifer sangirensis* (Mizunuma and Nagai, 1991)

(Figures 1E, 2E, 8A–K)

Cyclommatus metallifer sangirensis: Mizunuma and Nagai, 1991:

2–10; Mizunuma and Nagai, 1994: 235 pl. 47; Krajcik, 2001: 31; Krajcik, 2003: 51–52; Fujita, 2010: 156 p. pl. 93.

Redescription. Body length: male 32–82 mm, female 22–25 mm. Male body thin, elongated, and flattened, allied to nominotypical subspecies. Color generally copper gold, but reddish form also occurs. Both color form with greenish-gold luster as distinguishing character from other subspecies. In major male, mandible flattened and straight allied to nominotypical subspecies. Thin main tooth located medial part of mandible. At basal part of mandible, zero to five small teeth produced and teeth sometimes merged together. In minor male, main tooth diminished and apical tooth group remaining. Head angle in front of canthus strongly angulated. Head broad as pronotum and slightly wider at front. Wrinkle behind compound eye minute at lateral part of head. Pronotum trapezoidal with side process developed minutely at medial margin, hind angle protruded out. Body surface presents metallic gloss with smooth surface, elytral suture highly gloss as much as elytra. Elytral shoulder angulated allied to nominotypical subspecies, without process. Leg thin and straight, process of tibia not developed. Yellowish spot on femur exist. From femur to tarsus, bright orange hairs cover along ventral. Female body thin. Body surface with

strong greenish gold luster, reddish brown colored. Elytral shoulder rounded. Elytra surface rough, coarsely punctate.

Materials examined. 1♀, 7 xi 2008, Sangihe (PCEK); 1♂, 11 vi 2014, Ibid (PCEK); 3♂, 13 vi 2015, Ibid (PCEK); 1♂, 16 xii 2016, Ibid (PCEK); 1♂, Breed 2016, Sangir (PCEK); 1♂, 3–6 xii 2010, Tahuna (PCJK). All materials locality belongs to Indonesia.

Distribution. Indonesia; *Sangir Archipelago [Sangihe Is.=Tahuna Is.].

Remarks. This subspecies is similar to *ssp. metallifer* but is easily distinguished by the greenish golden luster on the body surface.

6. *Cyclommatus metallifer butonensis* Kim *ssp. nov.*

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(Figures 1F, 2F, 9A–K)

Type. Holotype: ♂, 10 x 2007, Buton Is. (PCEK). Paratypes: 2♂, 6 i 2003, Ibid (PCEK), 11♂, 1–10 x 2007, Ibid (PCEK); 1♂, 1–10 x 2007, Ibid (PCJK). All materials locality belongs to Indonesia.

Diagnosis. This subspecies is distinguished by the following characteristics: Body gloss than nominotypical subspecies. Mandible strongly inclined inside allied to nominotypical subspecies. Elytral shoulder strongly angulated without process. Ventrites of abdomen strongly glossy allied to nominotypical subspecies.

Description. Body length: male 39–65 mm, female unknown. Male body thin, elongated. Body color bright copper brown. In major male, mandible inclined at one-third from apex. Main tooth thicker allied to same size of nominotypical subspecies. At the basal part of mandible, zero to three small teeth produced and teeth sometimes merged together. In minor male, main tooth diminished and apical tooth group remaining. Head broad as pronotum and slightly wider at front. Wrinkle behind compound eye minute at lateral part of head. Body surface with stronger gloss allied to nominotypical subspecies. Near elytral suture highly gloss. Elytral shoulder strongly angulated without process. Leg

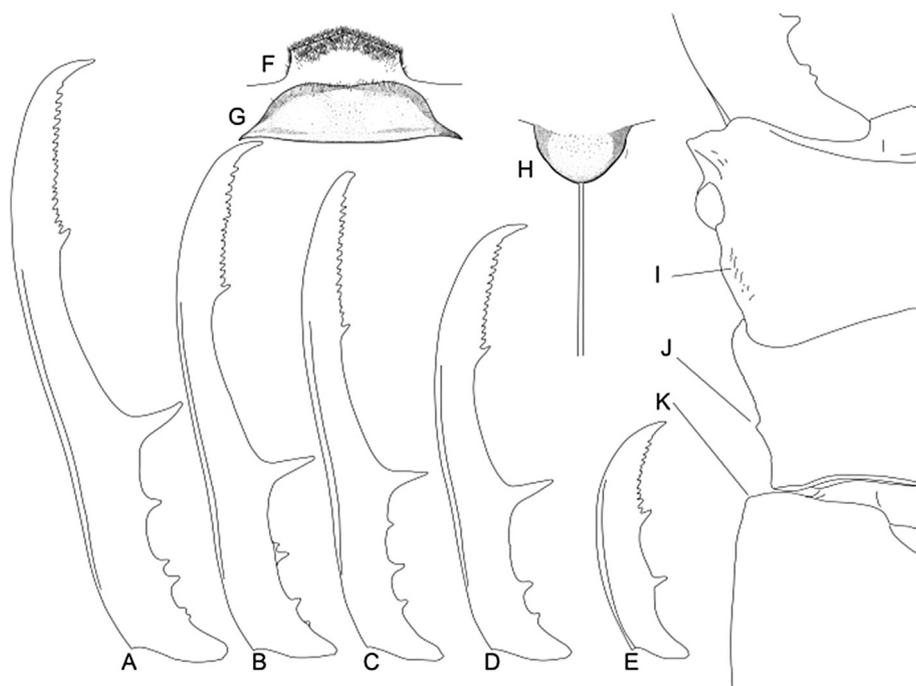


Figure 8. *Ssp. sangirensis*: A–E, Male mandible; F, Clypeus of male; G, Gula of male; H, Scutellum; I, Wrinkle of head; J, Pronotal side process; K, Shoulder of elytra.

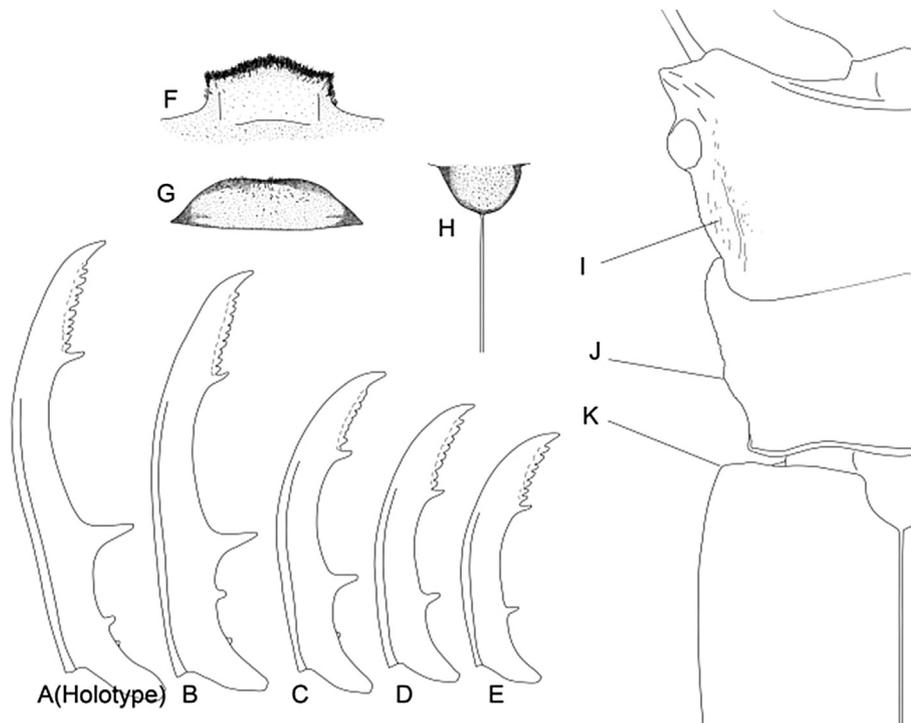


Figure 9. *Ssp. butonensis* ssp. nov.: A–E, Male mandible; F, Clypeus of male; G, Gula of male; H, Scutellum; I, Wrinkle of head; J, Pronotal side process; K, Shoulder of elytra.

thin and straight without process of tibia. Femur with yellowish spot. Female unknown.

Distribution. Indonesia; *Buton Is.

Etymology. Subspecies name derived from type locality, Buton Is. of Indonesia.

Remarks. This subspecies distinguished from *ssp. metallifer* by strong gloss of body surface, angulated elytral shoulder, and inclined mandibles. Type series will be deposited at PCEK (holotype and paratypes) and PCJK (paratype).

Conflicts of interest

The authors declare that there is no conflicts of interest.

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