



Taxonomic Notes on the *Lycocerus maculicollis* Group (Coleoptera: Cantharidae), with a Description of a New Species from Hainan Island, China

Younan Wang¹, Haoyu Liu^{1*}, Xingke Yang² & Yuxia Yang^{1*}

¹Key Laboratory of Zoological Systematics and Application, School of Life Science, Institute of Life Science and Green Development, Hebei University, Baoding 071002, Hebei Province, China

²Key Laboratory of Zoological Systematics and Evolution, Institute of Zoology, Chinese Academy of Sciences, Beijing 100101, China

Abstract: The *Lycocerus maculicollis* subgroup of *L. maculicollis* group is redefined. Originally, this subgroup contains two species, *L. maculicollis* (Hope, 1831) and *L. paviei* (Bourgeois, 1890). In the present study, four previously known species, including *L. nigroverticalis* (Fairmaire, 1881), *L. brahminicus* (Gorham, 1889), *L. prolongatus* (Wittmer, 1995) and *L. nigroverticaloides* (Wittmer, 1997) are attributed to this subgroup. Meanwhile, a new species from the Hainan Island, China is described under the name of *L. semicircularis* sp. n. The new species, *L. nigroverticalis* and *L. paviei* are illustrated with aedeagus of the male, abdominal sternite VIII and internal genitalia of the female and or the habitus of both sexes. In addition, an identification key to the species of subgroup *L. maculicollis* is provided.

Key words: soldier beetles, taxonomy, Oriental region

Introduction

Lycocerus Gorham, 1889 is a speciose cantharid genus with more than 330 species in the world (LIU et al. 2022). A total of 16 species groups have been recognised within this genus (OKUSHIMA 2005, OKUSHIMA & BRANCUCCI 2008, OKUSHIMA & YANG 2013, YANG et al. 2014, HSIAO & OKUSHIMA 2015, 2016, HSIAO et al. 2016, OKUSHIMA & HSIAO 2017, 2021, XI et al. 2021a, b, 2022, WANG et al. 2022). Among these groups, *L. maculicollis* group, consisting of three subgroups, was proposed by OKUSHIMA (2005). It is characterised by aedeagus with simple median lobe, female reproductive system with short spermathecal duct, one spiral-tubed spermatheca, which is relatively short and stout, with basal portion gradually expanded to base. Further, the subgroups have been differentiated from each other by

the characteristics of antennae: whether grooves are present on the male middle antennomeres (*L. ryukyuanus* subgroup) or not, and by the general shape being serrate in *L. maculicollis* subgroup or filiform as in *L. pallidulus* subgroup.

In our recent study, an interesting species of *Lycocerus* was discovered from the Hainan Island, China. After our examination, it was identified as a new member of the *L. maculicollis* subgroup of *L. maculicollis* group. Meanwhile, except for the two species *L. maculicollis* (Hope, 1831) and *L. paviei* (Bourgeois, 1890) originally included in this subgroup (OKUSHIMA 2005), some more similar species (never attributed to any species group) are found and compared. However, their antennae are filiform and present with grooves on middle antennomeres in male, which do not match the diagnosis of any subgroup. No matter how, the structures of aedeagus are quite uniform in

*Corresponding authors: liuhy@hbu.edu.cn; yxyang@hbu.edu.cn

these species, which confirm their close relationship. Thus, it is necessary to redefine the subgroup, which is the aim of the present study.

Materials and Methods

The studied material is preserved in the following collections: Muséum National d'Histoire Naturelle, Paris, France (MNHN), Naturhistorisches Museum Basel, Switzerland (NHMB), Institute of Zoology, Chinese Academy of Sciences, Beijing, China (IZAS); Museum of Hebei University, Baoding, China (MHB) and China West Normal University, Sichuan, China (CWNU). We identified specimens using the key by WITTMER (1995) and the revision provided by KAZANTSEV (1999), from which we also derived our taxon concepts and taxonomic classification.

Morphological terminology used in this study follows mainly that of OKUSHIMA (2005). The abbreviations in the figures are as follows:

For female genitalia – ag: accessory gland; di: diverticulum; sd: spermathecal duct; sp: spermatheca; ov: median oviduct; va: vagina.

For male genitalia – bp: basal piece; dp: dorsal plate of each paramere; lp: laterophyse; ml: median lobe; vp: ventral process of each paramere.

Genitalia of both sexes and abdominal sternites VIII of females were dissected and cleared in 10% NaOH solution, while female genitalia was dyed with hematoxylin. Habitus photos were taken using a Leica M205A stereomicroscope; multiple layers were stacked using Combine ZM (Helicon Focus 5.3). Line drawings were made using a camera lucida attached to a Nikon SMZ1500 stereomicroscope, then edited in CorelDraw 12 and Adobe Photoshop CS6.13.0.

The label of the specimens in Chinese are transliterated. The complete label data are cited for the type specimens, with quotation marks used to separate data from different labels and a double slash to separate different lines of the same label.

Results

Subgroup of *Lycocerus maculicollis*

Common characteristics. Body large and stout. Vertex almost flat. Eyes moderately prominent. Antennae serrate and without any groove or filiform and present with grooves on middle antennomeres in male. Pronotum trapezoidal, with arcuate anterior margin confluent with anterior angles and acute posterior angles. Elytra almost parallel-sided but often expanded posteriorly, disc with more or less vis-

ible longitudinal costae. All claws simple in male, fore and middle legs with a digitiform tooth on each outer claw, hind claws simple in female. Aedeagus (Figs 1, 2): basal piece with ventral margin largely protuberant near to middle nodule; ventral process of each paramere laterally compressed, with apices bent inwards; dorsal plate of each paramere obviously longer than ventral process and largely emarginate at inner margin, apical part above emargination bent downwards and ventrally, inner margin more or less bent ventrally below emargination, outer margin emarginate in middle; median lobe short and simple, laterophyse feebly shorter than ventral process, with apex acutely hooked and appreciably directing dorsolaterally, inner sac lengthened apically, nearly as long as tegmen. Internal organ of reproductive system (Fig. 3): vagina stout and abruptly thinned at ventroapical portion into a stout tube, where diverticulum and spermathecal duct arise separately; diverticulum moderately long, thin and spiral; spermathecal duct thicker and shorter than diverticulum; spermatheca provided with a spiral tube, abruptly thinned apically, longer than diverticulum and accessory gland, which is directly opening at base of spermatheca.

Diagnosis. In the new definition, *L. maculicollis* subgroup distinguishes from the other subgroups (*L. ryukyuanus* subgroup and *L. pallidulus* subgroup) by the shapes of pronotum and aedeagus.

In *L. maculicollis* subgroup, pronotum trapezoidal, of which anterior margin is arcuate and confluent with anterior angles, posterior angles acute. In contrast, pronotum subquadrate, subparallel-sided or slightly expanded posteriorly, anterior margin never confluent with anterior angles, posterior angles are sub-rectangular in either *L. ryukyuanus* subgroup or *L. pallidulus* subgroup.

Regarding the shape of aedeagus, *L. maculicollis* subgroup characterised by basal piece with ventral margin largely protuberant near to middle nodule, dorsal plate with apical part above the emargination bent downwards and ventrally. In comparison, basal piece never largely protuberant near the middle nodule, the dorsal plate simple and never bent downwards and ventrally in either of other two subgroups.

Included species. *L. maculicollis* (Hope, 1831), *L. paviei* (Bourgeois, 1890), *L. nigroverticalis* (Fairmaire, 1881), *L. brahminicus* (Gorham, 1889), *L. prolongatus* (Wittmer, 1995), *L. nigroverticaloides* (Wittmer, 1997) and *L. semicircularis* sp. n.

Distribution. Oriental Region (S. China (Yunnan, Hainan), Vietnam, Laos, Myanmar, Thailand, N. India, Bhutan and Nepal).

***Lycocerus nigroverticalis* (Fairmaire, 1887)**

Figs. 1A–C, 2A–C, 3A, 4A

Telephorus nigroverticalis Fairmaire, 1887: 123.*Cantharis subnitida* Pic, 1906: 83. Synonymised by WITTMER (1995: 191).*Cantharis nigroverticalis* Jacobson, 1911: 679.*Cantharis obconicicollis* Pic, 1914: 6. Synonymised by WITTMER (1995: 191).*Cantharis obconicicollis* var. *nigroabdominalis* Pic, 1914: 6. Synonymised by WITTMER (1995: 191).*Cantharis subarcuatipes* Pic, 1916: 12. Synonymised by WITTMER (1995: 191).*Cantharis obconicicollis* var. *subelongatipennis* Pic, 1921: 29. Synonymised by WITTMER (1995: 191).*Cantharis nigroverticalis* var. *trinotatithorax* Pic, 1921: 29. Synonymised by WITTMER (1995: 191).*Cantharis obconicicollis* var. *rufithorax* Pic, 1923: 40. Synonymised by WITTMER (1995: 191).*Athemus vaitor* var. *choganhensis* Pic, 1923: 40, 41. Synonymised by WITTMER (1995: 191).*Cantharis matensis* Pic, 1923: 61. Synonymised by WITTMER (1995: 191).*Athemus monostigma* Champion, 1926a: 197. Synonymised by WITTMER (1995: 191).*Cantharis testaceohumeralis* Pic, 1936: 1. Synonymised by WITTMER (1995: 191).*Cantharis humeroteatacea* Pic, 1938: 84 [Replacement name for *Cantharis testaceohumeralis* Pic, 1936, not 1917].*Athemus nigroverticalis*: Wittmer, 1972: 106.*Lycocerus nigroverticalis*: Kazantsev & Brancucci, 2007: 252.**Type material examined:**Holotype of *Cantharis subnitida*: 1♀ (MNHN), [h] “yunnan”, [h] “C. subnitida / Pic”, [h] “type”, [h] “*Athemus / nigroverticalis* / (Fairm.) / det. W. Wittmer”, [p] “HOLOTYPE”.Holotype of *Cantharis obconicicollis*: 1♀ (MNHN), [h] “Lao Kay”, [h] “obconicicollis / Pic”, [h] “*Athemus / nigroverticalis* / (Fairm.) / det. W. Wittmer”, [p] “HOLOTYPE”. Paratype: 1♀ (NHMB), [h] “Tonkin / Chapa”, [h] “paratype”, [h] “*Cantharis / obconicicollis* Pic”.Holotype of *Cantharis obconicicollis* var. *nigroabdominalis*: 1♀ (MNHN), [h] “Lao Kay / (ex Vailles)”, [h] “C. obconicicollis / v. nigroabdominalis”, [h] “*Athemus / nigroverticalis* / (Fairm.) / det. W. Wittmer”, [p] “HOLOTYPE”.Holotype of *Cantharis subarcuatipes*: 1♀ (MNHN), [h] “China”, [h] “subarcuatipes / Pic”, [h] “type”, [h] “*Athemus / nigroverticalis* / (Fairm.) / det. W. Wittmer”, [p] “HOLOTYPE”.Holotype of *Cantharis obconicicollis* var. *subelongatipennis*: 1♀ (MNHN), [h] “Chapa”, [h] “obconicicollis / subelongatipennis / Pic”, [h] “*Athemus / nigroverticalis* / (Fairm.) / det. W. Wittmer”, [p] “HOLOTYPE”.Holotype of *Cantharis nigroverticalis* var. *trinotatithorax*: 1♀ (MNHN), [h] “yunnan Chine/ yunnan”, [h] “nigroverticalis v. / trinotatithorax Pic”, [h] “*Athemus / nigroverticalis* / (Fairm.) / det. W. Wittmer”, [p] “HOLOTYPE”.Holotype of *Cantharis obconicicollis* var. *rufithorax*: 1♀ (MNHN), [h] “Chapa”, [h] “obconicicollis / v.”, [h] “rufithorax / Pic”, [h] “*Athemus / nigroverticalis* / (Fairm.) / det. W. Wittmer”, [p] “HOLOTYPE”.Holotype of *Athemus vaitor* var. *choganhensis*: 1♀ (MNHN), [h] “Choganh / Tonkin / 2 V.1912”, [h] “vaitor var. / choganhensis / Pic”, [h] “*Athemus / nigroverticalis* / (Fairm.) / det. W. Wittmer”, [p] “HOLOTYPE”.Holotype of *Cantharis matensis*: 1♀ (MNHN), [h] “Nam Mat / IV. 1919”, [h] “matensis / n. sp.”, [h] “*Athemus / nigroverticalis* / (Fairm.) / det. W. Wittmer”, [p] “HOLOTYPE”.Holotype of *Cantharis testaceohumeralis*: 1♂ (NHMB), [p] “China. / Prov. Yunnan.”, [p] “Valis flumin. / Soling-ho.”, [h] “*Cantharis / testaceohumeralis* / sp. n.”, [p] “TYPUS”, [h] “humeroteatacea / Pic / det. W. Wittmer”, [h] “*Athemus s.str. / nigroverticalis* / (Frm.) / det. W. Wittmer”.**Other material examined:**

China: 2♀, 5♂ (MHBU), Yunnan, Dali, Yunlong, Nuodeng, 2076 m a.s.l., 99.334002°E 25.878298°N, 16.VI.2020, leg. X. J. Zhao; 1♂ (MHBU), Yunnan, Dali, Yangbi, Pingpo, 1978 m a.s.l., 100.08576°E 25.581067°N, 16.VI.2020, leg. D. F. Gao; 3♂, 5♀ (MHBU), Yunnan, Tengchong, Hehua, 13.V.2004, leg. X. J. Yang & Y. S. Liu; 2♂, 1♀ (MHBU), Yunnan, Xiping, Xinhua, 1870 m a.s.l., 24.114°N 101.857°E, 29–30.VII.2009, leg. J. S. Xu & J. X. Zhang; 1♂ (MHBU), Yunnan, Binchuan, Qiaodian, 14.VI.2008, leg. J. S. Xu; 6♀ (MHBU), Yunnan, Yingjiang, Gangmeng, 16.V.2004, leg. X. J. Yang & Y. S. Liu; 1♀ (MHBU), Yunnan, Xishuangbanna, 31.V.2015, leg. L. M. Li; 1♀ (CWNU), Yunnan, Puer, Wenlong, 1280 m a.s.l., 18.VII.2010, leg. L. Qian & L. C. Liu; 1♀ (IZAS, IOZ(E) 1897832), Yunnan, Jinghong, Menghai, Bannahe Nature Reserve, Guomenshan, 1114 m a.s.l., 22.24644°N 100.60610°E, 26.IV.2019, leg. L. Z. Meng; 1♀ (IZAS, IOZ(E) 1897833), Yunnan, Jinghong, Menghai, Bannahe Nature Reserve, Mandian, 689 m a.s.l., 22.13091°N 100.66861°E, 6.VI.2019, leg. L. Z. Meng.

Descriptive notes:**Male.** Aedeagus (Figs. 1A–C, 2A–C): ventral process of each paramere with rounded apex; the part above the emargination of dorsal plate present with distinct keel on inner surface, the part below triangularly protuberant at inner margin, outer margin widely and roundly emarginate in lateral view.

Female. Internal organ of reproductive system (Fig. 3A): accessory gland feebly shorter than spermatheca but distinctly longer than diverticulum. Abdominal sternite VIII (Fig. 4A) triangularly emarginate on both sides and in middle of posterior margin, lateral emarginations obviously deeper than the middle one, portions between lateral and middle emarginations acute at apices, lateroapical angles truncated at apices.

Distribution: China (Yunnan), Vietnam, Laos, Thailand, Myanmar.

***Lycocerus paviei* (Bourgeois, 1890)**

Figs. 1D–F, 2D–F, 3B, 4B

Cantharis paviei Bourgeois, 1890: 186.

Lycocerus paviei: Pic, 1923: 33, 34.

Lycocerus minutus Champion, 1926b: 251. Synonymized by KAZANTSEV, 1999: 124.

Type material examined:

Paralectotype of *Cantharis paviei*: 1♂ (MNHN), [h] “MUSEUM PARIS / LUANG-PRA-BANG / à THENG Pavie 1888”, [h] “*Cantharis paviei* Bourg. / cotype”, [p–h] “*Lycocerus paviei* (Bourg.) / S. KAZANTSEV DET. 1997”, [p] “PARALECTOTYPUS”.

Other material examined:

China: 1♀, 2♂ (IZAS, IOZ(E) 1436633, 1436631, 1436632), Yunnan, Yongping to Yangbi, 29.V.1995, leg. X. C. Yang; 1♀ (IZAS, IOZ(E) 1436707), Yunnan, 25 km southeast of Jingdong, 30.IV.1957, leg. A. Monchards; 1♀ (IZAS, IOZ(E) 1436719), Yunnan, 25 km southwest of Baoshan, 1700 m a.s.l., 21.V.1955, leg. Kryzanovsk; 1♀ (IZAS, IOZ(E) 1436695), Yunnan, Damenglong, 700 m a.s.l., 12.IV.1957, leg. L. C. Zang; 1♂ (IZAS, IOZ(E) 1436445), Yunnan, Xishuangbanna, Meng’a, 800 m a.s.l., 29.V.1958, leg. S. Y. Wang; 1♂ (IZAS, IOZ(E) 1436722), Yunnan, 756 km of Kunlun Highway, 26.IV.1957, leg. L. C. Zang.

Descriptive notes:

Male. Aedeagus (Figs. 1D–F, 2D–F): ventral process of each paramere with apex obtusely-hooked; the part above emargination of dorsal plate with indistinct keel on inner surface, the part below feebly protuberant at inner margin, outer margin widely and subroundly emarginate in lateral view.

Female. Internal organ of reproductive system (Fig. 3B): accessory gland distinctly shorter than spermatheca but distinctly longer than diverticulum. Abdominal sternite VIII (Fig. 4B) triangularly emarginate on both sides and in middle of posterior margin, lateral emarginations feebly deeper than the middle one, portions between lateral and middle emarginations acute at apices, lateroapical angles widely rounded at apices.

Distribution: China (Yunnan), Laos, Thailand, Myanmar.

***Lycocerus brahminicus* (Gorham, 1889)**

Telephorus brahminicus Gorham, 1889: 26.

Athemus brahminicus: Wittmer, 1995: figs 32–33, 162.

Lycocerus brahminicus: Kazantsev and Brancucci, 2007: 249.

Type material examined:

Paralectotype: 1♂ (MHNN), [p] “India”, [h] “*T. brahminicus* / Gorham”, [h] “*Athemus brahminicus* / (Gorh.) / det. W. Wittmer”, [p] “PARALECTOTYPUS”.

Other material examined:

India: 1♂ (NHMB), Assam, Rhumkheng, 2000–5500 m a.s.l., 26.III.1960, leg. F. Schmid.

Distribution: N. India, Bhutan.

Notes: This species is attributed to *L. maculicollis* subgroup for the first time.

***Lycocerus prolongatus* (Wittmer, 1995)**

Athemus (s.str.) *prolongatus* Wittmer, 1995: 257, figs 115, 116.

Type material examined:

1♂ (NHMB), [p] “Laos / Umg. Vientinae / III.–VI.1963”, [h] “*Athemus* s. str. / *prolongatus* / Wittm.”, [p] “CANTHARIDAE / CANTH00001299”, [p] “HOLOTYPE”.

Distribution: Laos.

Notes: It has not been assigned to any group/subgroup of *Lycocerus* and herein it is placed in *L. maculicollis* subgroup.

***Lycocerus nigroverticaloides* (Wittmer, 1997)**

Athemus (s.str.) *nigroverticaloides* Wittmer, 1997: 283, figs 126, 127.

Type material examined:

1♂ (NHMB), [p] “Annam, / Cochinchina”, [p] “Agr. Stat. of Blao / Prov. Haut Donai / Alt. 800 M. V.14.(19)33, [h] “*Athemus* s. str. / *nigroverticaloides* / Wittm. / det. W. Wittmer”, [p] “CANTHARIDAE / CANTH00000585”, [p] “HOLOTYPE”.

Distribution: S. Vietnam.

Notes: It has not been assigned to any group/subgroup of *Lycocerus* and it is included in *L. maculicollis* subgroup in this study.

***Lycocerus semicircularis* Y. Yang et X. Yang, sp. n.**

Figs. 1G–I, 2G–I, 3C, 4C, 5A–B

Type material:

Holotype: ♂ (MHBU, HBU(E) 410008), China, Hainan, Wuzhishan, Shuiman, 14–18.V.2011, leg. X. Q. Yang & L. F. Wang.

Paratypes: China, Hainan: 2♀ (MHBU, HBU(E) 410009, 410010), same data as the holo-

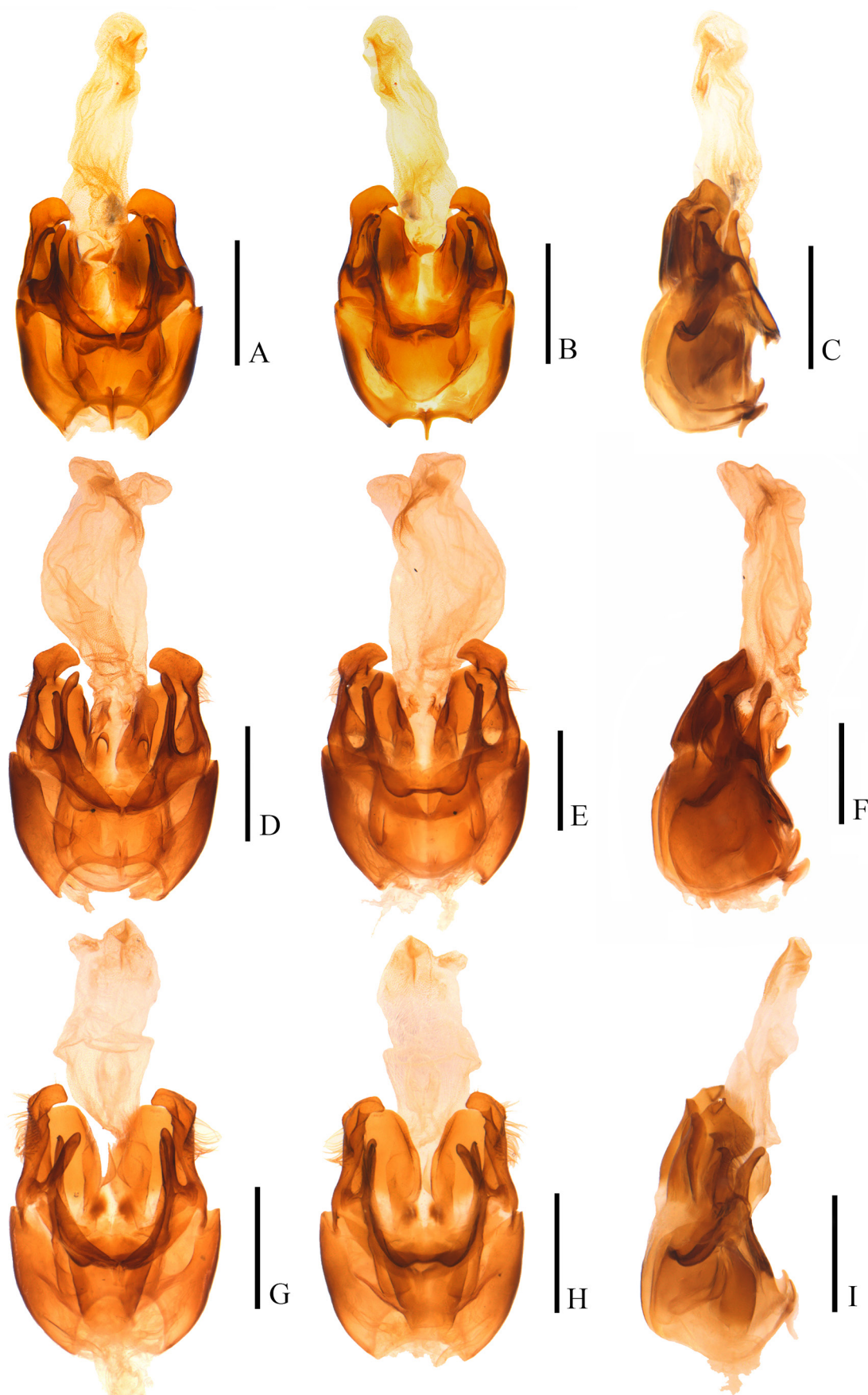


Fig. 1. Aedeagus (A, D, G ventral view; B, E, H dorsal view; C, F, I lateral view): A – C. *Lycocerus nigroverticalis* (Fairmaire, 1887); D – F. *L. paviei* (Bourgeois, 1890); G – I. *L. semicircularis* sp. n. (IZAS, IOZ(E)1902727). Scale bars: 1.0 mm.

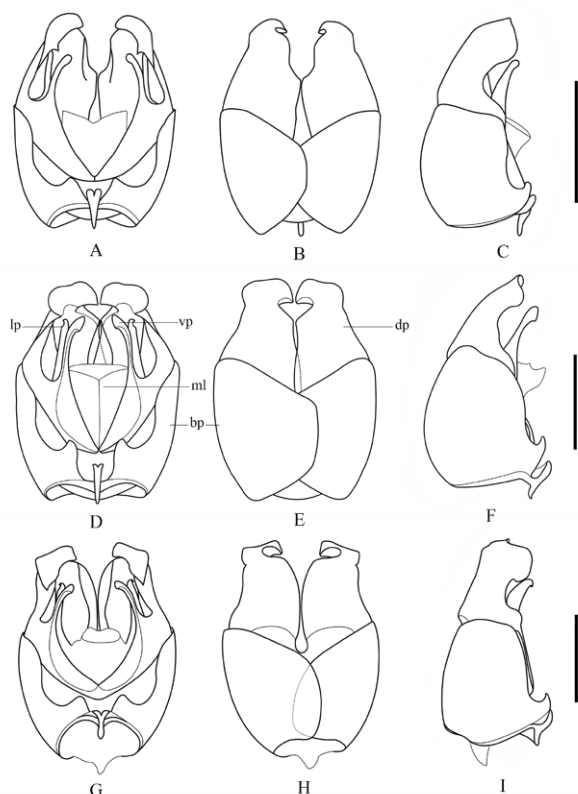


Fig. 2. Aedeagus (A, D, G ventral view; B, E, H dorsal view; C, F, I lateral view): A – C. *Lycocerus nigroverticalis* (Fairmaire, 1887); D – F. *L. paviei* (Bourgeois, 1890); G – I. *L. semicircularis* sp. n. (IZAS, IOZ(E)1902727). Scale bars: 1.0 mm.

type; 1♂ (MHB, HBU(E) 410011), Baisha, Nankai, Daoda, 450 m a.s.l., 24.V.2008, leg. Y. B. Ba & J. T. Lang; 1♀ (MHB, HBU(E) 410012), Lingshui, Diaoluoshan, 300 m a.s.l., 11.V.2014, leg. J. Y. Su; 1♀ (MHB, HBU(E) 410013), Ledong, Jianfeng Botanical Garden, 4.V.2014, leg. J. Y. Su; 3♀ (MHB, HBU(E) 410014, 410015, 410016), Wuzhishan, Shuiman, 637 m a.s.l., 14.V.2013, leg. J. Y. Su; 3♀ (MHB, HBU(E) 410017, 410018, 410019), Yinggeling, Hongxin, 11–13.V.2011, leg. X. Q. Yang & L. F. Wang; 2♀ (MHB, HBU(E) 410020, 410021), Wuzhishan, Shuiman, 23–25.V.2007, leg. Y. B. Ba & J. T. Lang; 1♂ (IZAS, IOZ(E)1902727), Wuzhishan, Shuiman, 740 m a.s.l., 10.V.2007, leg. X. Li.

Description:

Male (Fig. 5A): Body orange, mouthparts dark brown, antennae black, antennomeres I orange ventrally, elytra yellow, legs black, middle and hind legs with coxae, trochanters and ventral sides of femora orange. Body densely covered with yellow recumbent pubescence, of which feebly sparser on head and pronotum than other parts and feebly longer on clypeus than other parts.

Head feebly narrowed behind eyes, surface densely and finely punctate; eyes moderately protruding, head width across eyes nearly as wide as anterior margin of pronotum; terminal maxillary palpomere nearly triangular, widest in middle; antennae extending to elytral mid-length when reclined, antennomere II shortest, about twice longer than wide at apex, III–IX feebly widened apically, VI longest, X–XI nearly parallel-sided, XI feebly longer than X and acute at apex, III–XI each with a round smooth impression near basal part of outer margin.

Pronotum semicircular, distinctly wider than long, widest near base, anterior margin feebly arcuate, lateral margins distinctly diverging posteriorly, posterior margin nearly straight, anterior angles rounded, posterior angles acute, disc convex on posterolateral parts, surface finely and feebly sparsely punctate than that on head.

Elytra about 3.6 times longer than pronotum, 2.5 times longer than width across humeri, humeral width feebly wider than posterior margin of pronotum, outer margins nearly parallel, disc matt, coarsely and densely punctate, present with two feebly distinct longitudinal costae near inner margins.

Aedeagus (Figs. 1G–I, 2G–I): ventral process of each paramere with apex rounded; the part above the emargination of dorsal plate present with indistinct keel on inner surface, the part below fluently arcuate at inner margin, outer margin rectangularly emarginate in lateral view; laterophyse nearly as long as ventral process, bent dorsally, with apex obtusely hooked and feebly directing outwards.

Female (Fig. 5B): Similar to males but eyes less protruding, antennae shorter and narrower, extending to basal one-third length of elytra when reclined, middle antennomeres without impressions, pronotum indistinctly convex on disc, middle and hind legs mostly orange, black at apices of femora, dorsal sides of tibiae and tarsi.

Internal organ of reproductive system (Fig. 3C): accessory gland distinctly shorter than spermatheca and longer than diverticulum.

Abdominal sternite VIII (Fig. 4C) triangularly emarginate on both sides and in middle of posterior margin, lateral emargination much deeper than middle one, portions between lateral and middle emarginations acute at apex, lateroapical angles narrowly rounded at apices.

Body length: 13.0–16.0 mm (13.0 mm in holotype); width: 3.5–4.5 mm (3.7 mm in holotype).

Variation within type series: Only one male with uniformly black legs. Most of females with femora only black at apices, tibiae orange ventrally, except one same as that of holotype.

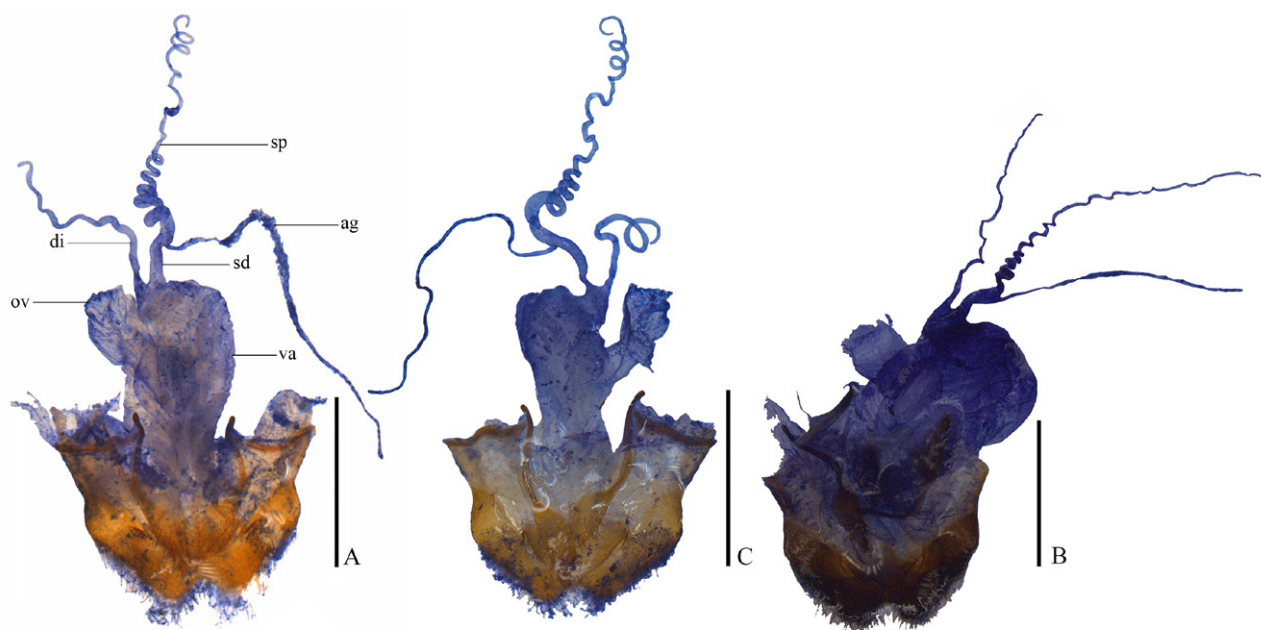


Fig. 3. Internal organ of female reproductive system, lateral view: A. *Lycocerus nigroverticalis* (Fairmaire, 1887); B. *L. paviei* (Bourgeois, 1890); C. *L. semicircularis* sp. n. Scale bars: 1.0 mm.



Fig. 4. Abdominal sternite VIII of female, ventral view: A. *Lycocerus nigroverticalis* (Fairmaire, 1887); B. *L. paviei* (Bourgeois, 1890); C. *L. semicircularis* sp. n. Scale bars: 1.0 mm.

Distribution: China (Hainan).

Etymology: The specific name is derived from the Latin prefix *semi-* (half) + *circularis* (circular), referring to its pronotum in semicircular form.

Diagnosis: The new species is most similar to *L. nigroverticalis* but can be distinguished from the latter in the larger body; aedeagus: apical part of dorsal plate above the emargination shorter and narrower, present with distinct keel on inner surface (indistinct keel in *L. nigroverticalis*), the part below fluently arcuate at inner margin (triangularly protuberant in middle in *L. nigroverticalis*), emargination of outer margin narrower and shallower; abdominal sternite VIII of female with deeper lateral emargination than that of *L. nigroverticalis*.

Discussion

The new species is located from Hainan, China and it is the third species of *Lycocerus* reported from this island, following *L. hainanus* Y. Yang et X. Yang, 2014 and *L. binotatus* Y. Yang et X. Yang, 2021. Although sympatric, *L. semicircularis* sp. n. looks much different from the latter two in both appearance and genitalia of both sexes. Instead, it is related to the species of *L. maculicollis* subgroup, which has never been reported from the Hainan Island. Although the appearance of the subgroup is variable in the body coloration and size, shape of antennae and sculpture of elytra (see the following key), the aedeagi are uniform in the structures, as summarised

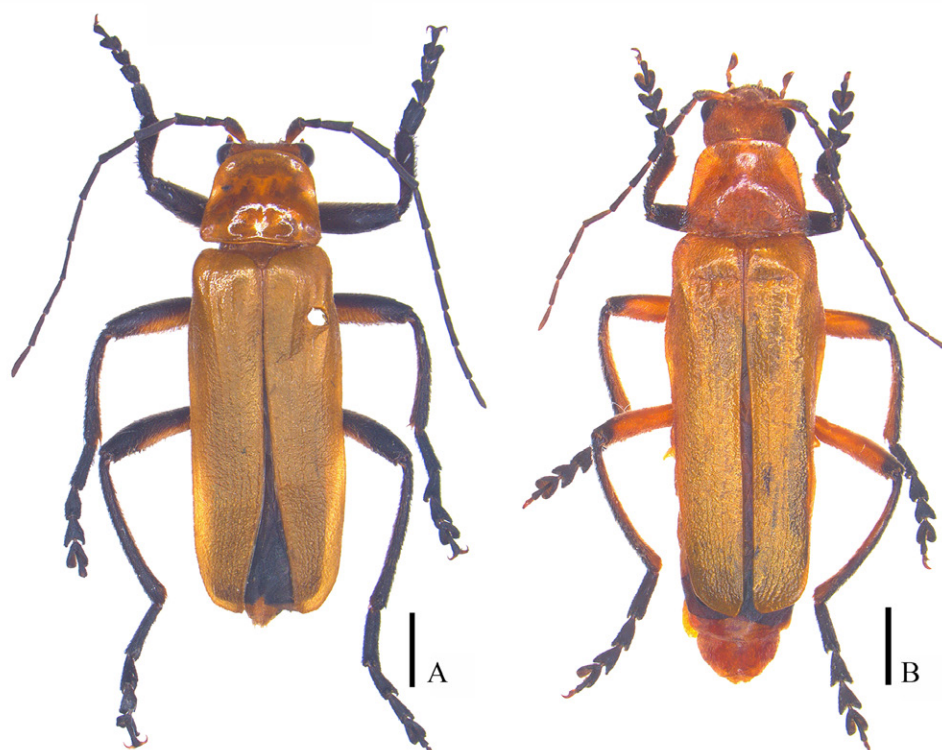


Fig. 5. Habitus of *Lycocerus semicircularis* sp. n., dorsal view: A. male; B. female. Scale bars: 2.0 mm.

in the diagnosis. The male genitalia is one of the most stable and reliable characters in the classification of Cantharidae (BRANCUCCI 1980), so the similar structures suggest close relationship among the species. In terms of this view, *L. nigroverticalis* (Fairmaire, 1881), *L. brahminicus* (Gorham, 1889), *L. prolongatus* (Wittmer, 1995) and *L. nigroverticaloides* (Wittmer, 1997) are attributed to *L. maculicollis* subgroup for the first time.

Furthermore, the female genitalia is considered of high value in the taxonomy of cantharid beetles, not only at the subfamily level (BRANCUCCI 1980), but also in the species groups (OKUSHIMA 2005). Like the male genitalia, the female internal genitalia, as illustrated with the three species in this study, is also quite conservative within the *L. maculicollis* subgroup, which further supports their affinity.

Besides, the shape of pronotum is consistent among the species of *L. maculicollis* subgroup: anterior margin confluent with anterior angles and posterior angles are acute. This is another evidence to demonstrate their closeness but cannot be highlighted as a synapomorphy to define the species group. Because the pronota of some other species, such as *L. cyanurus* (Hope, 1831) and *L. trimaculatus* (Hope, 1831), have the same shape but their aedeagi are obviously different from those of this subgroup (WITTMER 1995).

In addition, *L. maculicollis* subgroup is definitely different from the other two subgroups of *L. maculicollis* group in the above characteristics (OKUSHIMA 2005), so *L. ryukyuanus* subgroup and *L. pallidulus* subgroup probably should be separated as independent groups, which is beyond the scope of this study.

Key to the species of *Lycocerus maculicollis* subgroup

1. Antennae serrate, without smooth impressions on middle antennomeres in males; elytra red, with distinct longitudinal costae on disc.....2
 - Antennae nearly filiform, with smooth impressions on middle antennomeres in males; elytra brown, yellow or dark green, with obscure longitudinal costae on disc3
2. Aedeagus: outer apical angle of dorsal plate moderately widened inwards and clearly separated from each other (KAZANTSEV 1999: fig. 15). N. India, Nepal.....*L. maculicollis* (Hope, 1831)
 - Aedeagus: outer apical angle of dorsal plate strongly widened inwards and touching each other in middle (KAZANTSEV 1999: figs. 16–17). China: Yunnan; Laos, Thailand*L. paviei* (Bourgeois, 1890)
3. Elytra bicolored, mostly black, yellowish brown at apices. S. Vietnam*L. nigroverticaloides* (Wittmer, 1997)

- Elytra unicoloured4
- 4. Body larger, 13 – 16 mm in length5
- Body smaller, no more than 11 mm in length ..6
- 5. Elytra and legs uniformly black or brown; aedeagus: laterophyse abruptly narrowed apically and sharply hooked at apex (WITTMER 1995: figs. 115–116). N. Laos, N. Thailand
.....*L. prolongatus* (Wittmer, 1995)
- Elytra uniformly yellow, legs bicolored, mixed yellow with black; aedeagus: laterophyse gradually narrowed apically and obtusely hooked at apex. S. China (Hainan)*L. semicircularis* sp. n.
- 6. Elytra yellow, black or dark green, with weak metallic shine; aedeagus: apical widened part of dorsal plate with a keel on inner surface (WITTMER 1995: figs. 11 – 12); abdominal sternite VIII of female with portion between lateral and middle emarginations acute at apices (Fig. 4A). China: Yunnan; N. Vietnam, Laos, Thailand, Myanmar
.....*L. nigroverticalis* (Fairmaire, 1881)
- Elytra yellow or black but never green or shining; aedeagus: apical widened part of dorsal plate without keel on inner surface (WITTMER 1995: figs. 32 – 33); abdominal sternite VIII of female with portion between lateral and middle emarginations rounded at apices (WITTMER 1995: fig. 162). N. India, Bhutan.....*L. brahminicus* (Gorham, 1889)

Acknowledgments: We are grateful to the late Dr Michel Brancucci (NHMB) for his great help to Yuxia Yang in studying the taxonomy of Cantharidae. We also thank to Dr Antoine Mantilleri (MNHN) for his kind help to Yuxia Yang in accessing the cantharid types under his charge and to Prof. Aimin Shi (CWNU) for loaning some studied material to us. The present study was supported by the National Natural Science Foundation of China (Nos. 32270491, 31772507), the Natural Science Foundation of Hebei Province (No. C2022201005), the GDAS Special Project of Science and Technology Development (Nos. 2020GDASYL- 20200102021, 2020GDASYL-20200301003), and the Youth Scientific Research and Innovation Team of Hebei University (No. 605020521005).

References

- BOURGEOIS J. 1890. Collection d'insects formée dans l'Indo-Chine par M. Pavie, consul de France au Cambodge, Coléoptères, Cebrionidae, Rhipidoceridae, Dascillidae, Malacodermidae. *Nouvelles Archives du Muséum* 2(3): 179–188.
- BRANCUCCI M. 1980. Morphologie comparée, évolution et systématique des Cantharidae Cantharidae (Insecta: Coleoptera). *Entomologica Basiliensia*, 5: 215–388.
- CHAMPION G. C. 1926a. Some Indian (and Tibetan) Coleoptera (20). *The Entomologist's Monthly Magazine* 62: 194–210.
- CHAMPION G. C. 1926b. Some Indian Coleoptera (21). *The Entomologist's Monthly Magazine* 62: 243–256.
- FAIRMAIRE L. 1887. Coléoptères de l'intérieur de la Chine (3. partie). *Annales de la Société Entomologique de Belgique* 31: 87–136.
- HSIAO Y. & OKUSHIMA Y. 2015. A new species of the genus *Lycocerus* from Taiwan (Coleoptera: Cantharidae). *Elytra*, Tokyo, New Series 5(1): 109–113.
- HSIAO Y. & OKUSHIMA Y. 2016. A new species of the genus *Lycocerus* from Taiwan (Coleoptera: Cantharidae). *Acta Entomologica Musei Nationalis Pragae* 56(1): 255–264.
- HSIAO Y., OKUSHIMA Y., YANG P. S. & KO C. C. 2016. Taxonomic revision of the *Lycocerus hanatanii* species group (Coleoptera, Cantharidae), with the description of new species from Taiwan. *European Journal of Taxonomy* 170: 1–33.
- JACOBSON G. G. 1911. *Zhuki Rossii i Zapadnoy Evropy*. In: A. F. Devrjen (Ed.): *Rukovodstvo k opredeleniyu zhukov*. *Vypusk* 9. St-Petersburg, pp. 641–720.
- KASANTSEV S. V. 1999. Revision of *Lycocerus* Gorham of Indochina and adjacent regions, with the description of *Walteria*, a new genus (Coleoptera, Cantharidae). *Entomologica Basiliensia* 21: 115–134.
- KAZANTSEV S. & BRANCUCCI M. 2007. Cantharidae. In: Löbl I. & A. Smetana (Eds): *Catalogue of Palaearctic Coleoptera*, Vol. 4. Apollo Books, Stenstrup, pp. 234–298.
- LIU T., LIU H. Y., WANG Y. N., XI H. C. & YANG Y. X. 2022. Assessing the Diversity and Distribution Pattern of the Speciose Genus *Lycocerus* (Coleoptera: Cantharidae) by the Global-Scale Data. *Frontiers in Ecology and Evolution*. DOI: 10.3389/fevo.2022.794750.
- OKUSHIMA Y. 2005. A taxonomic study on the genus *Lycocerus* (Coleoptera, Cantharidae) from Japan, with zoogeographical considerations. *Japanese Journal of Systematic Entomology, Monographic Series* 2: 1–383.
- OKUSHIMA Y. & BRANCUCCI M. 2008. A remarkable new species of the genus *Lycocerus* Gorham, 1889 from Laos and Vietnam (Coleoptera, Cantharidae). *Entomological Basiliensia et Collectionis Frey* 30: 41–47.
- OKUSHIMA Y. & YANG Y. X. 2013. Two new species of the subfamily Cantharinae (Coleoptera, Cantharidae) from Taiwan. *Elytra*, Tokyo, New Series 3(1): 89–96.
- OKUSHIMA Y. & HSIAO Y. 2017. Revision of the *Lycocerus fainanus* group (Coleoptera, Cantharidae), with description of a new species from Taiwan. *Special Bulletin of the Coleopterological Society of Japan* 1: 121–130.
- OKUSHIMA Y. & HSIAO Y. 2021. An Additional New Species of the *Lycocerus oedemeroides* Species-group (Coleoptera, Cantharidae) from Taiwan. *Elytra*, Tokyo, New Series 11 (Supplement): 165–172.
- PIC M. 1906. Noms nouveaux et diagnoses de “Cantharini” (Telephorides) européens et exotiques. *L'Échange, Revue Linnéenne* 22: 81–85.
- PIC M. 1914. Coléoptères divers du Tonkin et de l'Indochine. Malacodermes (Telephorides = Cantharides). *Mélanges Exotico-Entomologiques* 9: 5–12.
- PIC M. 1916. Diagnoses génériques et spécifiques. *Mélanges Exotico-Entomologiques* 18: 2–20.
- PIC M. 1921. Nouveautés diverses. *Mélanges Exotico-Entomologiques* 33: 1–32.
- PIC M. 1923. Étude des malacodermes de l'Indochine recueillis par M. R. Vitalis de Salvaza. *Faune Entomologique de l'Indochine Française (Saigon)* 6: 7–63.
- PIC M. 1936. Neue Coleoptera (Malacodermata). *Entomologische Anzeiger* 16: 1–3.

- PIC M. 1938. Nouveaux coléoptères d'Afrique et mutations. Bulletin de la Société Zoologique de France 63: 82–85.
- WANG Y. N., XI H. C., YANG X. K., LIU H. Y. & YANG Y. X. 2022. Two new species-groups defined in *Lycocerus* Gorham (Coleoptera, Cantharidae), with a preliminary investigation on their phylogenetic positions. Annales Zoologici 72(2): 285–298.
- WITTMER W. 1972. Synonymische und systematische Notizen sowie neue Taxa in Cantharidae (Col.). Verhandlungen der Naturforschenden Gesellschaft in Basel 82(1): 105–121.
- WITTMER W. 1995. Zur Kenntnis Gattung *Athemus* Lewis (Col. Cantharidae). Entomologica Basiliensia 18: 171–286.
- WITTMER W. 1997. Neue Cantharidae Cantharidae (Col.) aus dem indo-malaiischen und palaearktischen Faunengebiet mit Mutationen. 2. Beitrag. Entomologica Basiliensia 20: 223–366.
- XI H. C., WANG Y. N., YANG X. K., LIU H. Y. & YANG Y. X. 2021a. New species and taxonomic notes on *Lycocerus hickeri* species-group (Coleoptera, Cantharidae). Zootaxa 4980(3): 541–557. DOI: 10.11646/zootaxa.4980.3.5.
- XI H. C., WANG Y. N., LIU T., YANG X. K., LIU H. Y. & YANG Y. X. 2021b. Spatial origin and diversification of the *Lycocerus fainanus* species group (Coleoptera, Cantharidae), with descriptions of four new species from China and Vietnam. Insects 12(5): 445. DOI: 10.3390/insects12050445.
- XI H. C., WANG Y. N., YANG X. K., LIU H. Y. & YANG Y. X. 2022. A new species group defined in *Lycocerus* Gorham (Coleoptera, Cantharidae), with description of a new species from Xizang, China. The European Zoological Journal. DOI:10.1080/24750263.2022.2044926.
- YANG Y. X., SU J. Y. & YANG X. K. 2014. Description of six new species of *Lycocerus* Gorham (Coleoptera, Cantharidae), with taxonomic note and new distribution data of some other species. Zookeys 456: 85–107. DOI: 10.3897/zookeys.456. 8465.

Received: 12.01.2022

Accepted: 02.03.2022