Thai Specimens 3: 41–61 (2024)

An Annotated Catalogue of the Large Green *Anomala* Samouelle, 1819 (Coleoptera: Scarabaeidae) Specimens Deposited in the Natural History Museum of the National Science Museum, Thailand

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Article History

Received: 18 February 2024

Accepted: 5 March 2024

Published Online: 20 March 2024

Printed: 30 June 2024

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Abstract

The specimens of the large green chafer in the genus *Anomala* Samouelle, 1819 were studied and cataloged. Specimens of nine species in the genus are housed in the Thailand Natural History Museum, National Science Museum in Pathum Thani Province, Thailand (including five new recorded species): *Anomala collotra* Zhang and Lin, 2008 (**new record**); *Anomala cupripes* (Hope, 1839); *Anomala diana* (Zhang and Lin, 2008) (**new record**); *Anomala granuliformis* Lin, 1996; *Anomala hemiseca* Zhang and Lin, 2008 (**new record**); *Anomala heterotricha* Ohaus, 1916 (**new record**); *Anomala monochroa* (Bates, 1891); *Anomala semipurpurea* Burmeister, 1855 (**new record**); and *Anomala truncata chlorochelys* (Arrow, 1912). A key to the Thai species and distributional maps based on specimens deposited in THNHM are provided.

Keywords

Anomalini, *Euchlora*, *Anomala cupripes* species group, *Anomala sinica* species group, *Anomala viridis* species group

Introduction

Anomala Samouelle, 1819 is notably the largest genus in the subfamily Rutelinae and one of the most speciose in the kingdom Animalia. It currently consists of more than 1,000 valid species globally (Jameson *et al*., 2003). Among them, the green individuals, former *Euchlora* MacLeay, 1819, were categorized as *Anomala viridis* species group with a predominantly green dorsal body and well-developed ventral sclerite of male aedeagus (Hope, 1839; Arrow,

Citation. Hongsuwong, T. and S. Sanguansub. 2024. An Annotated Catalogue of the Large Green *Anomala* Samouelle, 1819 (Coleoptera: Scarabaeidae) Specimens Deposited in the Natural History Museum of the National Science Museum, Thailand. *Thai Specimens* 3: 41–61.

1917; Ohaus, 1934). However, because of the extensive classification, some members were arranged to the different species groups later (Lin, 1996; Zorn, 2006; Zhang and Lin, 2008).

In Thailand, the large green chafer is one of the most prevalent groups that are associated with the local cultures in terms of edible insects, occasional agricultural pests, or even souvenirs (Ek-Amnuay, 2008; Sirimungkararat *et al*., 2017; Ek-Amnuay, 2019). Most Thai specimens were frequently identified as *Anomala grandis* (Hope, 1839) (Ek-Amnuay, 2008; Thailand Biodiversity Information Facility, 2021; iNaturalist, 2023), although this species is known to primarily inhabit the Himalayan region (Arrow, 1917). During our examination of the large green *Anomala* specimens deposited in the Natural History Museum of the National Science Museum, Thailand (THNHM), approximately 200 specimens were recognized, and the distributional maps were also illustrated. Herein, we hope that the present checklist and specific dispersal of these specimens will be useful to the taxonomic community.

Materials and Methods

To define the targeted specimens in the museum, the followed characteristics which adapted technical terms outlined by Zorn (2007) were used to classify the large green *Anomala* as: Body oval-ovate, rather large (average total length around 20 mm) to distinctly large (total length clearly above 20 mm); dorsum generally chromatically green (except blue form of *Anomala granuliformis* Lin, 1996); head and pronotum punctate, elytra almost smooth with minute to moderate size punctures but without clear striolation and setation; clypeus subtrapezoidal, apex weakly reflexed; antennal clubs relatively as long as combination of antennomeres 2–6 in both sexes; pronotum incompletely marginated, obsolete near level of base of scutellum; elytra incompletely marginated, obsolete near posterior corners of elytra (except finished near maximum widest in *Anomala hemiseca* Zhang and Lin, 2008); pygidium shining, surface with dense various shapes of sculptures; ventrum and legs very shining as metallic; pro– and metasternal process indistinct; apex of protibia bidentate, apical tooth short and acute in male, long and stout in female; tarsal claws sickle-shaped, except inner claw of protarsus and outer claw of mesotarsus with apex bifurcate, dorsal tooth clearly smaller than ventral tooth; ventral sclerite of male parameres remarkably distinct.

All localities were verified for correct spelling on the original labels and organized into six subdivisions of Thailand by following Martin and Ritchie (2020) as Northern Thailand (**N**), Northeastern Thailand (**NE**), Western Thailand (**W**), Central Thailand (**C**), Eastern Thailand (**E**), and Southern Thailand (**S**) (Figure 1). Male genitalia were dissected and put in 10% Potassium Hydroxide solution (KOH) for 8 hours, then mounted on triangular papers together with the same pin of specimens. Morphological observations were mainly made with a ST6 stereoscope. Multi-focused montage images of specimens were produced using Adobe Photoshop from a series of source images taken by Fuji XA5 camera with 60 mm macro lens.

Acronyms. Oxford University Museum of Natural History, United Kingdom (**OUMNH**); Thailand Natural History Museum, Khlong Luang, Pathum Thani, Thailand (**THNHM**); Total length, measured from apex of clypeus to apical of elytra (**TL**).

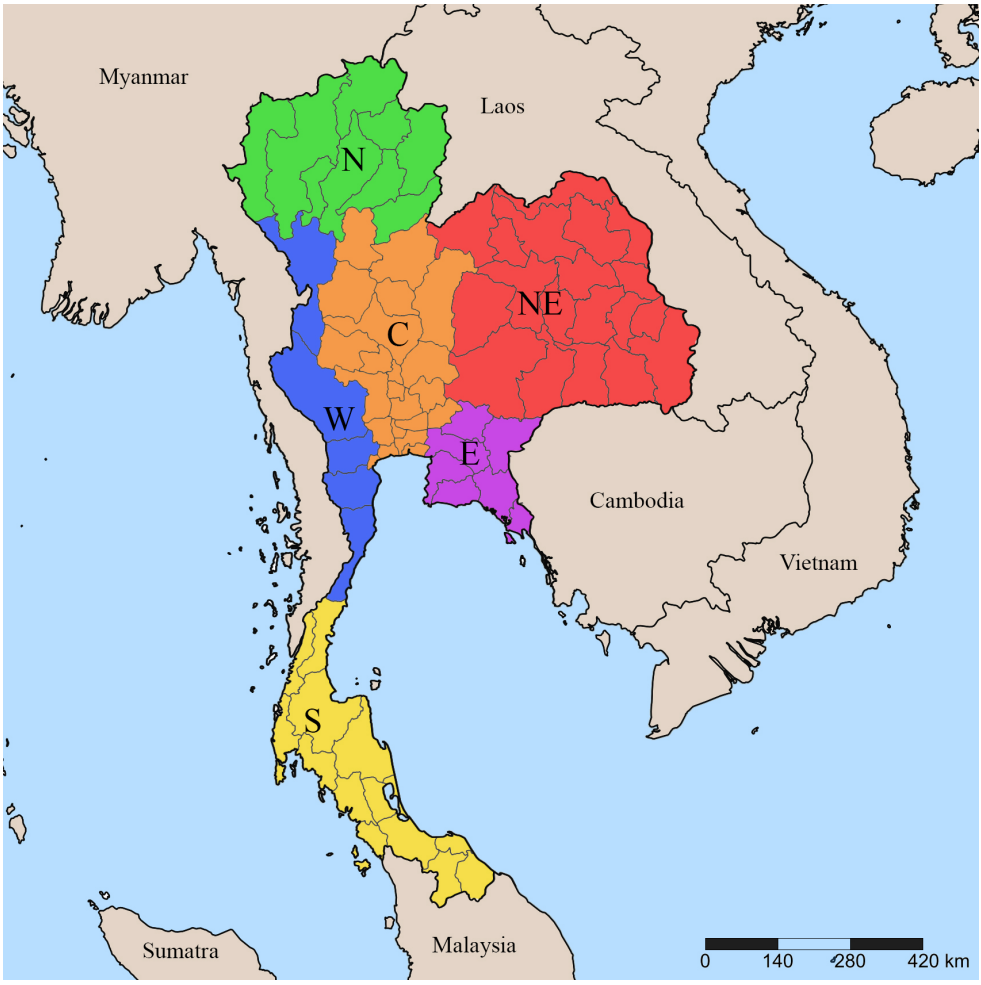

Figure 1. Six subdivisions of Thailand follow Martin and Ritchie (2020).

Results and Discussion

A total of nine species are provided in this study. Among them, only four large species have previously been noticed in the country: *Anomala cupripes* (Hope, 1839); *A. granuliformis*; Lin 1996 *Anomala truncata chlorochelys* (Arrow, 1912); and *Anomala monochroa* (Bates, 1891) (Ohaus, 1932; Leksawasdi, 1993; Lin, 1996). While the other five, which clearly have smaller bodies, are first recorded here with the followed species: *Anomala collotra* Zhang and Lin, 2008; *A. diana* (Zhang and Lin, 2008); *Anomala hemiseca*; Zhang and Lin, 2008 *Anomala heterotricha* Ohaus, 1916; and *Anomala semipurpurea* Burmeister, 1855. However, we have not found *A. grandis* to date in accordance with the comparing of those specimens with a type of *A. grandis* (Figure 2A–C). Thus, all specimens of *A. grandis* from Thailand should be re-identified.

The most prevalent species in Thailand, according to the number of specimens and wide distribution, is *A. cupripes*. The second and third are *A. monochroa* and *A. t. chlorochelys* respectively. The distribution of *A. t. chlorochelys* is located alongside the Myanmar–Thailand border, while *A. monochroa* is only found in the lower half of Tenasserim Hills. The distribution

of *A. granuliformis* is unclear, although it is confirmed to occur in the Northern and Eastern of Thailand based on the limited specimens available. With one specimen in each, *A. collotra*, *A. diana*, and *A. hemiseca* are likely rare species from the North, while *A. heterotrichia* is found in Central Thailand. The cluster of *A. semipurpurea* is gathered from the southern part (Figures 8–9).

Annotated Catalog of the Specimens

Subfamily Rutelinae MacLeay, 1819
Tribe Anomalini Streubel, 1839
Genus *Anomala* Samouelle, 1819

***Anomala collotra* Zhang and Lin, 2008**
แมลงนูนเขียวตองเหลือง
(Figures 3A, 4A, 5A, 6A)

Anomala collotra Zhang and Lin, 2008: 133, figs gM, gF, 22–25. Type locality: China, Yunnan.
Anomala collotra: Prokofiev, 2014: 4, figs 14–18; Zorn and Bezděk, 2016: 331.

Diagnosis. Size rather large, body somewhat slender, dorsum olive green with weak yellowish tinted but metallic luster lacking, elytral surface rather densely punctate; ventrum and femora shining metallic green with strongly yellowish tinted, pygidium olive yellowish green but without metallic luster, tibiae and tarsi uniformly metallic green; posterior corners of elytra round; pygidium densely shagreened, sparser in anteromedian portion; male parameres relatively short, inner outline widely sinuate in dorsal view; ventral sclerite carinated as a reversed subrtriangular with slightly round apex, median portion of anterior outline shallowly impressed in ventral view; apex of parameres round, two-third from base of ventral outline pointedly protruding ventrally, partly elevation of ventral sclerite visible in lateral view.

Materials examined. N THAILAND (n=1): 1 male (THNHM-I-09392), Chiang Mai Province, Mae Ai District, Pha Hom Pok National Park, 20° 06’ 00.2”N, 99° 16’ 22.4”E, 27.V.2008, T. Jeenthong leg.

Distribution. China, Myanmar, Vietnam, Laos, and Thailand (Chiang Mai, **new record,** Figure 9) (Prokofiev, 2014; Pham, 2018).

Remarks. A specimen in this study was clearly different from the original description which stated that pronotum had distinct furrow, and the ventral outline of parameres should be without any protrusion. Sensu Prokofiev (2014), this specimen resembles his *A. collotra* figures with the yellowish green coloring and lateral perspective of parameres with a pronouncing.

***Anomala cupripes* (Hope, 1839)**
แมลงนูนเขียวธรรมดา
(Figures 2D–I, 3B–D, 4B–D, 5B–D, 6B–C)

Euchlora cupripes Hope, 1839: 68. Type locality: Java; Tenasserim Coast. (synonymized genus with *Anomala* by Burmeisteri, 1844: 276).

Anomala cupripes (Hope, 1839): Burmeister, 1844; 276; Ohaus, 1915: 331; Arrow, 1917: 234, pl. II, fig. 17; Ohaus, 1918: 102; Ohaus, 1932: 134; Ohaus, 1934: 61; Paulian, 1959: 37, figs 178–180; Lin, 1996: 302, fig. 1; Zorn and Bezděk, 2016: 331.

Diagnosis. Large in size, dorsum shining grass green, elytra almost smooth with small punctures; lateral portions of dorsal surface, pygidium, entire ventrum and legs generally with copper metallic luster; posterior corners of elytra round; pygidium densely shagreened; male parameres slightly long, apex pointed and slightly bent inward in dorsal view; anterior half of ventral sclerite formed as two deep and elongated branches in ventral view; lateral view of parameres subcylindrical, ventral outline of ventral sclerite shallowly impressed medially.

Type examined. SYNTYPE (n=2): 2 females (OUMNH: COLE0560), Java.

Non-type materials examined. N THAILAND (n=11): 1 male (THNHM-I-09247) and 1 female (THNHM-I-09248), Mae Hong Son Province, Pang Mapha District, Tam Nam Lod, Tam Fossil, Lum Nam Pai Wildlife Sanctuary, 11.IX.2017, T. Jeenthong leg.; 1 female (THNHM-I-09249), Chiang Mai Province, Doi Pui, Ban Maew, 9.VIII.1975, P. Luecha leg.; 1 female (THNHM-I-09250), Chiang Mai Province, Mae Taeng District, 21.IV.1977, unknown collector; 1 female (THNHM-I-09251), Chiang Mai Province, 9.I.1966, J. Brandt leg.; 1 male (THNHM-I-09254) and 1 female (THNHM-I-09253), Chiang Mai Province, Chiang Dao District, Doi Chiang Dao Wildlife Sanctuary, 20.IX.2013, W. Jaitrong leg.; 4 females (THNHM-I-08507 to THNHM-I-08509, THNHM-I-22839), Lampang Province, Hang Chat District, Thung Kwian Plantation, light trap, 25–27.VI.2013, T. Jeenthong leg. **NE THAILAND** (n=28): 1 male (THNHM-I-09258) and 3 females (THNHM-I-09255 to THNHM-I-09257), Loei Province, Na Haeo District, 6.I.2002, unknown collector; 1 male (THNHM-I-09259) and 1 female (THNHM-I-09260), Loei Province, Phu Luang District, 25.XII.2009, T. Jeenthong leg.; 1 male (THNHM-I-09282) and 1 female (THNHM-I-09283), Chaiyaphum Province, Bamnet Narong District, Ban Nong Waeng, light trap, 23.IV.2018, W. Jaitrong leg.; 1 male (THNHM-I-08504), Kalasin Province, Nong Kung Si District, light trap, insect 4–9. XII.2014, W. Jaitrong leg.; 1 male (THNHM-I-08505) and 1 female (THNHM-I-08506), Kalasin Province, Nong Kung Si District, light trap insect 9, 14.IX.2014, W. Jaitrong leg.; 1 female (THNHM-I-09278), Khon Kaen Province, Mancha Khiri District, Mancha Khiri Plantation, 14.II.2014, W. Jaitrong leg.; 2 males (THNHM-I-09279 to THNHM-I-09280), Khon Kaen Province, Mancha Khiri District, Mancha Khiri Plantation, 1–2.VII.2014, W. Jaitrong leg.; 1 male (THNHM-I-09240) and 7 females (THNHM-I-09239, THNHM-I-09241 to THNHM-I-09246), Buriram Province, Khaen Dong District, Dong Phlong Forest Plantation, 29.I.2016, W. Jaitrong leg.; 1 male (THNHM-I-09284), Nakhon Ratchsima Province [= Korat], Sakaerat Environmental Research Station, 10.X.1969, unknown collector; 1 female (THNHM-I-09285), Nakhon Ratchsima Province [= Korat], Sakaerat Environmental Research Station, XI.1969, unknown collector; 1 female (THNHM-I-09287), Nakhon Ratchasima Province, Wang Nam Khiao District, Sakaerat Environmental Research Station, 16.V.2007, T. Jeenthong leg.; 1 male (THNHM-I-22831), Nakhon Ratchasima Province, Wang Nam Khiao District, Sakaerat Environmental Research Station, 11.V.2019, T. Jeenthong leg.; 1 male (THNHM-I-22833) and 1 female (THNHM-I-22832), Nakhon Ratchasima Province, Wang Nam Khiao District, Sakaerat Wildlife Research Station, 5.XI.2019, T. Jeenthong leg.

W THAILAND (n=12): 1 female (THNHM-I-09270), Tak Province, Tak Hotel, 15.III.1967, J. Fooden leg.; 3 females (THNHM-I-09271 to THNHM-I-09273), Tak Province, Tha Song Yang District, Moei River, 23.X.2014, T. Chan-ard leg.; 3 females (THNHM-I-09274 to THNHM-I-09276), Tak Province, Mae Sot District, Ban Pha Daeng, light trap, 10.III.2018, W. Jaitrong leg.; 1 female (THNHM-I-09277), Tak Province, Wang Chao District, Chiang Thong Plantation, 2.V.2014, W. Jaitrong leg.; 1 female (THNHM-I-09289), Kanchanaburi Province, Sai Yok District, Ban Phu Toei, 17.VI.1971, P. Lohavanigaya leg.; 1 female (THNHM-I-09290), Kanchanaburi Province, Kaeng Krachan National Park, Pala-U Waterfall, 23.III.2007, W. Jaitrong leg.; 2 males (THNHM-I-09297 to THNHM-I-09298), Petchaburi Province, Mueang District, roadside forest, 20.XI.2006, J. Nabhitabhata *et al*. leg. C THAILAND (n=11): 3 females (THNHM-I-09261 to THNHM-I-09263), Sukhothai Province, Sri Satchanalai District, 4.II.2013, W. Jaitrong leg.; 1 male (THNHM-I-09266) and 5 females (THNHM-I-09264 to THNHM-I-09265, THNHM-I-09267 to THNHM-I-09269), Sukhothai Province, Sri Satchanalai District, 27.V.2013, T. Jeenthong leg.; 1 female (THNHM-I-09281), Kamphaeng Phet Province, Ban Khlong Nam Lai Tai, 4.I.1967, J. Fooden leg.; 1 male (THNHM-I-22834), Saraburi Province, Kaeng Khoi District, Banpa Nature School, 28. VI.2020, T. Jeenthong leg. **E THAILAND** (n=19): 1 female (THNHM-I-22835), Nakhon Nayok Province, Mueang District, Nang Rong Waterfall, 31.VIII.2019, T. Jeenthong leg.; 1 female (THNHM-I-09291), Chachoengsao Province, Tha Takiap District, open site, 25. XI.2004, T. Jeenthong leg.; 1 female (THNHM-I-22838), Chachoengsao Province, Tha Takiap District, 110 m alt., 31.X.2005, Jin. and T. Jeenthong leg.; 1 female (THNHM-I-09292), Chonburi Province, Pattaya, 2.X.1967, G. Toman leg.; 1 female (THNHM-I-09293), Chonburi Province, Kram Island, 20.X.1917, S.S. leg.; 1 male (THNHM-I-09294) and 1 female (THNHM-I-09295), Chonburi Province, Si Racha District, 14.XI.1978, unknown collector; 1 female (THNHM-I-09296), Chonburi Province, Kasetsart University, Si Racha Campus, 19.IV.2003, J. Nabhitabhata leg.; 1 male (THNHM-I-22836) and 1 female (THNHM-I-22837), Chonburi Province, Si Racha District, Khao Kheow Open Zoo, 17.X.2015, W. Jaitrong leg.; 1 female (THNHM-I-09299), Chanthaburi Province, Pong Nam Ron District, Ban Krua Wai, 29.III.2009, T. Jeenthong leg.; 1 male (THNHM-I-09300), Trat Province, Mueang District, Trat Agro-forestry Research Station, headquater, 3.I.2006, W. Jaitrong leg.; 1 female (THNHM-I-09301), Trat Province, Khlong Yai District, Yada Resort, open area, 17.II.2009, T. Jeenthong leg.; 1 female (THNHM-I-09302), Trat Province, Khlong Yai District, Ta Nuek Waterfall, Ban Ta Nuek, 19.II.2009, T. Jeenthong leg.; 1 male (THNHM-I-09307) and 4 females (THNHM-I-09303 to THNHM-I-09306), Trat Province, Ko Kut District, Kut Island, Ban Khlong Chao, 11° 37’ 28.4’N, 102° 32’ 48.6’’E, 17–19.IV.2009, T. Jeenthong leg. **S THAILAND** (n=64): 1 female (THNHM-I-08509), Trang Province, Palian District, Thung Khai Peninsular Botanic Garden, 28.III.2005, W. Jaitrong leg.; 1 male (THNHM-I-09369) and 2 females (THNHM-I-09367 to THNHM-I-09368), Trang Province, Palian District, Thung Khai, 11.XII.2005, W. Jaitrong leg.; 10 males (THNHM-I-09308 to THNHM-I-09309, THNHM-I-093011, THNHM-I-09315 to THNHM-I-09319, THNHM-I-09321, THNHM-I-09323) and 6 females (THNHM-I-09310, THNHM-I-09312 to THNHM-I-09314, THNHM-I-09320, THNHM-I-09322), Chumphon Province, Mueang District, 13.XI.2001,

W. Jaitrong leg.; 1 female (THNHM-I-09324), Chumphon Province, Mueang District, 15.III.2002, W. Jaitrong leg.; 1 male (THNHM-I-09328) and 3 females (THNHM-I-09325 to THNHM-I-09327), Ranong Province, Kay Hotel, 2.IX.1967, N. Kobayashi leg.; 1 male (THNHM-I-09329), Ranong Province, Suk Samran District, Praphat Beach, 9° 22'N, 98° 23'E, alt. 9 m, 11.IX.2015, T. Jeenthong leg.; 1 female (THNHM-I-09330), Surat Thani Province, Chaiya District, gas station, 20.XI.2006, J. Nabhitabhata *et al*. Leg.; 1 female (THNHM-I-09331), Nakhon Si Thammarat Province, Lansaka District, 28.IV.2003, J. Nabhitabhata leg.; 1 male (THNHM-I-09332), Nakhon Si Thammarat Province, Papra, 4. IV.2006, T. Jeenthong leg.; 3 males (THNHM-I-09333 to THNHM-I-09335) and 1 female (THNHM-I-09336), Nakhon Si Thammarat Province, Sichon District, 4.IV.2006, T. Jeenthong leg.; 5 males (THNHM-I-09337, THNHM-I-09339 to THNHM-I-09340, THNHM-I-09343, THNHM-I-09345) and 5 females (THNHM-I-09338, THNHM-I-09341 to THNHM-I-09342, THNHM-I-09344, THNHM-I-09346), Nakhon Si Thammarat Province, Sichon District, light trap, 22–24.XI.2006, J. Nabhitabhata *et al*. leg.; 6 males (THNHM-I-09347 to THNHM-I-09349, THNHM-I-09351 to THNHM-I-09352, THNHM-I-09355) and 5 females (THNHM-I-09350, THNHM-I-09353 to THNHM-I-09354, THNHM-I-09356 to THNHM-I-09357), Nakhon Si Thammarat Province, Krung Ching Waterfall, tropical rainforest, 21–24.I.2007, N. Pinkhaw *et al*. Leg.; 3 females (THNHM-I-09358 to THNHM-I-09360), Nakhon Si Thammarat Province, Krung Ching Waterfall, tropical rain forest, 23.III.2007, W. Jaitrong leg.; 1 male (THNHM-I-09361), Nakhon Si Thammarat Province, Nopphitam District, Khao Nan National Park, Khlong Krai Station, 1.X.2008, W. Jaitrong leg.; 1 female (THNHM-I-22840), Nakhon Si Thammarat Province, Lan Sa Ka District, Khao Luang National Park, 17.XI.2003, T. Chan-Ard leg.; 1 female (THNHM-I-22841), Nakhon Si Thammarat Province, Tha Sala District, Khao Nan National Park, Huay Lak, 7. IV.2006, T. Jeenthong leg.; 3 males (THNHM-I-0963 to THNHM-I-09364, THNHM-I-09366) and 1 female (THNHM-I-09365), Krabi Province, Ko Lanta National Park, 16.III.2002, W. Jaitrong leg.; 1 female (THNHM-I-09370), Narathiwat Province, Waeng District, Lochut Subdistrict, Ban Ba-la, 23.IX.2011, T. Chan-Ard leg. NO DATA (n=3): 3 females (THNHM-I-08511 to THNHM-I-08513).

Distribution. India, China, Taiwan, Vietnam, Laos, Myanmar, Thailand (Chiang Mai, Mae Hong Son, Lampang, Tak, Sukhothai, Loei, Kamphaeng Phet, Chaiyaphum, Kalasin, Khon Kaen, Nakhon Ratchasima, Buriram, Kanchanaburi, Saraburi, Nakhon Nayok, Chachoengsao, Chonburi, Phetchaburi, Chanthaburi, Trat, Trang, Chumphon, Ranong, Surat Thani, Nakhon Si Thammarat, Krabi, and Narathiwat, Figure 8), Cambodia, Malaysia, Singapore, and Indonesia (Ohaus, 1915; Arrow, 1917; Ohaus, 1932; Ohaus, 1934; Paulian, 1959; Waterhouse, 1993; Lin, 1996).

Remarks. Pygidium, ventrum, and legs of this species are normally mixed with copper-red luster (Figures 2E, 2H, 3B–C, 4B–C), but the population from Central–Eastern Thailand are clearly uniformly metallic green (Figures 3D, 4D). This information matches the populations of the islands of South Vietnam in the remarks of *Anomala chloropus condorensis* Prokofiev (Prokofiev, 2015) Moreover, male parameres of Eastern Thailand populations seem shorter and clearly bent inward (Figure 6C).

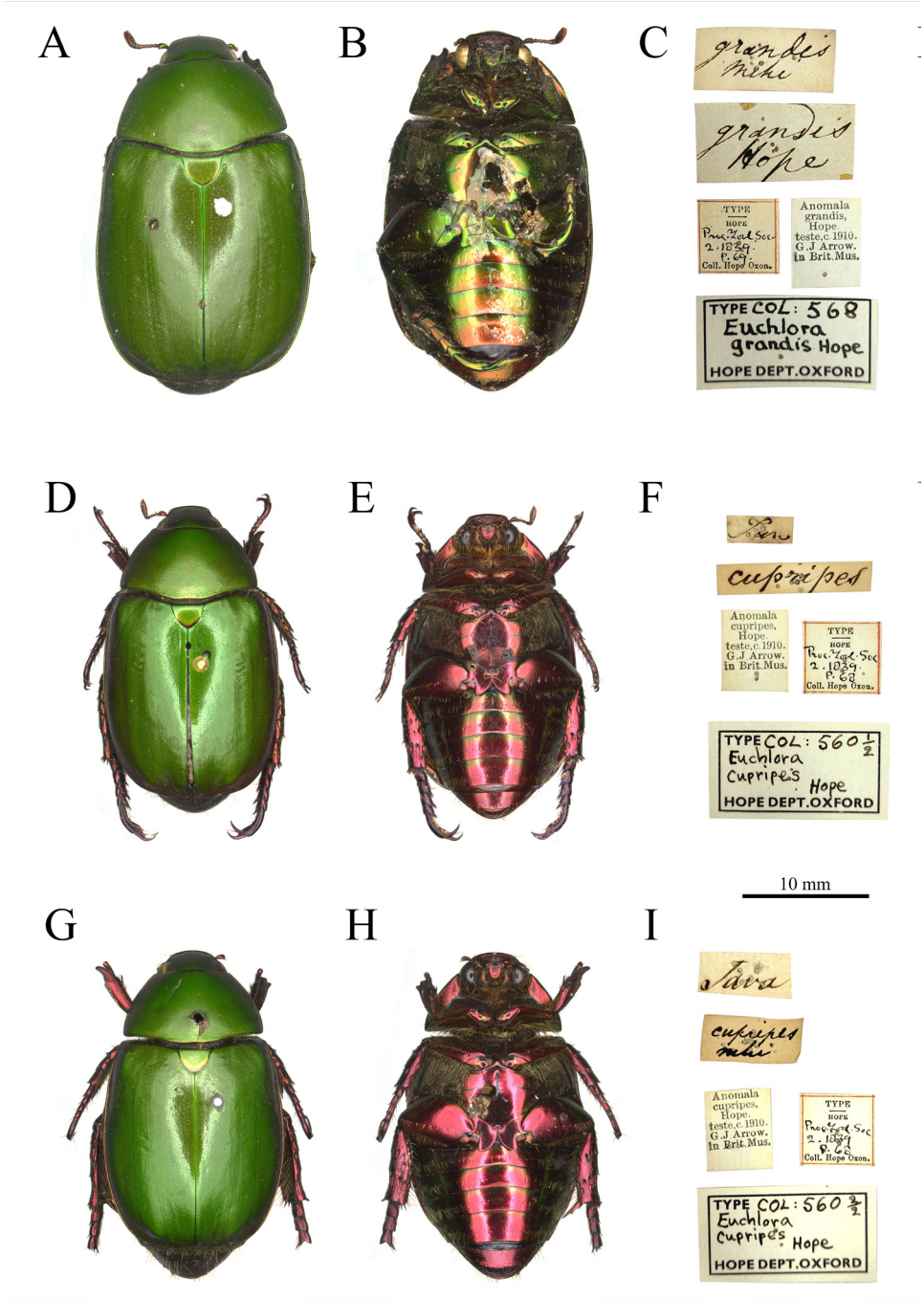

Figure 2. Type materials of large green *Anomala* spp. (OUMNH). A–C, *A. grandis*, Calcutta (COLE0568); D–F, *A. cupripes*, Java (COLE0560$^{1}/_{2}$); G–I, *A. cupripes*, Java (COLE0560$^{2}/_{2}$); A, D, G, dorsum; B, E, H – ventrum; C, F, I, type labels.

***Anomala diana* Zhang and Lin, 2008**
แมลงนูนเขียวพระอินทร์
(Figures 3E, 4E, 5E, 6D)

Anomala perplexa diana Zhang and Lin, 2008: 134, figs hM, hF, 26–29. Type locality: China, Yunnan Province (validated status as species by Prokofiev, 2021: 581).
Anomala diana: Prokofiev, 2021: fig. 21.

Diagnosis. Rather large in size, dorsum olive green, elytral surface with dense punctures; ventrum and legs shining metallic green with metallic copper luster; posterior corners of elytra round; pygidium with yellowish luster, surface mostly shagreened, anteromedial portion with foveae; male parameres rather shot with pointed but blunt apex, inner outline widely concave in dorsal view; ventral sclerite small, carinate backward as subrectangular in ventral view; parameres subcylindrical with round apex, ventral sclerite flat and almost invisible in lateral view.

Materials examined. N THAILAND (n=1): 1 male (THNHM-I-00028418), Chiang Mai Province, Doi Saket District, Thep Sadet Subdistrict, Mae Ton Luang, 11.VI.2020, T. Promsri leg.

Distribution. China and Thailand (Chiang Mai, **new record**, Figure 9) (Zhang and Lin, 2008).

Remarks. The only male specimen in this study shares the aedeagal morphology with *Anomala diana*; however, it is slightly different from aedeagus of the holotype of *A. diana*. Although the species concept of the ruteline beetle often was provided with a few small differences of male genitalia, somehow the variance in aedeagal structure across each species also seems to be rather diverse too (Huang and Wang, 2019; Moore *et al*., 2017). Due to a shortage of specimens, we thought it would be best to treat this specimen as *A. diana*.

***Anomala granuliformis* Lin, 1996**
แมลงนูนเขียวฟ้าหม่น
(Figures 3F–H, 4F–H, 5F–H, 6E–F)

Anomala granuliformis Lin, 1996: 310, fig. 8. Type locality: China, Yunnan Province, Lancang.
Anomala granuliformis: Zorn, 2006: 260; Zorn and Bezděk, 2016: 334; Zorn *et al*., 2017: 342; Zhao, 2021: 588.

Diagnosis. Large in size, dorsum dark green to deep blue, elytra with small punctures; pygidium, and ventrum shining with copper-golden metallic luster, but bluish-green in blue form; posterior corners of elytra round; median of pygidium with superficially dense granules; dorsal view of male parameres short with round apex; ventral sclerite enlarged, median of base elevated as convex ridge, anterior half widely dichotomous in ventral view; in lateral view, dorsal outline of parameres almost straight, apex round, base of ventral outline pointed downward; ventral sclerite with impressed (size and location depended on specimens), basal portion round while apical portion pointed downward in lateral view.

Materials examined. N THAILAND (n=1): 1 male (THNHM-I-09444), Chiang Mai Province, Mae Taeng District, Ban Kued Chang, 19° 19’ 04.1’’N, 98° 35’ 52.8’’E, Elevation 1,722 msl. 11.XI.2007, T. Jeenthong leg. **W THAILAND** (n=1): 1 male (THNHM-I-09445), Tak Province, Mae Sot District, Ban Pha Daeng, light trap, 4.X.2018, W. Jaitrong leg. **NE THAILAND** (n=2): 1 male (THNHM-I-09286), Nakhon Ratchasima Province, Sakaerat Environmental Research Station, dry evergreen forest, 9.V.2004, T. Jeenthong leg.; 1 male (THNHM-I-09446), Sakaerat Environmental Research Station, light trap, 19.IX.1968. **E THAILAND** (n=1): 1 male (THNHM-I-09288), Chanthaburi Province, Pong Nam Ron District, Thap Sai Subdistrict, Khao Kluea, 12° 51’ 06.3’’N, 102° 15’ 57.6’’E, 19.V.2008, T. Jeenthong leg.

Distribution. China, Vietnam, Laos, and Thailand (Chiang Rai, Chiang Mai, Tak, Nakhon Ratchasima, Chonburi, and Chanthaburi, Figure 8) (Lin, 1996; Zorn *et al*., 2017; Zhao, 2021).

Remarks. According to the available specimens, *A. granuliformis* is now limited from Northern and Eastern Thailand. Without examining specimens, it is hard to distinguish them from the sympatric species, *A. cupripes*. The species may be found outside of the current localities due to the widespread distribution and massive number of large green chafer.

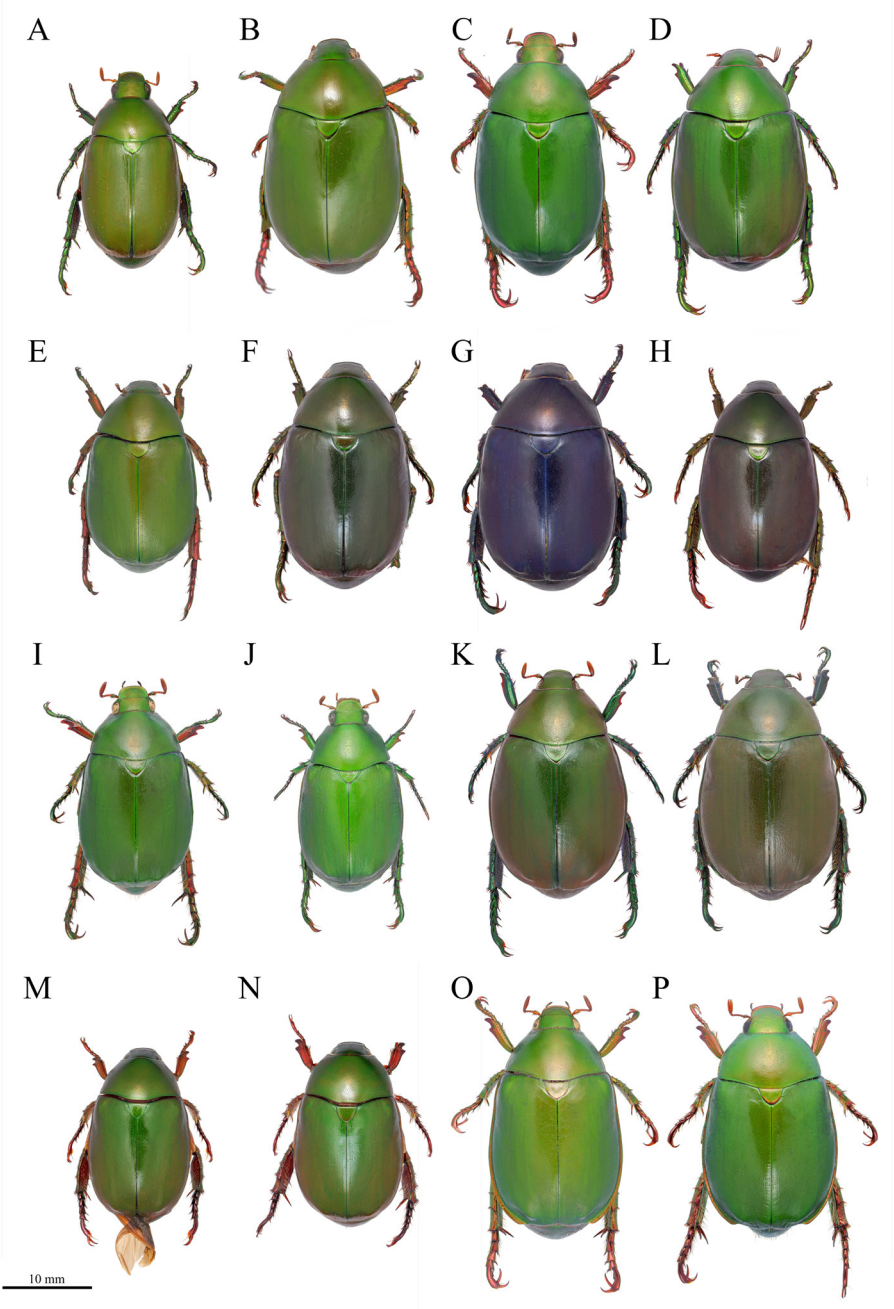

Figure 3. Dorsum of *Anomala* spp., Thailand. A. *A. collotra* (THNHM-I-09392); B–D. *A. cupripes* (B: THNHM-I-09254; C: THNHM-I-09283; D: THNHM-I-09307); E. *A. diana* (THNHM-I-00028418); F – H. *A. granuliformis* (F: THNHM-I-09286; G: THNHM-I-09444; H: THNHM-I-09238); I. *A. hemiseca* (THNHM-I-00028422); J. *A. heterotricha* (THNHM-I-00028419); K–L. *A. monochroa* (K: THNHM-I-00028420; L: THNHM-I-00028421); M–N. *A. semipurpurea* (M: THNHM-I-09362; N: THNHM-I-09396); O–P. *A. t. chlorochelys* (O: THNHM-I-00028423; P: THNHM-I-00028424); A–B, D–H, J–K, M, O. male; C, I, L, N, P. female.

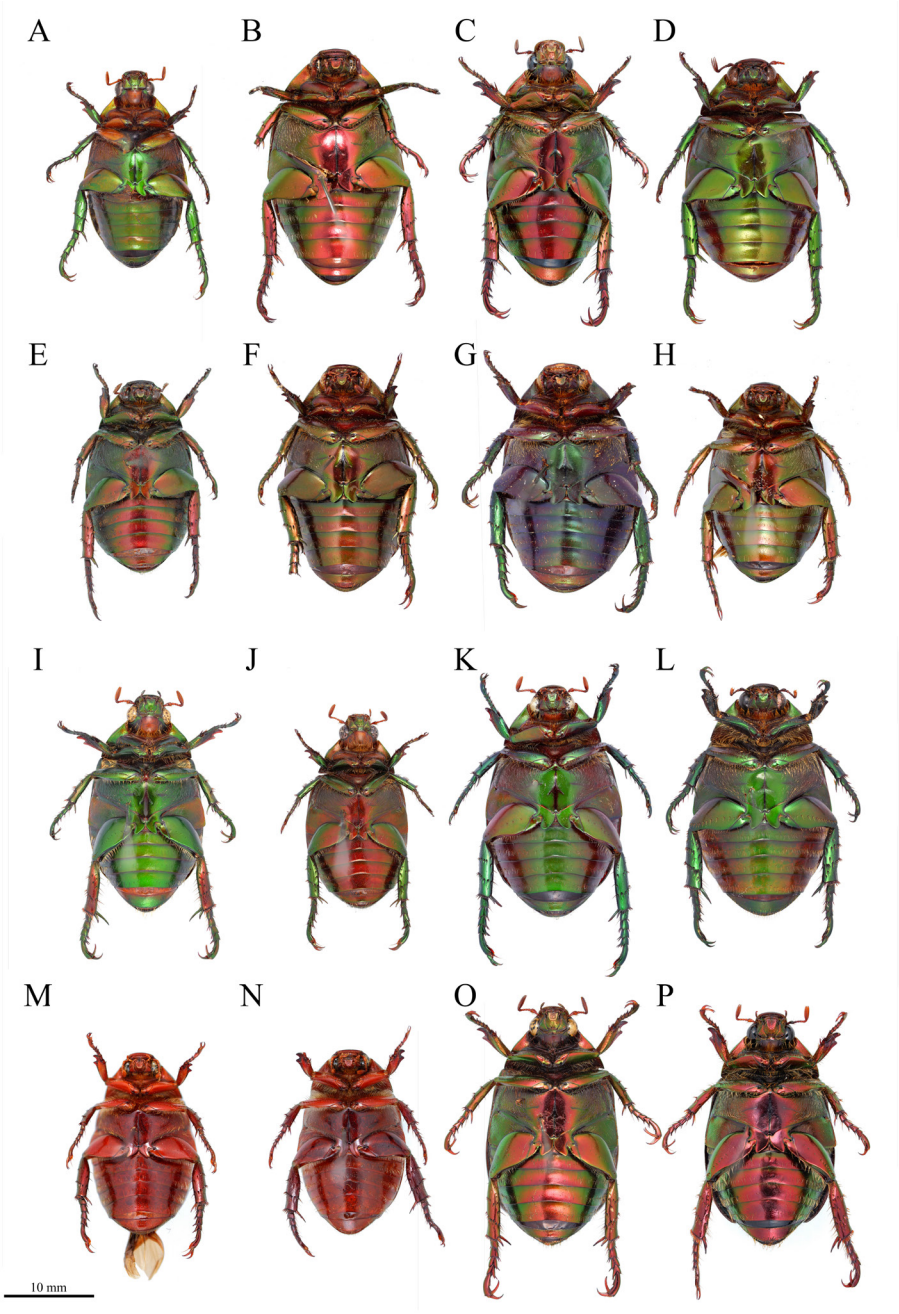

Figure 4. Ventrum of *Anomala* spp. Thailand. A. *A. collotra* (THNHM-I-09392); B–D. *A. cupripes* (B: THNHM-I-09254; C: THNHM-I-09283; D: THNHM-I-09307); E. *A. diana* (THNHM-I-00028418); F – H. *A. granuliformis* (F: THNHM-I-09286; G: THNHM-I-09444; H: THNHM-I-09238); I. *A. hemiseca* (THNHM-I-00028422); J. *A. heterotricha* (THNHM-I-00028419); K–L. *A. monochroa* (K: THNHM-I-00028420; L: THNHM-I-00028421); M–N. *A. semipurpurea* (M: THNHM-I-09362; N:THNHM-I-09396); O–P. *A. t. chlorochelys* (O: THNHM-I-00028423; P: THNHM-I-00028424); A–B, D–H, J–K, M, O. male; C, I, L, N, P. female.

***Anomala hemiseca* Zhang and Lin, 2008**
แมลงนูนเขียวท้ายพาดกลอน
(Figures 3I, 4I, 5I)

Anomala hemiseca Zhang and Lin, 2008: 130, figs dM, dF, 13–16. Type locality: China, Yunnan Province.
Anomala hemiseca: Zorn and Bezděk, 2016: 334.

Diagnosis. Size rather large, dorsum green without distinct metallic luster, elytra minutely punctate, ventrum shining almost uniformly metallic green, tibiae reddish copper-red; elytral margination obsolete near maximum widest of elytra, posterolateral corners of elytra round; ground color of pygidium green, lateral portions with a pair of yellow longitudinal patches, surface shagreened.

Materials examined. N THAILAND (n=1): 1 female (THNHM-I-00028422), Nan Province, Bo Kluea District, 19° 11’ 13.7”N, 101° 10’ 05.7”E, light trap, 19.IV.2021, L. Khaton leg.

Distribution. China and Thailand (Nan, **new record,** Figure 9) (Zorn and Bezděk, 2016).

Remarks. In the first study, this species was described “pygidium with metallic luster and usually an indistinct light fusco-rufous long pattern on two sides”. However, this character of a specimen in THNHM is relatively different from the description, its pygidium is almost indistinct luster with clearly visible yellow patches (Figure 5I).

***Anomala heterotricha* Ohaus, 1916**
แมลงนูนเขียวบ้านป่า
(Figures 3J, 4J, 5J, 7A)

Anomala heterotricha Ohaus, 1916: 94, fig. 42. Type locality: Sumatra, Palembang.
Anomala heterotricha: Ohaus, 1918: 103; Ohaus, 1934: 65.

Diagnosis. Rather large in size, body somewhat slender, dorsum light green, elytral surface densely punctate; ventrum and femora shining with metallic copper luster, pygidium and remaining leg parts uniformly metallic green; posterior corners of elytra round; pygidium mostly shagreened, anteromedial portion foveate; male parameres long with stout apex, inner outline sinuate in dorsal view; ventral sclerite small with anterior outline distinctly impressed, median portion elevated as small tubular in ventral view; parameres long with round apex, partly elevation of ventral sclerite visible as subtriangular in lateral view.

Materials examined. C THAILAND (n=1): 1 male (THNHM-I-00028419), Saraburi Province, Kaeng Khoi District, Banpa Nature School, 20–21.VI.2020, T. Unnahachote leg.

Distribution. Indonesia and Thailand (Saraburi, **new record,** Figure 9) (Ohaus, 1916).

Remarks. From hitherto knowledge, *A. heterotricha* has only been known from Sumatra since Ohaus’s description, but the species was surprisingly collected in Central Thailand, where it is so far from the type locality in this study. Its distribution possibly widens from Sundaic to Indochinese regions.

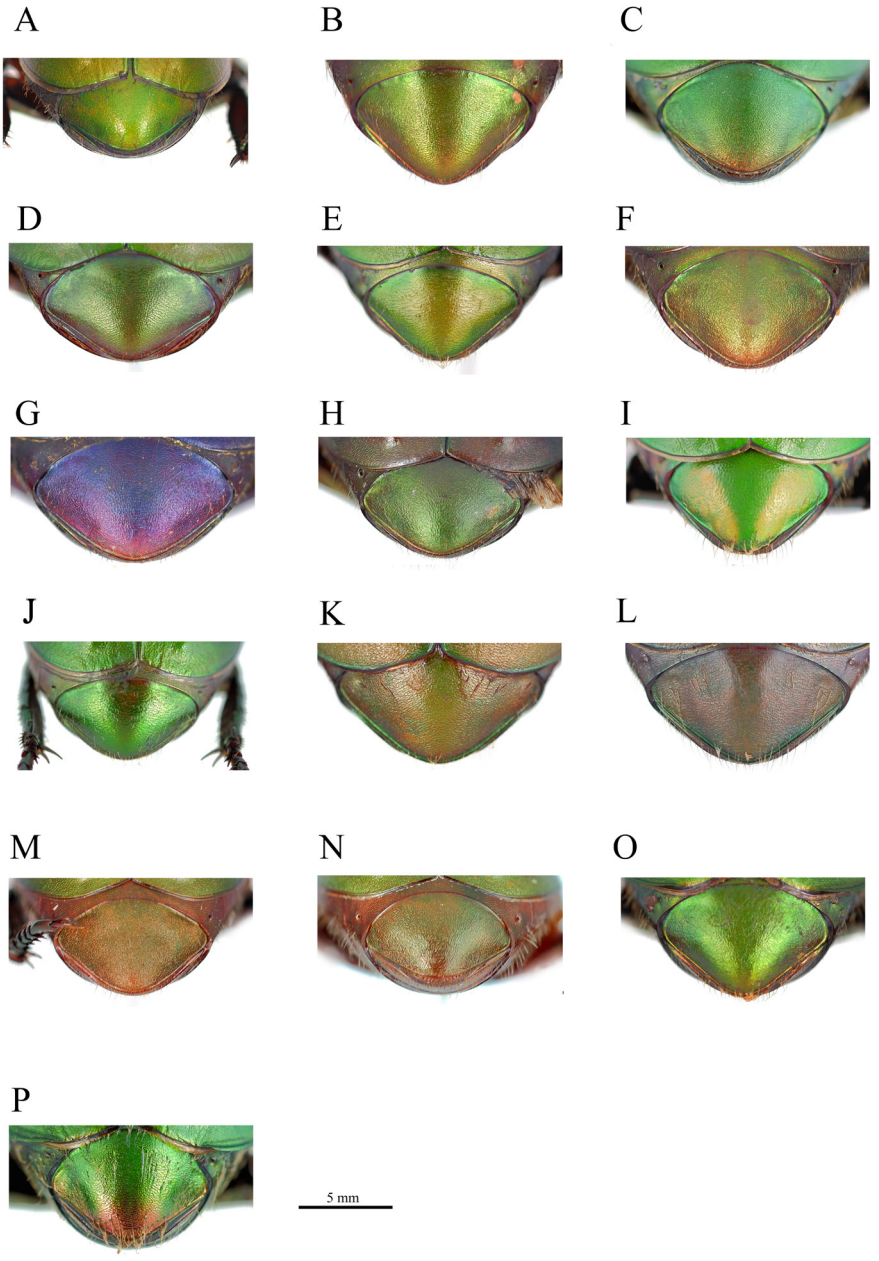

Figure 5. Pygidium of *Anomala* spp., Thailand. A. *A. collotra* (THNHM-I-09392); B–D. *A. cupripes* (B: THNHM-I-09254; C: THNHM-I-09283; D: THNHM-I-09307); E. *A. diana* (THNHM-I-00028418); F – H. *A. granuliformis* (F: THNHM-I-09286; G: THNHM-I-09444; H: THNHM-I-09238); I. *A. hemiseca* (THNHM-I-00028422); J. *A. heterotricha* (THNHM-I-00028419); K–L. *A. monochroa* (K: THNHM-I-00028420; L: THNHM-I-00028421); M–N. *A. semipurpurea* (M: THNHM-I-09362; N: THNHM-I-09396); O–P. *A. t. chlorochelys* (O: THNHM-I-00028423; P: THNHM-I-00028424); A–B, D–H, J–K, M, O. male; C, I, L, N, P. female.

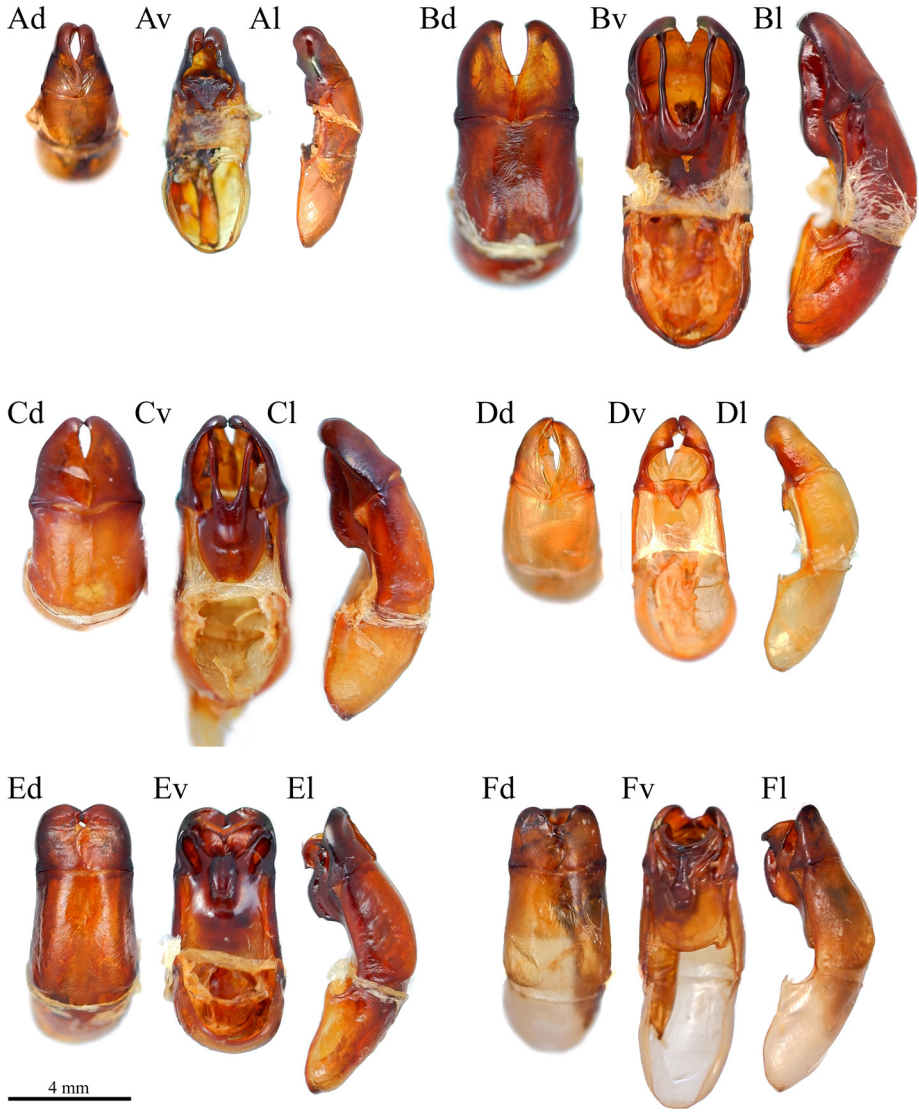

Figure 6. Male aedeagus of *Anomala* spp., Thailand. A. *A. collotra* (THNHM-I-09392); B–C. *A. cupripes* (B: THNHM-I-09254; C: THNHM-I-09307); D. *A. diana* (THNHM-I-00028418); E–F. *A. granuliformis* (E: THNHM-I-09286; F: THNHM-I-09444); d. dorsal view; v. ventral view; l. lateral view.

***Anomala monochroa* (Bates, 1891)**
แมลงนูนเขียวป่าใต้
(Figures 3K–L, 4K–L, 5K–L, 7B)

Euchlora monochroa Bates, 1891: 18. Type locality: Kulu Kaschmir. (synonymized genus with *Anomala* by Burmeister, 1844: 276; noted as incorrect type locality by Arrow, 1917: 231; Zorn, 1998: 499).

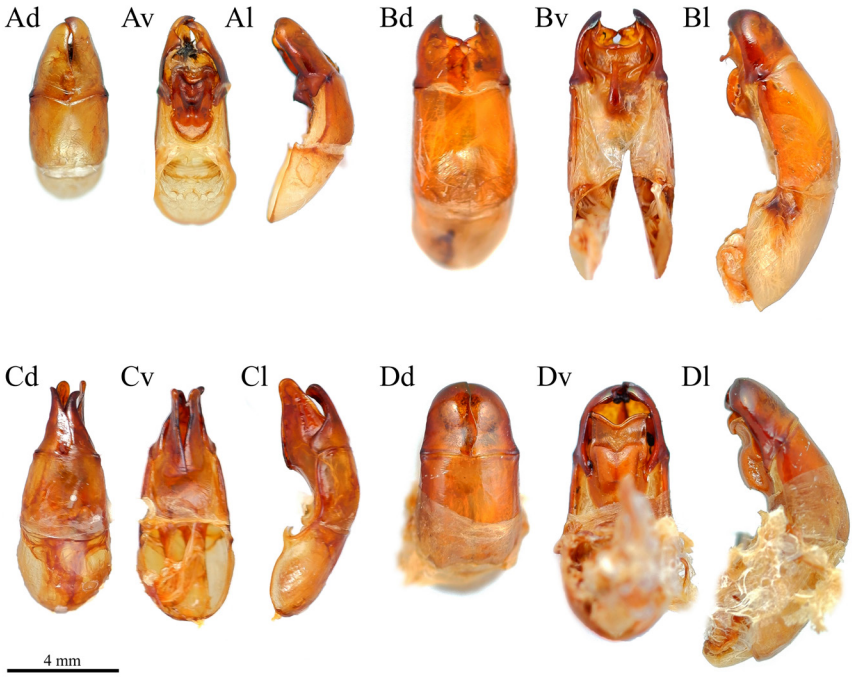

Figure 7. Male aedeagus of *Anomala* spp., Thailand (continued). A. *A. heterotricha* (THNHM-I-00028419); B. *A. monochroa* (THNHM-I-00028420); C. *A. semipurpurea* (THNHM-I-09362); D. *A. t. chlorochelys* (THNHM-I-00028423); d. dorsal view; v. ventral view; l. lateral view.

Anomala monochroa (Bates, 1891): Arrow, 1917: 231; Ohaus, 1918: 103; Ohaus 1934: 62; Zorn, 1998: 498.

Anomala (*Euchlora*) *psittacina* Ohaus, 1916: 104, fig. 50. Type locality: Sumatra. (synonymized with *A. monochroa* by Zorn, 1998: 498).

Diagnosis. Large in size, dorsum deep green, elytra with rather dense and moderately large punctures; pygidium, ventrum, and legs uniformly metallic green or rarely with reddish tinted; posterior corners of elytra round; pygidium densely shagreened; dorsum of male parameres short, outer outline convex, apical inner outline concave with small and sharp protruding medially, apex sharply pointed; ventral sclerite largely produced, base elevated medially, median of base elevated as convex ridge, anterior half widely dichotomous in ventral view; in lateral view, dorsal outline of paramere almost straight, apex round, base of ventral outline pointed downward; ventral sclerite with impressed (size and location depended on specimens), basal portion round while apical portion pointed downward in lateral view.

Materials examined. S THAILAND (n=27): 1 male (THNHM-I-09371) and 2 females (THNHM-I-09372 to THNHM-I-09373), Nakhon Si Thammarat Province, Thung Yai District, Prik Subdistrict, 6.V.2003, Unknown collector; 1 male (THNHM-I-09374) and 1 female (THNHM-I-09375), Nakhon Si Thammarat Province, Lan Saka District, 19–20.V.2003, W. Jaitrong leg.; 1 male (THNHM-I-09378) and 5 females (THNHM-I-09376 to THNHM-I-09377, THNHM-I-09379 to THNHM-I-09381), Nakhon Si Thammarat Province, Krung Ching Waterfall, tropical rain forest, 23.III.2007, W. Jaitrong leg.; 2 males (THNHM-I-09382 to THNHM-I-09383), Nakhon Si Thammarat Province, Nopphitam District, Khlong Krai Station, 1.VIII.2008, W. Jaitrong leg.; 2 females (THNHM-I-09384 to

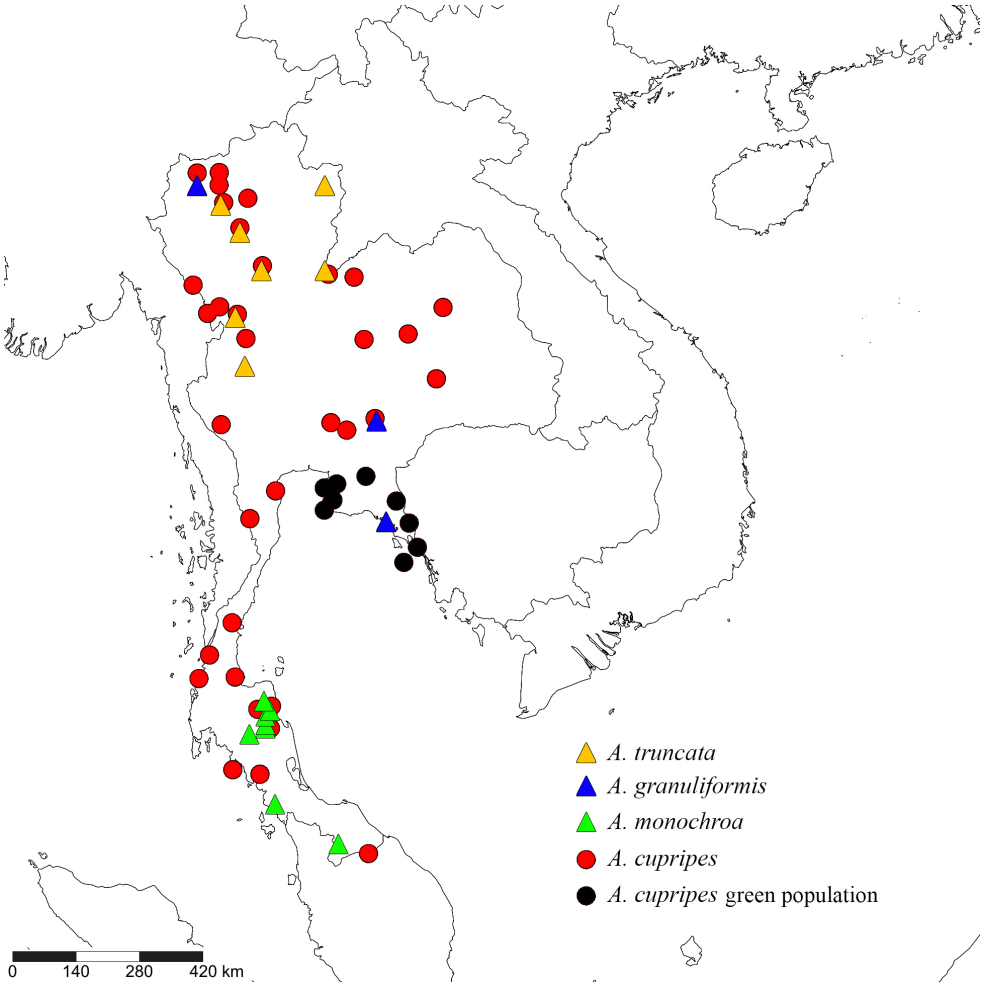

Figure 8. Distributional map of large green chafer in Thailand.

THNHM-I-09385), Nakhon Si Thammarat Province, Sichon District, , Huay Khiao Waterfall, 1.IX.2008, W. Jaitrong leg.; 1 female (THNHM-I-09386), Nakhon Si Thammarat Province, Sichon District, Huay Khiao, 1.X.2008, W. Jaitrong leg.; 2 females (THNHM-I-09387 to THNHM-I-09388), Nakhon Si Thammarat Province, Sichon District, Huay Khiao, 20.IV.2008, T. Jennthong leg.; 1 male (THNHM-I-09389) and 1 female (THNHM-I-09390), Nakhon Si Thammarat Province, Sichon District, Yodnam Waterfall, 26.VI.2008, W. Jaitrong leg.; 1 male (THNHM-I-22830) and 1 female (THNHM-I-22829), Nakhon Si Thammarat Province, Lan Saka District, Khao Luang, 17.XI.2013, W. Jaitrong leg.; 1 female (THNHM-I-09391), Satun Province, 3–29.VIII.1967, K. Thonglongya leg.; 1 male (THNHM-I-00028420) and 1 female (THNHM-I-00028421), Yala Province, Betong District, V.2021, S. Sae-Liang leg.

Distribution. Myanmar, Thailand (Nakhon Si Thammarat, Satun, and Yala, Figure 8), Malaysia, and Indonesia (Ohaus, 1916; Arrow, 1917; Ohaus, 1932; Ohaus, 1934; Zorn, 1998).

Remarks. We noticed two forms of the species among all the specimens, while the body of individuals surrounding Nakhon Si Thammarat Province is evenly oval and green, the pop-

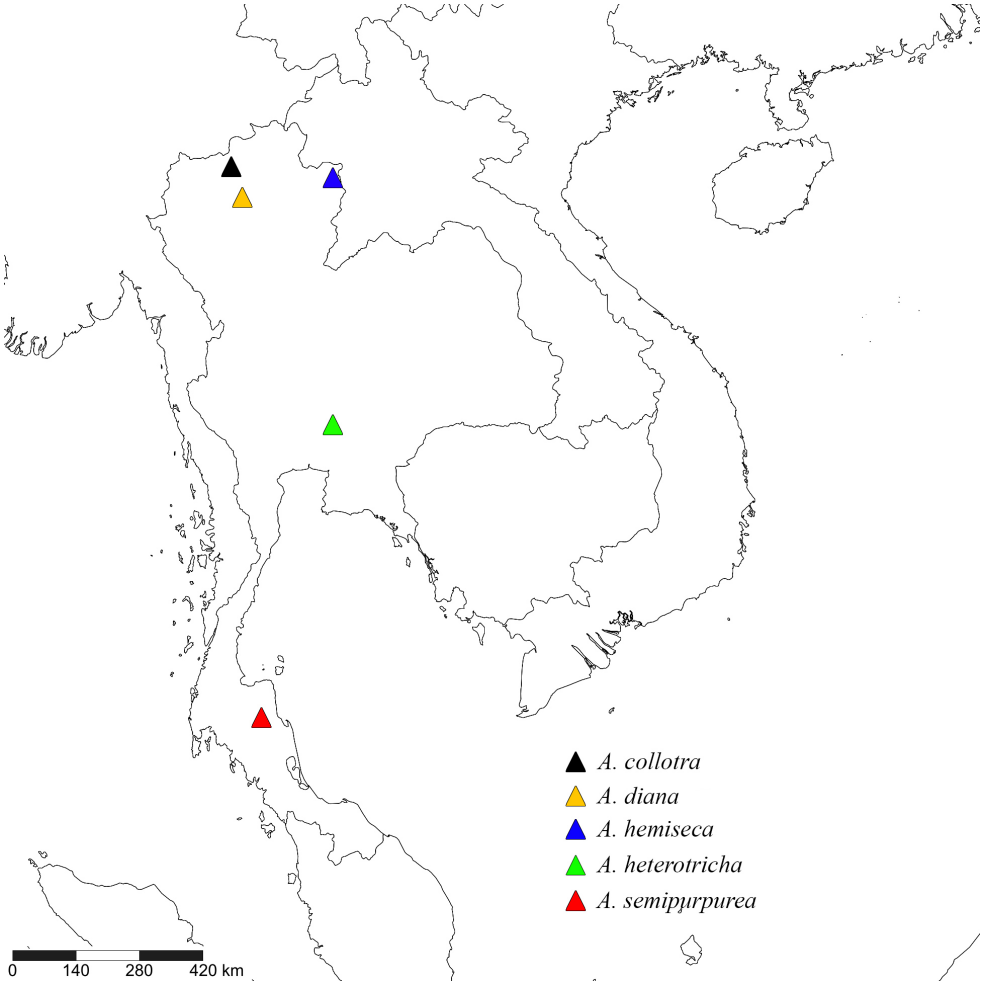

Figure 9. Distributional map of large green chafer in Thailand (continued).

ulation near Yala Province is obviously ovoid and more reddish, but there was no dissimilarity between aedeagal structures from those two localities.

***Anomala semipurpurea* Burmeister, 1855**
แมลงนูนเขียวสลับแดง
(Figures 3M–N, 4M–N, 5M–N, 7C)

Anomala semipurpurea Burmeister, 1855: 505 Type locality: Sumatra.
Anomala semipurpurea: Ohaus, 1918: 104; Ohaus, 1932: 135; Ohaus, 1934: 66.

Diagnosis. Rather large in size, dorsum mostly green with weak yellowish luster, elytral surface punctate; ventrum and legs glossy red, but not shining as metallic; posterior corners of elytra round; pygidium shining reddish green with reticulate surface; in dorsal view, ventral sclerite of male aedeagus clearly visible, parameres subtriangular with apex curvedly bent

outward; in ventral view, ventral sclerite well-developed as two large pieces; in lateral view, ventral outline of parameres greatly concave as sickle-shaped with round apex, ventral sclerite superficially rhombus with size much large than parameres.

Materials examined. S THAILAND (n=4): 2 males (THNHM-I-09362 and THMHM-I-09396) and 2 females (THNHM-I-09394 and THMHM-I-09395), Nakhon Si Thammarat Province, Sichon District, Huay Khiao Waterfall, 8° 55’ 09.2”N, 99° 40’ 34.8”E, 20.IV.2008, T. Jeenthong leg.

Distribution. Thailand (Nakhon Si Thammarat, **new record,** Figure 9), Malaysia and Indonesia (Ohaus, 1932).

Remarks. The Malay Peninsula and Sumatra were primarily distribution areas of the species, at this moment, Nakhon Si Thammarat Province is the northernmost point of distribution.

***Anomala truncata chlorochelys* Arrow, 1912**
แมลงนูนเขียวปีกหลังบาน
(Figures 3O–P, 4O–P, 5O–P, 7D)

Anomala (*Euchlora*) *chlorochelys* Arrow, 1912: 310. Type locality: Bhamo, Myanmar (synonymized with *Anomala truncata* Bates, 1890 and validated as a subspecies by Lin, 1996: 306).

Anomala truncata chlorochelys: Lin, 1996: 306; Zorn and Bezděk, 2016: 340.

Diagnosis. Size notably large, dorsum glossy grass green, elytra sparsely and minutely punctate, ventrum shining as metallic with wide copper-red luster; posterolateral corners of elytra distinctly expanded; pygidium metallic green with copper red luster, surface shagreened; male parameres very short with round apex, inner outline bisinuate in dorsal view; ventral sclerite clearly developed, base swollen as subrectangular with a hollow medioapically, anterior outline with a rather deep concave medially in ventral view; in lateral view, dorsal outline and apex of parameres roundly convex, ventral outline concave; ventral sclerite strongly sinuate in lateral view.

Materials examined. N THAILAND (n=5): 1 male (THNHM-I-00028423) and 1 female (THNHM-I-00028424), Nan Province, Bo Kluea District, 19° 11’ 137”N, 101° 10’ 057”E, light trap, 19.IV.2021, L. Khaton leg.; 2 females (THNHM-I-09227 to THNHM-I-09228), Chiang Mai Province, Doi Pui, 3–17.V.1967, K. Thonglongya leg.; 1 male (THNHM-I-22828), Lampang Province, Hang Chat District, Thung Kwian Forest Plantation, light trap, 27.VI.2013, T. Jeenthong leg. **NE THAILAND** (n=1): 1 female (THNHM-I-09229), Loei Province, Na Haeo District, Phu Suan Sai National Park, 1.VI.2002, W. Jaitrong leg. **W THAILAND** (n=4): 2 males (THNHM-I-09235 to THNHM-I-09236) and 2 females (THNHM-I-09237 to THNHM-I-09238), Tak Province, Wang Chao District, Chiang Thong Plantation, light trap, 19.VI.2014, W. Jaitrong leg. **C THAILAND** (n=5): 1 female (THNHM-I-09234), Sukhothai Province, Si Satchanalai District, 27.VI.2013, T. Jeenthong leg.; 4 females (THNHM-I-09230 to THNHM-I-09233), Uthai Thani Province, Huai Kha Khaeng Wildlife Sanctuary, 1–2. VI.2002.

Distribution. Nepal, China, Vietnam, Myanmar, and Thailand (Nan, Chiang Mai, Lampang, Tak, Sukhothai, Loei, and Uthai Thani, Figure 8) (Arrow, 1912; Arrow, 1917; Leksawasdi, 1993; Zorn and Bezděk, 2016; Wang, 2021).

Remarks. In THNHM, the southernmost distribution of this species is Uthai Thani Province, Central Thailand. However, the first author has discussed with some other Coleopterist and found that this species maybe occurred along the Myanmar–Thailand border through Southern Thailand and Malaysia.

Key to species of Thai large green chafer in genus *Anomala* Samouelle, 1819

1 Larger species, TL clearly over 20 mm. **2**
- Smaller species, TL ≤ 20 mm. **5**
2 Posterior corners of elytra expanded (Figures 3O–P). ..... ***A. t. chlorochelys***
- Posterior corners of elytra round, expansion of margin indistinct (Figures 3B–D, F–H, K–L) **3**
3 Dorsum deep green with moderately large punctures; ventrum uniformly metallic green or rarely with reddish tinted; particularly in Southern Thailand. ..... ***A. monochroa***
- Dorsum color generally green (rarely blue), surface minutely punctate; ventrum usually with copper metallic luster (partly uniformly metallic green); Widespread distributed in Thailand. **4**
4 Dorsal body oval, surface shining grass green; pygidium densely shagreened; ventral sclerite of male aedeagus formed as two deep and elongated branches in ventral view. ***A. cupripes***
- Dorsal body somewhat ovate, surface dark green to deep blue; pygidium superficially granulate; ventral sclerite of male aedeagus enlarged, median of base elevated as convex ridge, apex widely dichotomous in ventral view. ..... ***A. granuliformis***
5 Elytra incompletely marginate, obsolete near maximum widest of elytra; lateral portions of pygidium with a pair of longitudinal yellow patches (Figure 5I); femora metallic green without reddish coloration. ..... ***A. hemiseca***
- Elytra almost completely marginated; coloration of pygidium uniform (Figures 5A, E, J, M–N); femora reddish or at least with yellow-red luster. **6**
6 Surface of elytra punctate; pygidium shining reddish green with reticulate surface; ventrum uniformly glossy red; ventral sclerite of male aedeagus much larger than parameres in lateral view. ..... ***A. semipurpurea***
- Surface of elytra rather densely punctate; pygidium shining green with surface shagreened; ventral colored base metallic green with yellow-red luster; ventral sclerite of male aedeagus much smaller than parameres in lateral view. **7**
7 Dorsum oval; tibiae and tarsi shining with copper-red luster; inner margin of parameres widely concave in dorsal view; anterior outline of ventral sclerite almost straight in ventral view. ..... ***A. diana***
- Body fairly elongate oval in dorsal view; tibiae and tarsi uniformly metallic green; inner margin of parameres sinuate in dorsal view; anterior outline of ventral sclerite distinctly impressed in ventral view. **8**
8 Apical margin of clypeus almost straight; dorsum olive green, yellowish tinted upon dorsum, pygidium, ventrum, and femora; parameres short, inner outline widely and deeply sinuate; median of ventral sclerite without elevation; China to Northern Thailand. ..... ***A. collotra***
- Apical margin of clypeus roundly convex; dorsum bright green, pygidium uniformly metallic green, ventrum, and femora shining with reddish metallic luster; parameres somewhat long, median of ventral sclerite elevated as small tubule; Indonesia to Central Thailand..... ***A. heterotricha***

Acknowledgments

We would like to thank Dr. Weeyawat Jaitrong, Tatsanai Jeenthong and the staff at THNHM (Thailand) who allowed the first author to examine specimens in their collection, and Rob Douglas (OUMNH, Parks Road, Oxford, London, UK) who enabled images and information of type specimens of *A. cupripes* and *A. grandis*. Furthermore, we sincerely appreciate Carsten Zorn (Gnoien, Germany) who helpfully suggested valuable knowledge.

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