

Taxonomic Review of the Genus *Phola* Weise, 1890 (Coleoptera: Chrysomelidae: Chrysomelinae)

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Abstract

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The taxonomic status of *Phola octodecimguttata* (Fabricius, 1775) and its synonyms are re-evaluated. *Phyllophila sedecimpustulata* Stål, 1857 as a junior synonym of *Phola octodecimguttata* is supported by examining their type specimens and genital characters in a large number of specimen. In addition, *Chalcolampra dipa* Maulik, 1926 **n. syn.** is herein synonymized with *Phola octodecimguttata*. *Phola decempustulata* (Baly, 1864) **n. comb.**, transferred from *Chalcolampra*, is examined and redescribed. New data on the biology of *P. octodecimguttata* are provided. Its association with the coastal plant *Vitex rotundifolia* helps explain its occurrence on many small islands.

Key words: Leaf beetle, Taxonomy, Lamiaceae, *Vitex*, Island biogeography.

INTRODUCTION

The genus *Phola* was established by Weise (1890) for *P. keyserlingi* Weise, 1890 for a single species, *P. keyserlingi* Weise, 1890. It was synonymized with *Chalcolampra* Blanchard, 1835 by Daccordi (1994), and this synonymy was followed by Kippenberg (2010) and some Japanese researchers (e.g., Takahashi 2012; Kamezawa 2015; Shigetoh 2019, 2020a; Shigetoh *et al.* 2019). However, the type species of *Phola* and *Chalcolampra* both occur in and were treated in a detailed revision of the Australian Chrysomelinae genera by Reid (2006). Based on morphological and biological differences, he regarded them both as distinct genera. Most subsequent taxonomists agreed with his opinion (Yang *et al.* 2015; Matsumura *et al.* 2018; Suenaga *et al.* 2018; Shigetoh 2020b, 2020c). In the present study, we therefore decided to also follow Reid (2006) by treating *Phola* and *Chalcolampra* as distinct genera.

Phola octodecimguttata (Fabricius, 1775) seems to be a widespread species with variable color patterns. It is not surprised to such a species having many synonyms. Several synonyms have been proposed by various authors. *Chalcolampra (Phyllophila) cybele* was described from Hong Kong (China) by Stål (1860) and was synonymized by Gressitt & Kimoto (1963). *Chalcolampra viticis* was described from Jiangxi (China) by Fairmaire (1888) and synonymized by Chen (1934). *Phola keyserlingi* was described from Sichuan (China) by Weise (1890) and synonymized by Jacoby (1896). In addition, *Phyllophila sedecimpustulata* was described from Pulo Penang (Malaysia) by Stål (1857). It was synonymized by Baly (1867), but Kimoto & Gressitt (1981) still regarded it as valid species based on larger size and its distinct color pattern, and Mohamedsaid (1993, 1997) followed their opinions. None of the acts, however, provided strong morphological or biological evidence from a

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wide geographical sampling. Consequently, some synonymizations were not fully acknowledged. In addition, there could be more potential synonyms of *P. octodecimguttata* or true *Phola* species remained hidden in *Chalcolampra*. This study re-evaluate the taxonomic status of each specific names by examining genitalic characters of both sexes collected from different localities.

In addition to *Phola octodecimguttata* (Fabricius, 1775), two species originally described as *Chalcolampra* can be attributed to *Phola*: these are *C. decempustulata* Baly, 1864 from Becan Island (Maluku, Indonesia) and *C. dipa Maulik*, 1926 from Andaman Island (India). These two are currently treated as valid species. The aim of our present study is to re-evaluate the synonymy of *P. octodecimguttata* and its relatives, including *Chalcolampra dipa* and *C. decempustulata* based on a large material collected throughout their geographic range, and to give more detailed re-descriptions of all the valid species of the genus. Fresh material collected in Taiwan also allows us to add some notes on the biology of *P. octodecimguttata*.

MATERIALS AND METHODS

To study the biology of *P. octodecimguttata* in detail, the beetles from Taiwan were collected from the field and kept for captive breeding together with their host plant *Vitex rotundifolia* for a complete generation. Females laid eggs inside the plastic bags when they were collected on May 7, 2008 (Fig. 5A). Hatched larvae were placed in small glass containers (diameter 142 mm × height 50 mm) with cuttings from host plants. When mature larvae began searching for pupation sites, they were transferred to smaller plastic containers (diameter 90 mm × height 57 mm) filled with moist soil, the amount about 80% of container volume.

The present study is based on morphological examination of over 400 dry-mounted adult specimens. For delimiting variability of diagnostic characters, at least one pair from each locality was examined. Length was measured from the anterior margin of the eye to the ely-

tral apex, and width at the greatest width of the elytra. Type specimens available for study and voucher specimens are deposited at The Natural History Museum, London, UK (BMNH); Naturhistoriska Riksmuseet, Stockholm, Sweden (NHRS); the Laboratory for Systematic Entomology, Hokkaido University, Sapporo, Japan (SEHU), and the Applied Zoology Division, Taiwan Agricultural Research Institute, Taichung, Taiwan (TARI); Zoological Institute, Russian Academy of Science, St. Petersburg, Russia (ZIN).

Exact label data are cited for all type specimens of described species; a double slash (//) divides the data on different labels and a single slash (/) divides the data in different rows. Other comments and remarks are in square brackets: [p] – preceding data are printed, [h] – preceding data are handwritten, [w] – white label, and [r] – red label.

RESULTS

Genus Phola Weise, 1890

Phola Weise, 1890:482 (type species: *Phola keyserlingi* Weise, 1890, by monotypy, a junior synonym of *Chrysomela octodecimguttata* Fabricius, 1775).

Phyllophila Stål, 1857:59 (nec Guenée, 1852) (type species: *Phyllophila sedecimpustulata* Stål, 1857).

Remarks. The genus *Phyllophila* Stål, 1857 was synonymized with *Chalcolampra* Blandchard, 1853 by Baly (1867) who regarded *P. sedecimpustulata* Stål, 1857 as a junior synonym of *C. octodecimguttata* (Fabricius, 1775). However, *Phyllophila* has been preoccupied by a moth genus described by Guenée (1852). Chen (1934) noticed that *Phyllophila* Stål was a junior homonym, also a distinct genus from *Chalcolampra*. He confirmed the validity of *Phola* Weise, 1890 and used the name to replace *Phyllophila* Stål, 1857.

A detailed generic diagnosis was provided by Reid (2006). The genus is similar to *Chalcolampra* but differs in possessing larger eyes

and almost impunctate venters and epipleura. Biological characteristics are based on the type species, *Phola octodecimguttata* (see below).

Included species. *Phola octodecimguttata* (Fabricius, 1775) and *P. decempustulata* (Baly, 1864), **comb. nov.**

Even though Reid (2006) only mentioned a single described species in Australia (*P. octodecimguttata*), Australian Faunal Directory (Australian Biological Resources Study (ABRS) 2020) lists four additional species: *P. decemmaculata* (Lea, 1903), *P. delicatula* (Lea, 1916), *P. quadrifasciata* (Lea, 1916), *P. tenuis* (Lea, 1916) and *P. vitticollis* (Lea, 1915). We are not able to find a published source formally transferring these species to *Phola*, nor are we able to confirm their generic placement. We are not treating these species in the present study but acknowledge the possibility that they may indeed be members of *Phola*.

Distribution. Oriental region, extending into Japan, Australia, Solomon Islands, and Papua New Guinea.

Phola octodecimguttata (Fabricius, 1775)

Chrysomela octodecimguttata Fabricius, 1775:100 (Nova Hollandia = Australia); Fabricius 1781:123 (catalogue); Gmelin 1790:1676 (catalogue); Fabricius 1792:322 (catalogue); Fabricius 1801:439 (catalogue).

Phyllocharis octodecimguttata: Boisduval 1835:575.

Chalcolampra octodecimguttata: Baly 1855:186 (re-examination of the type specimens); Baly 1867:281 (Malaysia, Singapore, Sri Lanka); Harold 1874:3467 (catalogue); Jacoby 1884:27 (Indonesia: Sumatra); Jacoby 1896:254 (India: Kanara; Malaysia: Perak; China); Weise 1916:199 (catalogue); Maulik 1926:87 (redescription: India, Sri Lanka, Myanmar); Winkler 1930:1298 (catalogue: China); Wang & Yang 2006:66 (China: Gansu); Takahashi 2012:280 (Japan: Honshu: Tottori Prefecture; Kyushu: Kagoshima Prefecture; Shikoku: Kochi Prefecture); Kamezawa 2015:52 (Japan: Bôsô-hantô Peninsula); Shige-

toh & Yoshitake 2018:35 (Japan: Yoro-jima Island); Shigetoh 2019:22 (Japan: Tonaki-jima Island); Shigetoh *et al.* 2019:146 (Japan: Ou-jima Island); Shigetoh 2020a:43 (Japan: Tsuken-jima Island).

Phola octodecimguttata: Chen 1934:81 (redescription, China: Jiangsu, Jiangxi, Zhejiang; Taiwan; Philippines: Luzon; Vietnam); Chûjô 1935a:81 (Japan: Ishigaki, Iriomote, and Okinawa Islands); Chûjô 1935b:211 (distribution); Chûjô 1958 (redescription; Taiwan, including Pescadores (= Penghu Islands 澎湖群島) and Botel-Tobago (= Lanyu Island 蘭嶼); Chen 1936:90 (catalogue); Nakane & Kimoto 1961a:75 (Japan: Nakanoshima Island and Takara-jima Island); Nakane & Kimoto 1961b:17 (Japan: Ishigaki Island); Chûjô & Kimoto 1961:154 (list; Japan: Okinawa, Tokara Islands); Gressitt & Kimoto 1963:372 (China: Anhui, Guandong, Guanxi, Fujian, Shanxi, Hainan); Kimoto 1964a:285 (catalogue; Japan: Kyushu); Kimoto 1964b:487 (Taiwan: Takao = Kaohsiung); Kimoto 1966:25 (Taiwan: Takao = Kaohsiung); Kimoto & Gressitt 1966:517 (Japan: Amami-Ôshima); Kimoto 1969:22 (Taiwan: Taoyuan: Kuanyin (觀音); Lanyu Island); Azuma & Kimoto 1978:125 (Japan: Yonaguni Island); Azuma & Kimoto 1981 (Japan: Hateruma Island, Tarama Island, Yakabi Island, Iheya Island); Kimoto & Gressitt 1981:390 (catalogue); Wang *et al.* 1998:51 (China: Fujian: Wuyishan 武夷山); Yang *et al.* 2015:4 (China: Hebei, Hubei, Hunan, Guizhou); Matsumura *et al.* 2018:13 (Japan: Iheya-jima Island); Suenaga *et al.* 2018:107 (Japan: Tokunoshima Island); Yamazaki *et al.* 2019:33 (Japan: Iheyajima Island); Shigetoh 2020b:48 (Japan: Ou-jima Island); Shigetoh 2020c:151 (Japan: Yoron-jima Island).

Phyllophila sedecimpustulata Stål, 1857: 59 (Malaysia: Pulo Penang). Synonymized by Baly (1867).

Phola sedecimpustulata: Kimoto & Gressitt 1981:390 (valid species; Thailand, Laos, Vietnam).

Chalcolampra sedecimpustulata: Mohamedsaid 1993:6 (East Malaysia: Sabah); Mo-

hamedsaid 1997:122 (Peninsular Malaysia: Johor, Kedah, Melaka, Negeri Sembilan, Pahang, Selangor, Terengganu).

Chalcolampra (Phyllophila) cybele Stål, 1860:464 (China: Hong Kong). Synonymized by Gressitt & Kimoto (1963)

Chalcolampra viticis Fairmaire, 1888:39 (China: Jiangxi); Chen 1938:1 (list). Synonymized by Chen (1934)

Phola keyserlingi Weise, 1890:482 (China: Sichuan). Synonymized by Jacoby (1896)

Chalcolampra dipa Maulik, 1926:89 (India: Andaman Islands). **syn. nov.**

Types. *Chrysomela octodecimguttata* (Figs. 1A–D). Two syntypes in the Banks collection at the BMNH, among them one bearing a transverse square label: “*Chrys: 18guttata* [h] / Fab. Entom. p. [p] 100. n. sp. [h, w, with black border]; the other one damaged seriously, with one circle label: “97 / 89 [h, w]”. Here the intact specimen (Fig. 1A) is designated as the lectotype and the other specimen with lost right elytron (Fig. 1B) as the paralectotype.

Phyllophila sedecimpustulata (Figs. 1E–H). Holotype ♀ (NHRS, fixed by monotypy): “Pulo / Penang [h, w] // Westerm [p, w] // *Phyllophila / 16pustulata* / St. [h, w] // Type. [p, w] // NHRS-ALJB / 000000798 [p, w]”.

Chalcolampra (Phyllophila) cybele (Figs. 1I–L). Holotype ♀ (NHRS, fixed by monotypy): “Hong / Kong [h, w] // Stål [h, w] // Type. [p, w] // Typus [p, r, with black border] // *Cybele* / Stål. [h, w] // NHRS-ALJB / 000000797 [p, w]”.

Phola keyserlingi. (Figs. 2A–D). Holotype ♀ (ZIN, fixed by monotypy): “Sze-tchuan / 1885 / G. Patanin. [p, w] // 22/VIII [h, under-side of the same label] // unicum [h, w, probably mening returning material] // *Phola / Keyserlingi* Ws. [h, w]”. This type was supposed to be deposited at the Museum für Naturkunde der Humboldt-Universität, Berlin, German (ZMB) (Gressitt & Kimoto 1963) probably because it was described by Weise. However, Bernd Jäger (curator at the ZMB) indicated that the type should be at the ZIN since it was collected by Potanin during the Russian expedition to Mongolia and China (personal communication, June

16, 2023). Alexey Moseyko (curator at the ZIN) confirmed its existence (personal communication, July 14, 2023).

Chalcolampra dipa (Figs. 2E–H). Holotype ♂ (BMNH, fixed by monotypy): “Andaman / Islands [p, w] // Roepstorff [p, w] // Type [p, w, circle label with red border] // *Chalcolampra / dipa* Maulik [h] / Det. S. Maulik [p] / Type 1923 [h, w] // 47461 [h, w]”.

Specimens examined. AUSTRALIA. New South Wales: 1♂ (BMNH); Northern Territory: 2♂, 2♀ (BMNH), Darwin, 1915–381, leg. G. F. Hill; 1 ex. (BMNH), same locality, 1909, coll. G. Bryang; 1♂ (BMNH), same but with “1921–274”; Queensland: 1 ex. (BMNH), Bundaberg, 1904, coll. R. C. L. Perkins; 1 ex. (BMNH), Cairns, XI.1909, leg. G. E. Bryant; 2 exs. (BMNH), same but “II.1909”; 4♂, 4♀ (SEHU), Lone Pine, 8.I.1973, leg. Y. Komiya; 148 exs. (BMNH), Thursday Island, 14.I.1939; 2 exs. (BMNH), Townsville, 11.II.1903, leg. F. P. Dodd; 2 exs. (BMNH), same locality, 1921–274, leg. G. F. Hill; 2♂, 2♀ (BMNH), same but with “1922–230”; **BRUNEI.** 1 ex. (BMNH), Seira, at light, V.–VII.1978, leg. P. H. Hammond & J. E. Marshall; **CHINA.** 1♂ (BMNH), “N.China”; Fujian: 1♀ (BMNH), Chongan (崇安), 9.II.1969, leg. S. Q. Jiang; 1♀ (BMNH), same locality, 10.VI.1960, leg. Y. R. Zhang; 9 exs. (BMNH), Foochow (= Fuzhou, 福州), 1935, leg. M. S. Yang; 1 ex. (BMNH), same but “1936”; 1 ex. (BMNH), same but “10.VI.1936”; 1♂ (BMNH), Jianyang (建陽), 19.VI.1960, leg. S. Q. Jiang; Gansu: 1♀ (BMNH), Wenxian (文县), 27.VI.1998, leg. X. K. Yang; Hong Kong: 2♂, 1♀ (BMNH), coll. Baly; Yunnan: 1 ex. (TARI), Mocheng (磨整), 19.III.2018, leg. Y. T. Wang; 4 exs. (TARI), Mohan (磨憨), 19.III.2018, leg. Y. T. Wang; 1 ex. (TARI), same locality, 1.IV.2018, leg. Y. T. Wang; 1 ex. (TARI), same locality, 13.V.2018, leg. C. C. Chen; 1 ex. (TARI), Nabang (那邦), 27.V.2016, leg. Y. T. Wang; 1 ex. (TARI), same but with “17.VI.2017”; 1 ex. (TARI), same but with “20.VI.2017”; 1 ex. (TARI), same but with “30.VI.2017”; **INDIA.** Andaman Islands: 1 ex. (BMNH). Tamil Nadu: 1♂ (BMNH), Nilgiri

Hills, 1894-89, leg. G. F. Hampson; **INDONESIA**. Java: 1♂ (BMNH), 60-15, coll. Horsfield; Kalimantan: 1 ex. (BMNH), Borneo, S. East, German Mission, Fry Coll.; Sulawesi: 1♀ (BMNH), Sulawesi Utara, Dumoga-Bone N. P., Fog 13, BMNH Plot A, 230 m, 11.VII.1985, Project Wallace; Sumatra: 3 exs. (TARI), Sanggul, IV.2004, leg. S. Jakl; **JAPAN**. Amami Islands: Amami-Oshima: 3♂, 3♀ (SEHU), Katsutsu, Setouchi-chô, 22.VII.1962, leg. Y. Komiya; 1♀ (SEHU), Sude, Setouchi-chô, 13.VII.1962, leg. Y. Komiya; Okinawa Islands: Iriomote Island: 4♂, 9♀ (TARI), V.1932, leg. S. Hirayama; 2♀ (SEHU), Ohara, 23.V.1977, leg. J. Okuma; 1♂ (SEHU), same but with "7.VI.1977"; 1♀ (SEHU), Toyohara, 25.V.1977, leg. J. Okuma; Ishigaki Island: 1♂, 2♀ (TARI), 22.IV.1930, leg. R. Takahashi 2♂, 6♀ (TARI), V.1933, leg. S. Hirayama; 1♂, 2♀ (SEHU), Hirakubo, 1.IV.1976, leg. K. Kusama; 2♀ (SEHU), Tomino, 5.V.1976, leg. M. Yagi; Okinawa Island: 2 exs. (TARI), Mawashi, 12.VI.1932, leg. H. Yashiro; 2♂, 4♀ (TARI), Naha, Loo-Choo (= Okinawa Island), 4.V.1931, leg. S. Asahina; 1♂ (TARI), Syuri, 11.IV.1937, leg. A. Morisita; **MALAYSIA**. Johor: 1♂, 1♀ (BMNH), Mt. Ophir, 23.VIII.1905; 1 ex. (BMNH), Nr. Jitra, catchment area, 8.IV.1928, ex F.M.S. Museum; 1 ex. (BMNH), West Coast, Langkawi Is., 22.IV.1928, ex F.M.S. Museum; Kelantan: 1♀ (BMNH), Tebing Tinggi, VII.1920, Coll. V. Knight, ex F.M.S. Museum; Kuala Lumpur: 1♀ (BMNH), 12.XI.1934; 1♀ (BMNH), 2.III.1919; Melaka: 1♂, 1♀ (BMNH); 2 exs. (BMNH), coll. H. Clark: 1 ex. (BMNH), coll. Baly; 1♀ (BMNH), 1901-37, coll. H. N. Ridley; 1 ex. (BMNH), C.B.H. Hunt. 1908-194; Penang: 1♂ (BMNH), coll. Pascoe; Perak: 1♀ (BMNH), 1905-313, coll. Sharp; 1♂ (BMNH), 1905-100, leg. Doherty; 4 exs. (BMNH), Fry Coll; 1 ex. (BMNH), Perak Museum, Taiping, ex F.M.S. Museum; 1 ex. (BMNH), Kuala Kangsar, VIII.1907, R.H. Coll., ex F.M.S. Museum; Sabah: 1♀ (SEHU), Poring, 9.IV.1979, leg. N. Nishikawa; Sarawak: 2 exs. (BMNH), Bidi, 1. II.1909, leg. C. J. Brooks; 1♂ (BMNH), 17th ml., kls Rd., 17.VIII.1963, coll. S. Kueh; Selangor: 1♂ (SEHU), Templer Park, 23.XII.1983, leg. M. Takakuwa; **MYANMAR**. Bago Region: 1♂ (BMNH), Tharrawaddy; Chin State: 1 ex. (TARI), Kanpetlet, 24.V.2017, leg. Y. T. Wang; 1 ex. (TARI), Mindat, 22.V.2017, leg. Y. T. Wang; 1♀ (BMNH), North Chin Hills, 1894-4; Mandalay Region: 4 exs. (TARI), Mt. Popa, 25-26.V.2017, leg. Y. T. Wang; **PAPUA NEW GUINEA**. Jiwaka: 1♂, 1♀ (BMNH), Jimi Valley, 20.VII.1972, leg. B. Gray; **PHILIPPINES**. 1 ex. (BMNH), "Phil.Isla"; **SINGAPORE**. 1 ex. (BMNH), 1933-227, coll. Saunders; **SOLOMON ISLANDS**. Guadalcanal: 1♀ (BMNH), Kukum, 25.V.1963, leg. P. J. M. Greenslade; 1♀ (BMNH), same but "10.I.1963"; 1♀ (BMNH), same but with "2.I.1965"; 8♂, 2♀ (BMNH), same but with "11.II.1965"; Shortland: 1♀ (BMNH), Alu (= Shortland), III.1884; **SRI LANKA**. 1♂, 2♀ (BMNH), Ceylon (= Sri Lanka); 1 ex. (BMNH), Balangoda, 1776 ft., 13-16. III.1882, coll. G. Lewis; 1 ex. (BMNH), Dikoya, 6.XII.1881-16.I.1882, coll. G. Lewis; 1 ex. (BMNH), Kandy, 1919-147, coll. G. Bryant; 1 ex. (BMNH), same but "VI.1908"; 1♂, 2♀ (BMNH), Peradeniya, 26.VIII.1914, leg. A. Rutherford; **TAIWAN**. Hualien: 1♀ (TARI), Karenko (= Hualien, 花蓮), 21.IV.1910, leg. I. Nitobe; Kaohsiung: 25 exs. (TARI), Baolai (寶來), 17.IV.2016, leg. U. Ong; 1♂ (TARI), Rokki (= Liuguei, 六龜), 2.V.1907, leg. I. Nitobe; 1♀ (TARI), same locality, 23.X.1921, leg. M. Yoshino; 1♂ (SEHU), 26.IV.1978, leg. Y. Komiya; 2♀ (SEHU), Liuguei, Kenshan, 20.III.1978, leg. Y. Ito; 1♀ (TARI), Rono (= Laonung, 荖濃), 3.V.1907, leg. I. Nitobe; Matsu: 3 exs. (TARI), Beigan Island (北竿島), 11.V.2023, leg. C. F. Lee; New Taipei City: 5 exs. (TARI), Qianshuiwan (淺水灣), 7.V.2007, H. J. Chen; 9 exs. (TARI), same but with "25.V.2007"; 3 exs. (TARI), Linshanpi (麟山鼻), 15.IX.2007, leg. S. F. Yu; 1♀ (TARI), Sinten (= Hsindien, 新店), VII.1929, leg. Y. Miwa; Penghu: 1♀ (TARI), Bokoto (= Penghu Island, 澎湖本島), 25.IV.1920, leg. T. Shirake; 4 exs. (TARI), Donji Island (東吉嶼), 19.V.2023, leg. Y. C. Liao; 1♀ (TARI), Hookotoo (= Penghu), V.1930, leg. S. Minowa; Kinmen: Kinmen Island (金門島): 8 exs. (TARI),

Jinsha (金沙), 13.IV.2022, leg. C. F. Lee; Lieyu Island (烈嶼): 13 exs. (TARI), Xihu (西湖), 2.V.2015, leg. Y. J. Chang; 6 exs. (TARI), same but with “Chilinsan (麒麟山)”; Pingtung: 3♂, 1♀ (TARI), Heito (= Pingtung, 屏東), V.–VI.1931, leg. Y. Miwa; 1 ex. (TARI), Junaishan (女乃山), 28.XI.2020, leg. Y. T. Chung; 2♂, 2♀ (BMNH), Kenting (墾丁), 2.VIII.2008, at light, leg. H. Mendel, M. V. L. Barclay; 1 ex. (TARI), same locality, 26.VII.2016, leg. Y. T. Chung; 2♂ (TARI), Koshun (= Hengchun, 恆春), 25.IV.–25.V.1918, leg. J. Sonan; 1♂ (TARI), Gueishan (龜山), 3.IV.2023, leg. J. C. Chen; 7 exs. (TARI), Lilungshan (里龍山), 7.VIII.2015, leg. Y. T. Chung; 7♂, 2♀ (TARI), Liuqui Island (琉球嶼), 22–23.III.1982, leg. K. C. Chou & C. C. Pan; 1♂ (TARI), Rikiriki (= Lilisheh, 力里社), 22.III.1924, leg. N. Takeda; 1♂, 1♀ (SEHU), Shimen (Shihmen), 17.V.1975, leg. M. Kubota; 2 exs. (TARI), same locality, 12.V.2012, leg. Y. L. Lin; Taitung: 23♂, 32♀ (TARI), Kotosho (= Lanyu Island, 蘭嶼), 10.III.–14.IV.1920, leg. J. Sonan & T. Okuni; 4♂ (TARI), same locality, III.–IV.1932, S. Hirayama; 15 exs. (TARI), same locality, 28.I.2010, leg. Y. T. Wang; 1 ex. (TARI), same locality, 17.III.2012, leg. J. C. Chen; 2 exs. (TARI), same locality, 1.IV.2014, leg. Y. T. Chung; 1 ex. (TARI), same locality, 7.IV.2015, leg. Y. T. Wang; 3 exs. (TARI), same locality, 7.V.2015, leg. Y. T. Chung; 1 ex. (TARI), same locality, 27.VII.2015, leg. Y. T. Wang; 1 ex. (TARI), Shouka (壽卡), 28.IV.2015, leg. Y. T. Chung; 1♂ (TARI), Taito (= Taitung, 台東), 25.II.–27.III.1919, leg. S. Inamura; 4 exs. (TARI), Taren (達仁), 17.IX.2008, leg. W. C. Wang; **THAILAND**. 1 ex. (BMNH), “Siam, Bowring” Chiang Mai: 9 exs. (BMNH), Chiang Dao res. nat. 10–23.III.2010, leg. Machálik. Kanchanaburi; 1♀ (SEHU), Doi Suthep, 3.V.1980, leg. Y. Komiya; 1♂ (SEHU), same locality, VI.1985; 1♀ (SEHU), Phuping Palace, 29.IV.1980, leg. K. Ikeda; 1♀ (SEHU), Whuay Kaeo Falls, 1.VI.1983, leg. Y. Komiya; Kanchanaburi: 1 ex. (BMNH), Sai Yok, 26.III.1988, leg. M. J. D. Brendell; 1♂ (SEHU), Tham Than Lot N. P., 15–16.II.1981, S. Ohmomo; Lanpang: 1♂, 1♀ (SEHU), Mae Lung Mountain, 20.V.1985, Y. Komiya; Mae Hong Son: 2♂♂

(BMNH), Ban Huai Po, 17–23.V.1991, leg. J. Horák; 1♂ (BMNH), Ban Si Lang, 23–31.V.1991, leg. J. Horák; Nan: 1♂, 2♀ (SEHU), 15.V.1993, leg. S. Ohmomo; Nan: 2 exs. (BMMH), Doi Phu Kha N. P., 22–26.IV.1999, leg. D. Hauck; Phrae: 2♂ (SEHU), Wieng Ko Sai N. P., 19.V.1985, leg. Y. Komiya.

Redescription. Length 5.5–8.8 mm, width 2.7–4.7 mm. General color variable (see “Color variations”). Antenna filiform in males (Fig. 3A), ratios of lengths of antennomeres I–XI 1.0 : 0.6 : 0.7 : 0.7 : 0.8 : 0.8 : 0.8 : 0.8 : 0.9 : 0.9 : 1.2; ratios of length to width from antennomeres I–XI 2.1 : 1.6 : 1.9 : 2.0 : 2.1 : 1.9 : 1.8 : 1.8 : 1.9 : 2.1 : 2.8; shorter in females (Fig. 3B), ratios of lengths of antennomeres I–XI 1.0 : 0.6 : 0.7 : 0.7 : 0.8 : 0.8 : 0.8 : 0.8 : 0.9 : 0.9 : 1.2; ratios of length to width from antennomeres I–XI 2.1 : 1.6 : 1.8 : 1.9 : 2.0 : 1.8 : 1.7 : 1.9 : 2.0 : 2.0 : 2.9. Pronotum 1.6–1.7 times wider than long; disc evenly convex, glabrous but with dense fine punctures; lateral margins straight in small individuals but slightly rounded in large individuals; apical margin slightly concave, basal margin slightly convex in small individuals, but producing posteriorly at middle in large individuals. Elytra 1.4–1.5 times longer than wide; parallel-sided, apices convergent; disc with coarse punctures arranged into longitudinal striae, with scarce, fine punctures between striae punctures. Aedeagus (Figs. 3C, 3D) slender, 6.1 times longer than wide; narrower in apical 1/6, apex narrowly rounded; moderately curved in lateral view; tectum membranous, with a paired, longitudinally sclerotized area; internal sac with elongate flagellum and two pairs of slender sclerites, one pair longitudinal, sinuous and basally connected, other pair separated and curved. Gonocoxae (Fig. 3G) separate; abdominal tergite IX longitudinal, basally narrowed; abdominal ventrite IX coiled, broad; coxites cylindrical, with a ring of long setae near apex; styli cylindrical, much narrower than coxites, with several long apical setae, surrounding by short setae. Ventrite VIII (Fig. 3F) in females wide and spiculum reduced, with a paired longitudi-

nally sclerotized area, dense, long setae along apical margin, a few setae of different lengths scattered near apex. Spermathecal receptaculum (Fig. 3E) slender, narrower than pump, not separated from pump; pump long and curved, apex widely rounded; sclerotized spermathecal duct slender, not coiled.

Sexual dimorphism. Apical margin of abdominal ventrite V truncate, slightly and medially convex in males, but widely rounded in females.

Color variations. Adults of *Phola octodecimguttata* display great variation in color patterns, depending on where they occur across the species' geographic distribution. Color patterns can be categorized into four major forms as follow:

(1) The octodecimguttata form (Figs. 4A–C): general color yellowish-brown; antenna black except three basal antennomeres; vertex with one black spot; pronotum with three black spots: one circular pair near midline of basal 1/3, and a single spot smaller and longitudinal at midline of apical 1/3; scutellum brown; elytra dark brown but with nine pairs of large yellow spots: two pairs near base, basal 1/3, middle, apical 1/3 respectively, one pair apically, with yellow band along basal margin extending from base of lateral margin to middle, sometimes connected with yellow spots; prothoracic ventrites yellowish-brown, meso-, and metathoracic, and abdominal ventrites dark brown but sides of abdominal ventrites more or less yellowish-brown; legs yellowish-brown, but apices of femora and bases of tibiae dark brown, tarsi more or less darker; typical of specimens from Australia and South India. Yellow spots enlarged and connected with other spots in some individuals (Fig. 4D); spots smaller in populations from Solomon Islands and Papua New Guinea. Populations from Sri Lanka (Fig. 4F) similar to those of Solomon Islands (Fig. 4E) and Papua New Guinea, with small yellow spots on elytra but with one additional pair of dark brown

spots on pronotum between pair of circular spots and single longitudinal spot.

- (2) The cybele form (Figs. 3G–I): similar to typical form of octodecimguttata, but longitudinal brown spot on pronotum more or less reduced, mesoventrite paler, with yellow band along base of lateral margin to apex, typical of specimens from eastern China, Taiwan, and Japan. Populations on islands surrounding China (such as Hong Kong, Kinmen Islands) (Figs. 4J, 4K) with yellow spots on elytra extremely enlarged, sometimes brown areas greatly reduced.
- (3) The sedecimpustulata form (Figs. 1E–G): similar to those of octodecimguttata with small yellow spots on elytra, but general color reddish-brown, vertex and pronotum without black spots, paired yellow spots on apices and yellow bands along lateral margins reduced, metathoracic ventrites darker, legs similar typical octodecimguttata form; typical of specimens collected from western China (Yunnan), Myanmar, Peninsular Malaysia, Indonesia, and Thailand; black spots on vertex and pronotum present in few specimens. Specimens from Singapore, Brunei, and East Malaysia with one pair of yellow spots on apices of elytra (Fig. 4L).
- (4) The dipa form (Figs. 2E–G): similar to typical octodecimguttata, but interior of lateral and posterior yellow spots on elytra brown; meso-, and metathoracic, and abdominal ventrites yellowish-brown.

Diagnosis. Adults of *Phola octodecimguttata* are easily separated from those of *P. decempustulata* with their characteristic color patterns; in addition, there are significant differences in female genitalic characters. Females of *P. octodecimguttata* have a broad spermathecal receptaculum (Fig. 3E), as broad as pump, and a broad, short duct (slender spermathecal receptaculum (Fig. 8C), narrower than pump, and extremely slender and coiled duct in *P. decempustulata*), and complete ventrite VIII with one pair of longitudinal dark bands (Fig. 3F) (medially separated ventrite VIII in *P. decempustulata* (Fig. 8B)).

Host plants. *Vitex rotundifolia* L. f. (Chûjô & Kimoto 1961; current study), *Vitex negundo* L. (Hsieh 2012), *V. negundo* var. *cannabifolia* (Siebold & Zucc.) Hand.-Mazz. (Chen 1964, 1985; Yu *et al.* 1996; current study); *Vitex trifolia* L. (current study).

Biological notes. Chen (1964, 1985) suggested that “*Phola octodecimguttata* is a primitive species of Chrysomelinae, and stated that the larvae are stem feeders on *Vitex cannabifolia* and construct tubiform nests with excrement on or between the branches. The larvae live in concealment with the anterior half of the body in the nest and the tip of the abdomen exposed”.

However, in the current study larvae of this species were observed to be leaf feeders on *Vitex rotundifolia*. Females laid more than 30 eggs into one layer of young leaves (Fig. 5A). Larvae (Fig. 5C) hatched in four to five days. They produced a tube of faeces fixed to a leaf or branch as a shelter (Fig. 5B). The whole body was concealed under the shelter. The larval duration was 12 to 14 d. Mature larvae burrowed into soil and built underground chambers for pupation, which was surrounded by a few black silk fibers. Duration of the pupal stage (Fig. 5D) was seven to eight days (Lee & Cheng 2007). Host plants produced new leaves during early spring. Young larvae were observed feeding on new leaves on April 12, 2022 in Kinmen Island (Fig. 5E). Adults and larvae were found on May 7, 2007 at Qienshuiwan (淺水灣), northern Taiwan. Thus, *Phola octodecimguttata* is presumably an univoltine species, based on observations of adults during spring. Larval morphology was studied by Kimoto (1962). In the subtropical northern parts of its range, adults appear in spring.

Yi-Xuan Hsieh (謝怡萱) observed larvae and adults of this species feeding on leaves of *Vitex negundo* in South Taiwan. Larvae did not build tubes of faeces and were exposed (her blog: <https://blog.xuite.net/mbbrgs/twblog1/137792188>).

Distribution. Japan, China, Taiwan (Fig.

6), Thailand, Laos, Vietnam, Myanmar, South India, Sri Lanka, Malaysia, Singapore, Brunei, Indonesia, Papua New Guinea, Solomon Island, Australia.

***Phola decempustulata* (Baly, 1864), COM. NOV.**

Chalcolampra decempustulata Baly, 1864: 619 (Batchian = Becan Island); Baly 1867:281 (redescription with illustration of habitus); Mohamedsaid 1997:121 (Peninsular Malaysia: Negeri Sembilan, Perak).

Types. 1♀ (BMNH): “Bou [h, w] // SYN- / TYPE [p, w; circle label with blue border] // Type [h, w] // Type [p, w; circle label with red border] // Chalcolampra / 10 pustulata / Baly / Batchian [w, b] // Type / likely / Coll Wallace”; 1♀ (BMNH): “Bou [h, w] // SYN- / TYPE [p, w; circle label with blue border] // Type [h, w]”.

Specimens examined. **EAST MALAYSIA.** Sarawak: 1♀ (BMNH), Quop, IV.1914, leg. G. E. Bryant; 1♀ (TARI), 4th Division, Gn. Mulu NP., V.–VIII.1978, leg. P. M. Hammond & J. E. Marshall, at light; **INDONESIA.** Sulawesi: 1 ex. (BMNH), Sulawesi Utara, Dumoga-Bone N. P., “Hog’s Back” Camp, Lowland Forest, 492 m, IX, 1985, Malaise trap, Project Wallace; **THAILAND.** Chiang Mai: 1♀ (SEHU), Doi Pui, 3.V.1984, leg. M. Akiyama.

Redescription (Female). Length 4.4–5.0 mm, width 2.4 mm. General color (Figs. 7A–C) yellowish-brown, but meso- and meta thoracic, and abdominal ventrites blackish-brown; four or five apical antennomeres darker; five pairs of yellow spots on elytra, two pairs near base, two at middle, one at apical 1/3. Antenna filiform (Fig. 8A), antennomeres VII–X apically widened, ratios of lengths of antennomeres I–XI 1.0 : 0.6 : 0.7 : 0.6 : 0.7 : 0.7 : 0.7 : 0.8 : 0.8 : 0.8 : 1.2; ratios of length to width from antennomeres I–XI 2.2 : 1.9 : 2.3 : 2.0 : 2.1 : 2.0 : 1.6 : 1.8 : 1.8 : 1.8 : 2.7. Pronotum 1.7 times wider than long; disc slightly or moderately convex, glabrous but with sparse fine punctures mixed with tiny punctures; lateral margins slightly rounded apical margin slightly concave, basal margin slightly convex. Elytra 1.5 times

longer than wide; parallel-sided, apices convergent; disc with coarse punctures arranged into longitudinal striae, with scarce fine punctures between strial punctures. Gonocoxae (Fig. 8D): separated; abdominal tergite IX longitudinal, basally narrowed; abdominal ventrite IX coiled, wide; coxites cylindrical, with one ring of long setae near apex; styli cylindrical, much narrower than coxites, with several long setae on apex. Ventrite VIII (Fig. 8B) wide and spiculum reduced, with one longitudinal membranous area, several long setae mixed few short setae along apical margin. Spermathecal receptaculum (Fig. 8C) slender, narrower than pump, not separated from pump; pump long and curved, apex widely rounded; sclerotized spermathecal duct extremely slender and coiled.

Variations. Specimens from Sarawak (Figs. 7D–F) have coarser punctures on the pronotum.

Diagnosis. As diagnosis in *Phola octodecimguttata* (Fabricius, 1775).

Biology. Unknown.

Distribution. Indonesia (Becan Island, Sulawesi: new record), Malaysia, Thailand (new record).

DISCUSSION

The widespread distribution of *Phola octodecimguttata* is likely associated with one of its host plants- *Vitex rotundifolia*. This plant is native to seashores throughout the Pacific. Its range includes continents and islands stretching from India east to Hawaii and from Korea south to Australia (Wikipedia n.d.). *Phola octodecimguttata* has a similar distribution except for its absence from Korea and Hawaii. These leaf beetles were found on more than 20 small islands in Japan (Chûjô 1935a; Nakane & Kimoto 1961a; Kimoto & Gressitt 1966; Azuma & Kimoto 1978, 1981; Kamezawa 2015; Matsumura *et al.* 2018; Shigetoh & Yoshitake 2018; Suenaga *et al.* 2018; Shigetoh 2019, 2020a, 2020b, 2020c; Shigetoh *et al.* 2019). In Taiwan, Chûjô (1958) recorded it from Penghu Island (澎湖) and Lanyu Island (蘭嶼). It was

also found on Liuchiu Island (琉球嶼) based on the historical collection at the TARI. Recently, it was recorded from Lieyu Island (烈嶼) and Dadan Island (大膽島) by Chang (2017). The first author found it on Kinmen Island (金門島) and Beigan Island (北竿島) (Figs. 5F, 5G) by searching *V. rotundifolia* plants. In addition, this species was found on Dongji Island (東吉嶼) (Fig. 5H), a small island of the Penghu Island Archipelago. There is substantial supportive evidence of long-distance dispersal by drift fruits of vitex (Wikipedia n.d.). This may explain the frequent presence of *Vitex rotundifolia* in seashore habitats. The colonization of *P. octodecimguttata* on so many islands and coastal areas across the Pacific and Indian Oceans is likely associated with this peculiar features of their host plants. Even though more data are required to determine the exact dispersal mechanisms for *P. octodecimguttata*, we can conclude that this species is an excellent disperser and will be recorded from additional small islands throughout its range in the future.

We also found that some records of *P. octodecimguttata* are located far inland (e.g., NW Thailand, Laos, Yunnan), outside the range of *V. rotundifolia*. It seems likely that all these inland populations, primarily in China and Indochina, use other *Vitex* species, including but maybe not exclusively *V. negundo* as their host plants.

Phola octodecimguttata shows a wide range of geographically correlated variation in color patterns, which has led previous authors to treat its populations under multiple species names. However, none of the color forms originally described as separate species show significant differences in genitalia and the size differences stated by Kimoto & Gressitt (1981) could not be confirmed after a larger material was examined, so we must conclude that they are indeed forms of a single species. Aside from *P. octodecimguttata*, we only confirmed *P. decempustulata* (here transferred from *Chalcolampra*) as a separate species of *Phola*, leaving only two verified valid species within the genus.

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especially thank Jan Bezděk for studying and taking photos of the syntypes of *Chrysomela octodecimguttata* Fabricius, Anna Jerve for types of *Phyllophila sedecimpustulata* Stål and *Chalcolampra (Phyllophila) cybele* Stål, Bernd Jäger and Alexey Moseyko for the type of *Phola keyserlingi* Weise, Masahiro Ohara and Takuya Takemoto for loan specimens at the SEHU. We thank Chang-Chin Chen (陳常卿) for assisting our study in various ways. We thank Chris Carlton for reading the draft and editing for American English style. This study was supported by the Bureau of Animal and Plant Health Inspection and Quarantine, Ministry of Agriculture 112AS-5.5.4-BQ-B2.

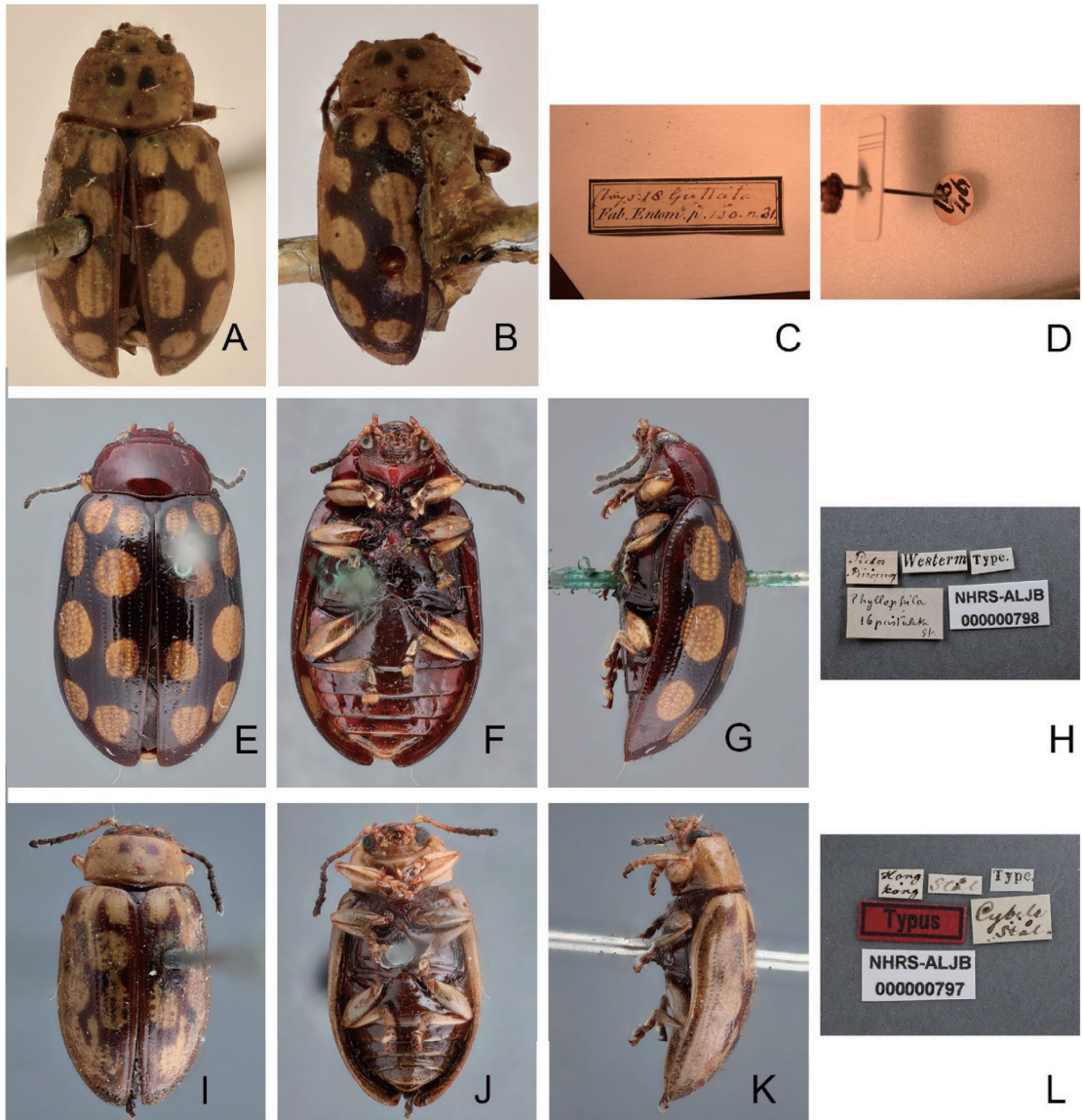


Fig. 1. Type specimens and labels of *Phola octodecimguttata* and its synonyms. A–D: *Chrysomela octodecimguttata*, A. lectotype, dorsal view; B. paralectotype, dorsal view; C. one label; D. the circle label pinned with damaged syntype; E–H: *Phyllophila sedecimpustulata*, E. holotype, dorsal view; F. ditto, ventral view; G. ditto, lateral view; H. labels; I–L: *Chalcolampra (Phyllophila) cybele*, I. holotype, dorsal view; J. ditto, ventral view; K. ditto, lateral view; L. labels.

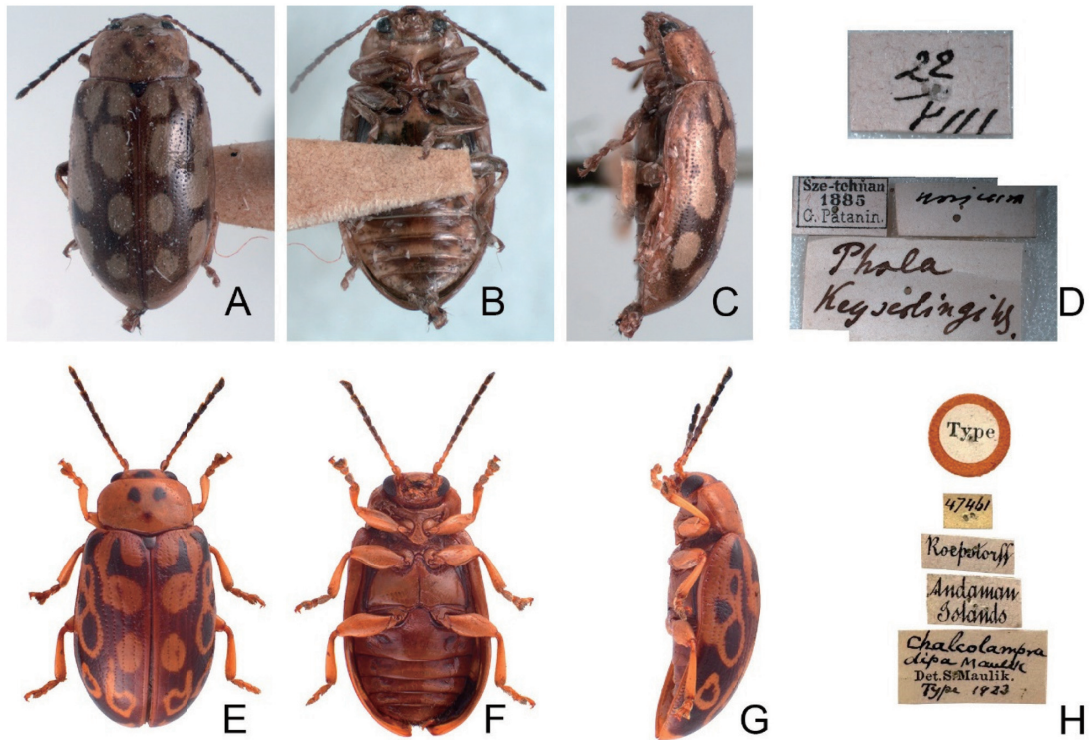


Fig. 2. Type specimens and labels of synonyms of *Phola octodecimguttata*. A–D: *Phola keyserlingi*, A. holotype, dorsal view; B. ditto, ventral view; C. ditto, lateral view; D. labels; E–H: *Chalcolampra dipa*, E. holotype, dorsal view; F. ditto, ventral view; G. ditto, lateral view; H. labels.

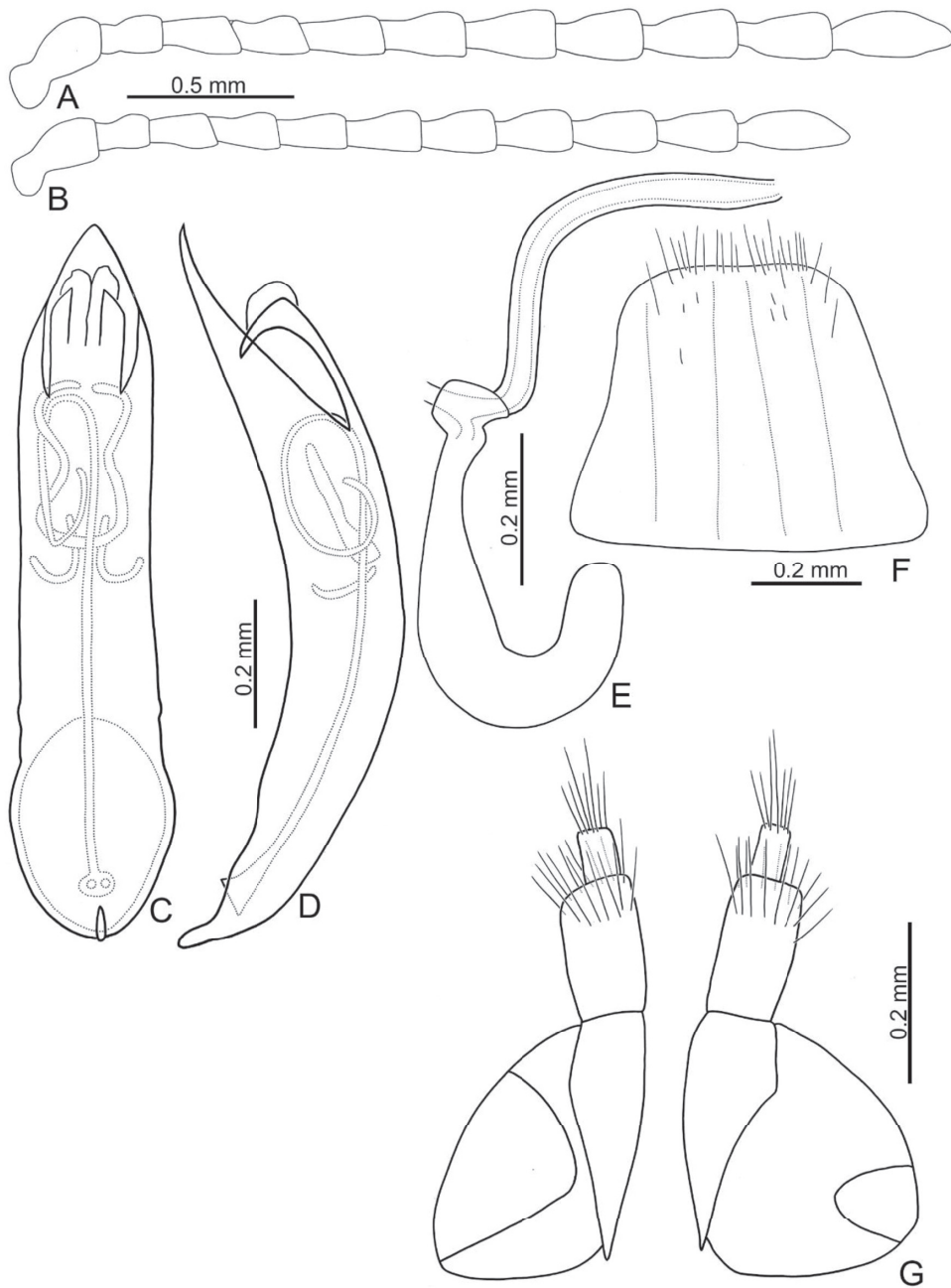


Fig. 3. Diagnostic characters of *Phola octodecimguttata*. A. antenna, male; B. antenna, female; C. aedeagus, dorsal view; D. ditto, lateral view; E. spermatheca; F. abdominal ventrite VIII, female; G. gonocoxae.

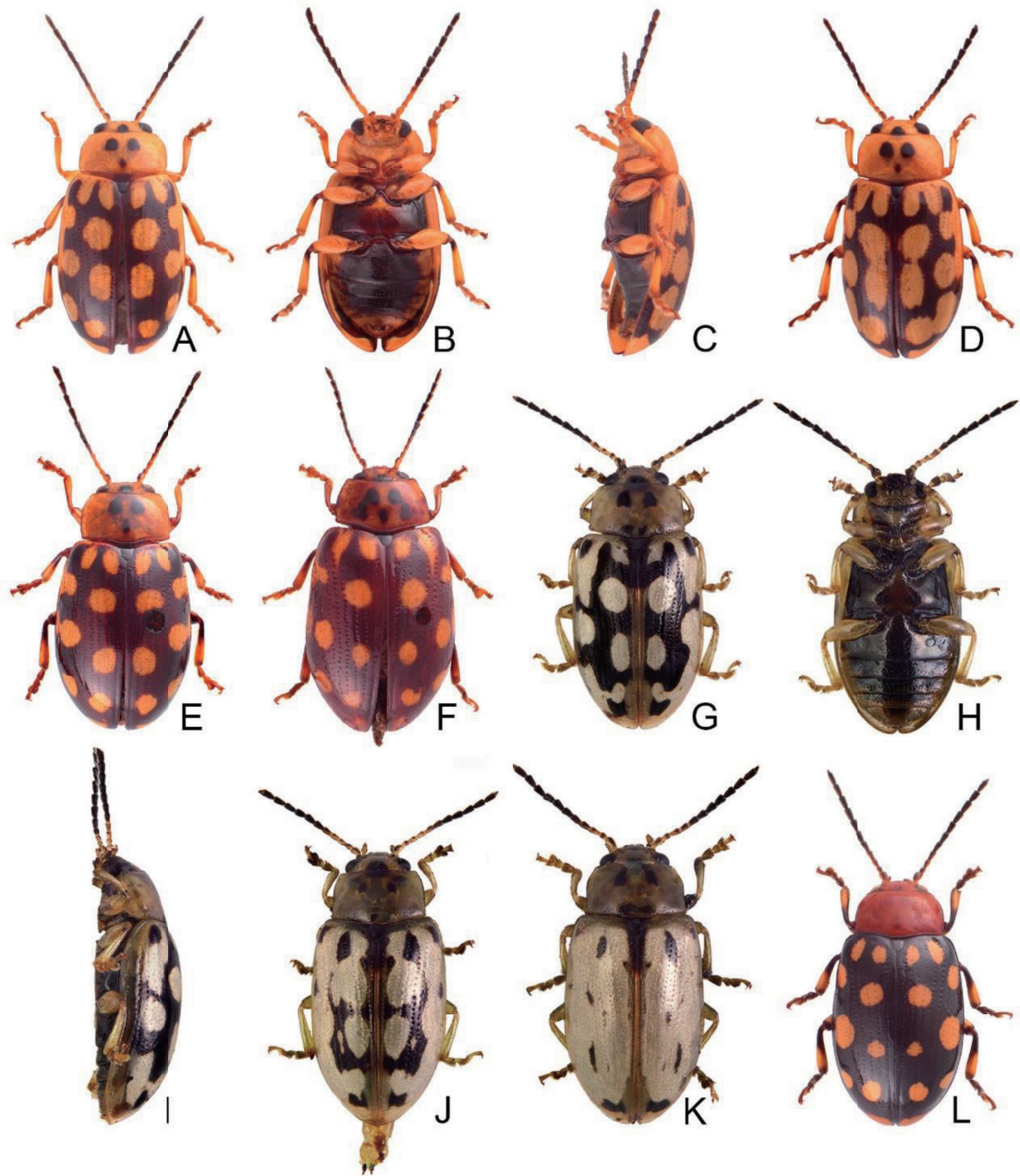
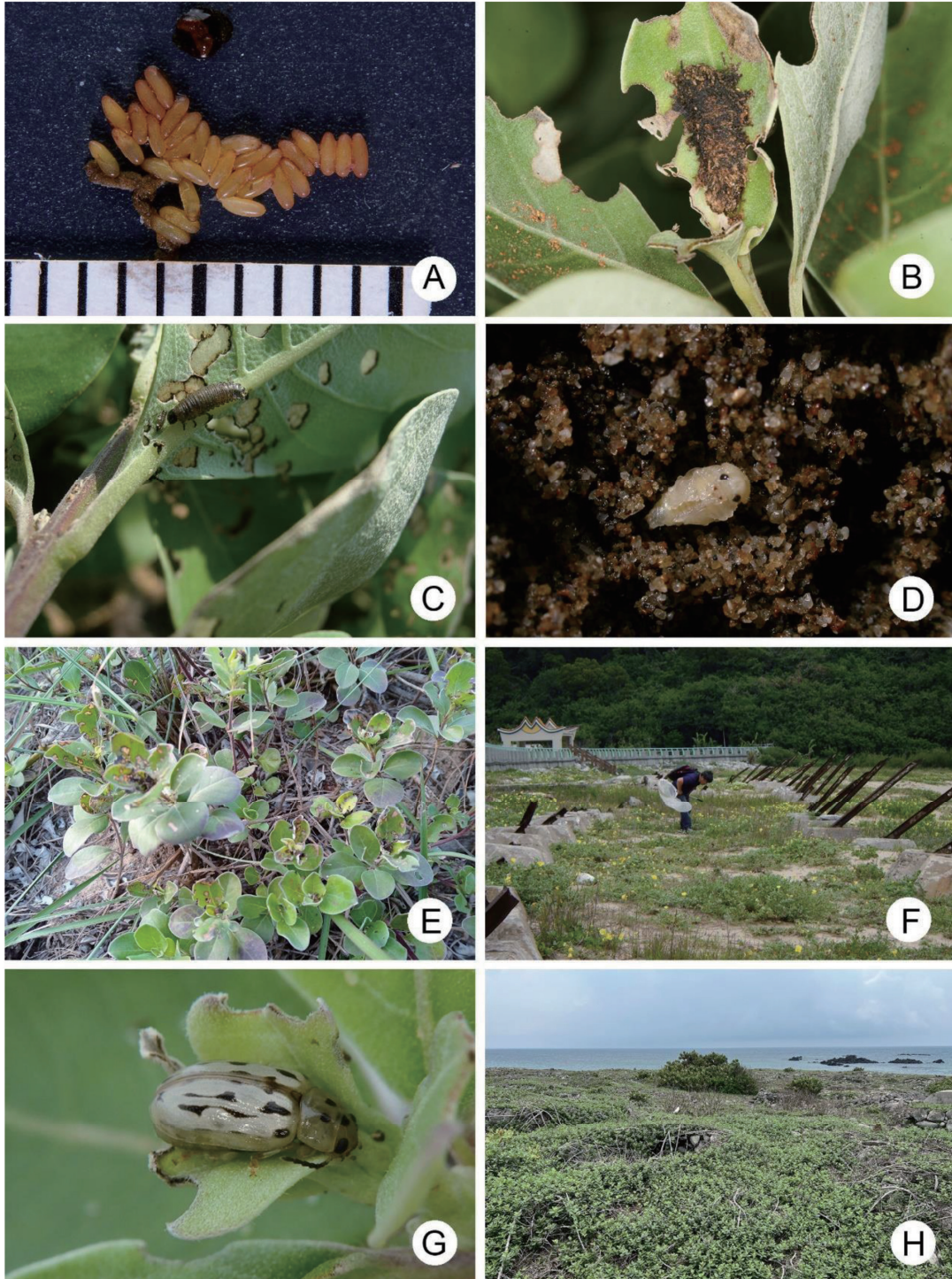


Fig. 4. Color variations of *Phola octodecimguttata*. A. from Australia, dorsal view; B. ditto, ventral view; C. ditto, lateral view; D. from same population, dorsal view; E. from Solomon Islands, dorsal view; F. from Sri Lanka, dorsal view; G. from Taiwan, dorsal view; H. ditto, ventral view; I. ditto, lateral view; J. from Kinmen Island, dorsal view; K. from same population, dorsal view; L. from Brunei, dorsal view.



Figs. 5. Field photographs of *Phola octodecimguttata*. A. eggs; B. fecal tunnel nest on leaf with larva concealed inside; C. larvae and their feeding marks on the leaves of the host plant; D. pupa; E. young shoots and larvae on Kinmen Island (金門島); F. microhabitat on beach of Beigan Island (北竿島); G. adult found on beach of Beigan Island (北竿島); H. microhabitat on beach of Dongji Island (東吉嶼).

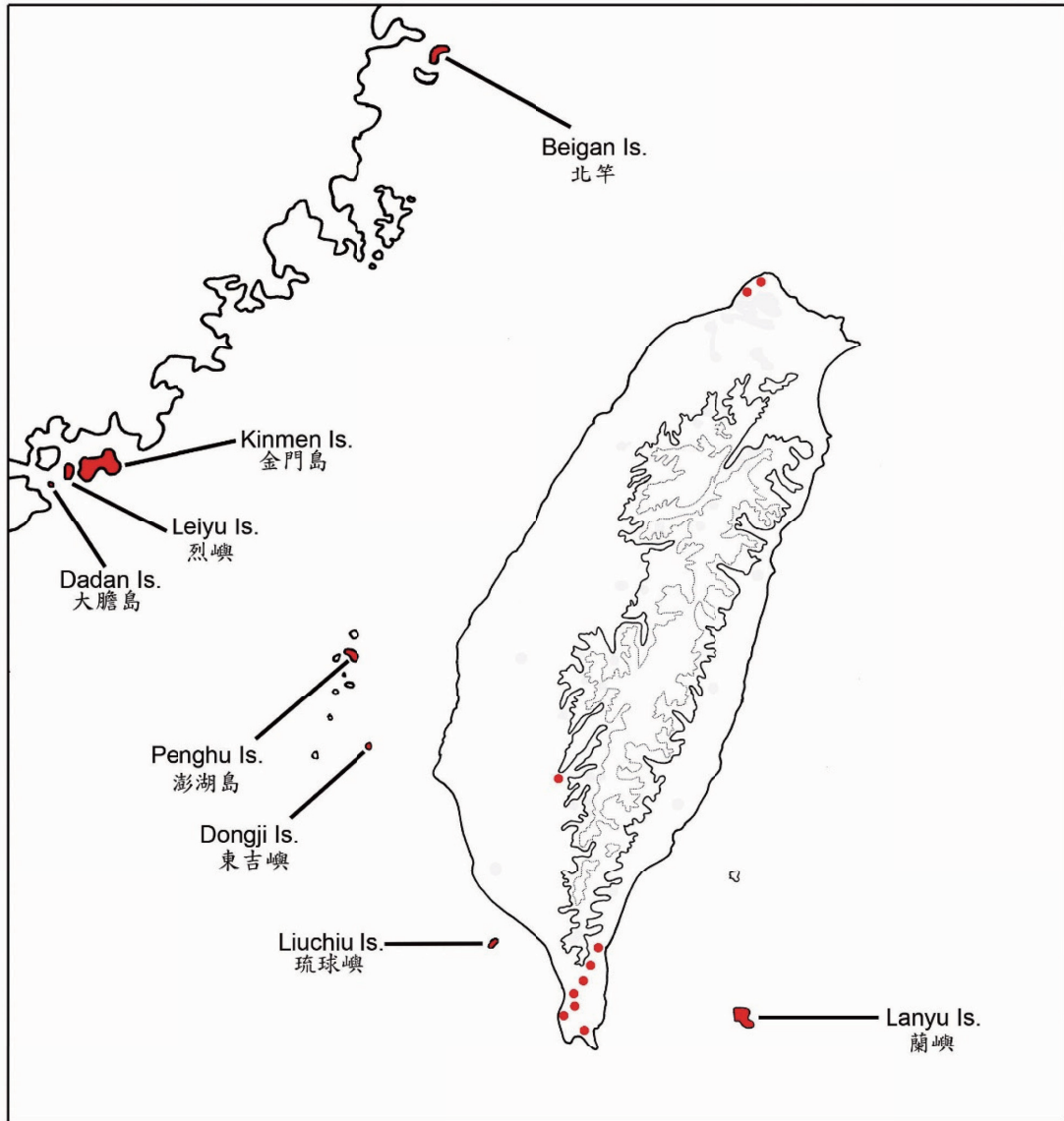


Fig. 6. Distribution map of *Phola octodecimguttata* in Taiwan, marked with red; topographic contour lines: black: 1000 m, gray: 2000 m.

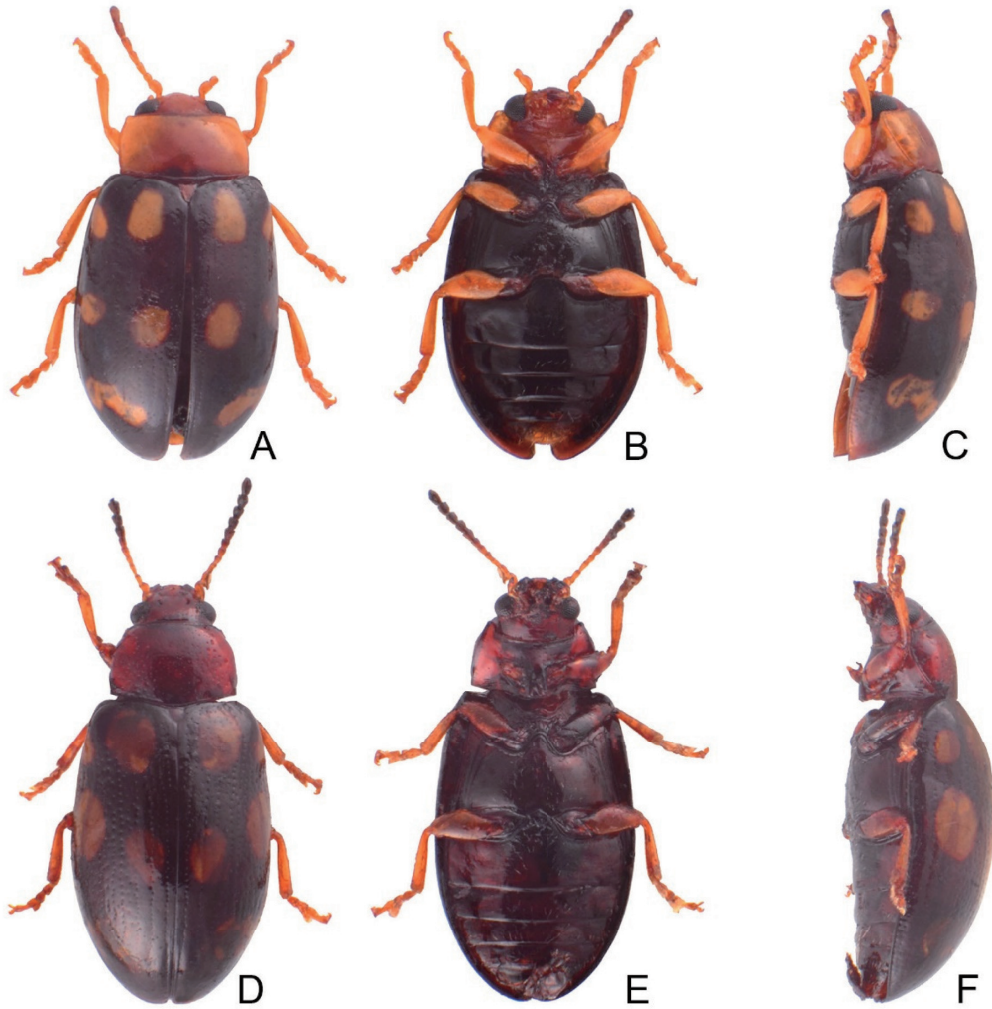


Fig. 7. Color variations of *Phola decempustulata*, female. A. from Becan Island, dorsal view; B. ditto, ventral view; C. ditto, lateral view; D. from Sarawak, dorsal view; E. ditto, ventral view; F. ditto, lateral view.

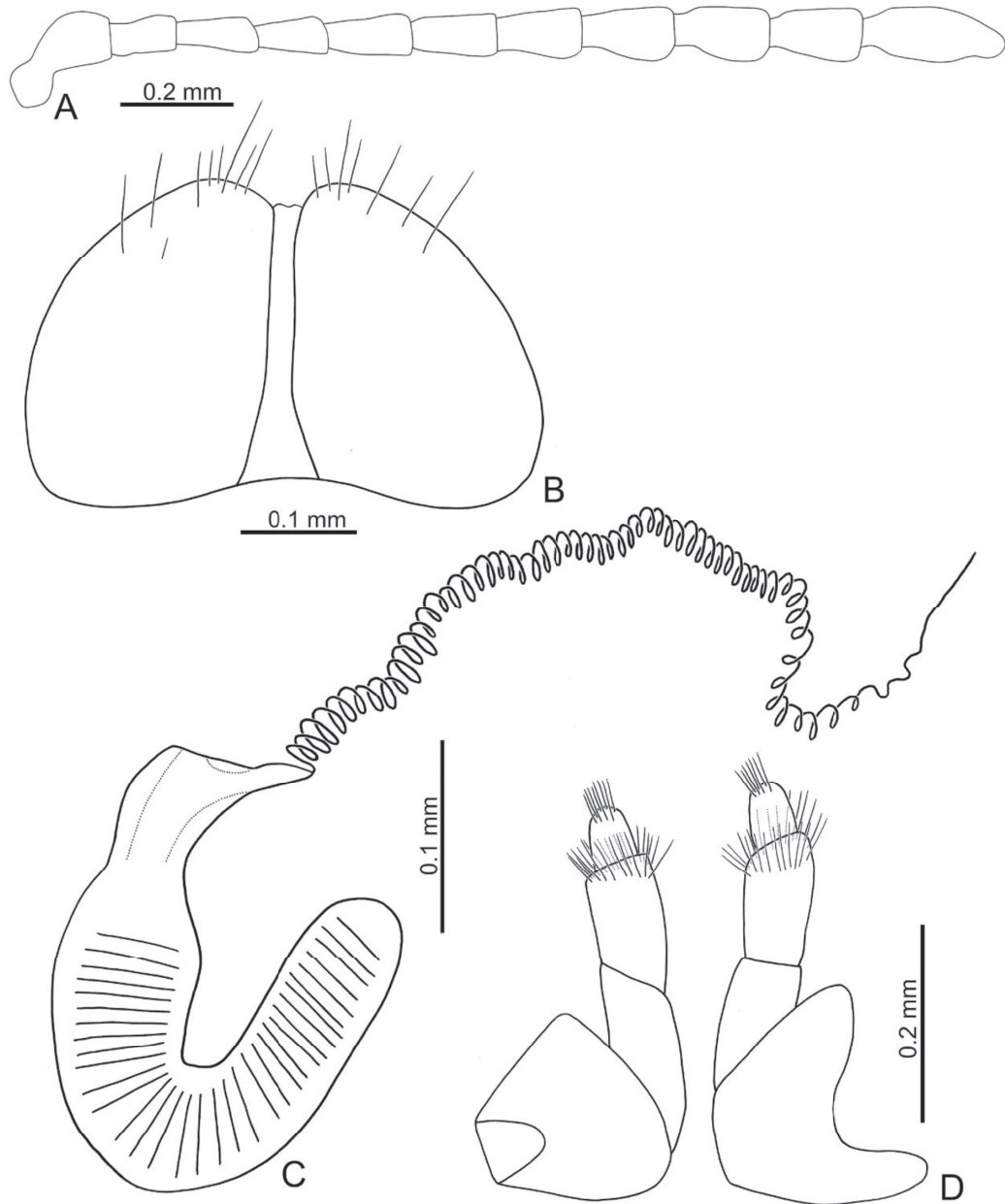


Fig. 8. Diagnostic characters of *Phola decempustulata*, female. A. antenna; B. abdominal ventrite VIII, female; C. spermatheca; D. gonocoxae.

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瘦金花蟲屬 (*Phola* Weise, 1890) 的分類回顧 (鞘翅目：金花蟲科：金花蟲亞科)

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摘要

李奇峰、Michael F. Geiser。2023。瘦金花蟲屬 (*Phola* Weise, 1890) 的分類回顧 (鞘翅目：金花蟲科：金花蟲亞科)。台灣農業研究 72(3):197–218。

本研究重新評估十八斑瘦金花蟲 (*Phola octodecimguttata* (Fabricius, 1775)) 及其同物異名，經由檢查模式標本及其生殖器特徵，本研究支持 *Phyllophila sedecimpustulata* Stål, 1857 是十八斑瘦金花蟲的同物異名，而 *Chalcolampra dipa* Maulik, 1926 則為新的同物異名；此研究並討論十八斑瘦金花蟲能夠在許多小島立足的能力。此外，將十斑瘦金花蟲 (*Chalcolampra decempustulata* Baly, 1863) 轉移至瘦金花蟲屬並重新描述。

關鍵詞：金花蟲、分類學、唇形科、牡荊屬、島嶼生物學。

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