



Four new species of the *Mesolycus ilyai* species group (Coleoptera: Lycidae) from China

RUO-LAN DU^{1,4}, YU-XIA YANG^{1,2,5*} XING-KE YANG^{3,6} & HAO-YU LIU^{1,2,7*}

¹Key Laboratory of Zoological Systematics and Application, School of Life Sciences, Hebei University, Baoding 071002, China

²Hebei Basic Science Center for Biotic Interaction, Hebei University, Baoding 071002, China

³Key Laboratory of Zoological Systematics and Evolution, Institute of Zoology, Chinese Academy of Sciences, Beijing 100101, China

⁴✉ 20218017193@stumail.hbu.edu.cn; <https://orcid.org/0009-0003-8774-4001>

⁵✉ yxyang@hbu.edu.cn; <https://orcid.org/0000-0002-3118-6659>

⁶✉ yangxk@ioz.ac.cn; <https://orcid.org/0000-0003-3676-6828>

⁷✉ liuhy@hbu.edu.cn; <https://orcid.org/0000-0003-1383-5560>

*Corresponding author

Abstract

Four new species of the *Mesolycus ilyai* species group are described from China, namely, *M. baoi* **sp. nov.**, *M. latidentatus* **sp. nov.**, *M. hainanensis* **sp. nov.** and *M. clausus* **sp. nov.** The generic diagnosis of *Mesolycus* is summarized; and an identification key and a distribution map of the *M. ilyai* species group in the world is updated.

Key words: net-winged beetles, *Mesolycus*, taxonomy, new species, China

Introduction

The lycid genus *Mesolycus* Gorham, 1883 is currently classified in the tribe Dilophotini of the subfamily Metriorrhynchinae (Bocak & Bocakova 2008; Kusy *et al.* 2019). It could be easily differentiated from all other lycid beetles by its bifid claws in male, with tooth basally in female, serrate or sub-filiform antennae, elytral sutures dehiscent at least at apical half part, each elytron present with three costae, and the characteristic aedeagus, which has a symmetric, highly sclerotized and complex internal sac (Kazantsev 2004; Liu *et al.* 2022). Although it has a long taxonomic history, the species diversity remained poorly known before the 21st century (Bic 2002). Recent morphology-based taxonomic research has resulted in descriptions of dozens of species by several specialists (Kazantsev 2000, 2004, 2013; Bic 2002; Liu *et al.* 2022). At present, a total of 30 species are included in *Mesolycus* and they are widely distributed in East Palearctic and Oriental regions (Liu *et al.* 2022).

Within *Mesolycus*, the species were divided into two species groups (Bic 2002), which were most recently commented on their valid names by Liu *et al.* (2022). Between them, nine species are hitherto known in the *M. ilyai* species group, and the rest belongs to the *M. atrorufus* species group (Liu *et al.* 2022). The former can be distinguished from the latter by the structures of aedeagus (Bic 2002; Liu *et al.* 2022).

In our preceding study (Li *et al.* 2022), we added some species of the *M. atrorufus* species group mostly occurring in southwest China. During our recent study, we assembled some material of the *M. ilyai* species group from southeast China. After our examination and comparison, we identified them as new to science, which are going to be described herein.

As one of the diversity center of *Mesolycus* species, Chinese fauna acts an important role in tracking the biogeographic history of this taxon or its higher grades (Masek *et al.* 2018; Li *et al.* 2022). Thus, extensive and thorough field surveys and intensive taxonomic studies are needed constantly to fully understand the species diversity of Chinese *Mesolycus*.

Material and methods

The studied material is deposited in the Institute of Zoology, Chinese Academy of Sciences, Beijing, China (IZAS), and the Museum of Hebei University, Baoding, China (MHBUC). We identified the species based on the publications of Kazantsev (2000, 2004, 2013), Bic (2002) and Liu *et al.* (2022). The description format and terminology follow that of Liu *et al.* (2022).

The specimens were softened in water first, then the male genitalia was dissected and cleared in a 10% NaOH solution, then examined and photographed in glycerol. After examination, the genitalia was glued on a paper card for permanent preservation. Images of adults were taken with a Canon EOS 80D digital camera and aedeagi by Leica M205A stereomicroscope, then stacked in Helicon Focus 7. The assembled photos were edited in Adobe Photoshop CS3.10.0.1.

The measurements were taken with Image J 1.50i (NIH, Bethesda, MD, USA). Body length was measured from the anterior margin of the head to the elytral apex, and the width across the elytral humeri. Pronotal length was measured from the middle of anterior margin to the middle of posterior margin of the pronotum and the width across its widest part. Eye diameter was measured at the maximal width and the interocular distance at the minimal point.

The distribution information data was collected from the publications Kazantsev (2000, 2004, 2013), Bic (2002) and Liu *et al.* (2022), and the present studied material. The distribution map was prepared by ArcMap 10.8 and edited in Photoshop CS3.10.0.1.

Taxonomy

Class Insecta Linnaeus, 1758

Order Coleoptera Linnaeus, 1758

Family Lycidae Laporte, 1836

Subfamily Metriorrhynchinae Kleine, 1926

Tribe Dilophotini Kleine, 1928

Genus *Mesolycus* Gorham, 1883

Chinese common name: 中红萤属

(incl. the *M. atrorufus* and the *M. ilyai* species groups)

Updated diagnosis. Body slender, larger in female than male, brown to black. Pronotum and elytra black, red or orange, surface covered with decumbent pubescence. Antennae serrate or sub-filiform, at least overlapping elytral mid-length when inclined, antennomere II very short and transverse, III long-triangular, IV–XI long-triangular or nearly parallel-sided, XI pointed at apex (Fig. 2). Pronotum trapezoidal, disc with a median longitudinal keel extending from anterior margin to middle part of disc, anterior margin widely rounded, lateral margins nearly straight and posterior margin straight or bisinuate; anterior angles rounded or confluent with anterior margin, posterior angles sharp and projected. Scutellum inverted trapezoidal, emarginate or straight at apex. Elytra with lateral margins parallel-sided or feebly diverging posteriorly and sutures dehiscent at least at apical half part, each elytron with three costae. Claws slender, bifid in male, while tooth basally in female. Aedeagus: basal piece large and irregularly spoon-shaped, about 2/3 length of phallus; phallus slender or stout, cylindrical, with apical hood; internal sac sclerotized and complex, small or large, about 1/5–1/2 length of phallus.

Mesolycus can be differentiated from *Dilophotes* Waterhouse, 1879, the other genus of Dilophotini, by the following characters: antennae serrate or sub-filiform, extending to at most apical 1/3 length of elytra; pronotum with median longitudinal keel only at anterior half part; metathoracic wing without wedge cell; aedeagus: phallus longer than phallobase and internal sac highly sclerotized and complex. Unlike that, in *Dilophotes*, the antennae are serrate to flabellate, reaching to elytral apices; pronotum is provided with complete median longitudinal keel on

disc, extending from anterior to posterior margin; metathoracic wing has wedge cell; phallus of aedeagus is shorter than phallobase and internal sac is membranous.

Within *Mesolycus*, the two species groups are similar to each other in the external morphology, but they are definitely different in the structures of aedeagus. In the *M. atrorufus* species group, the phallus is slender, internal sac is attached to the phallus by two basal rods and additionally formed by two apical sclerotized and complex plates (e.g., Liu *et al.* 2022: figs 1D–F, H–P, 3A–L). In comparison, in the *M. ilyai* species group, the phallus is robust and considerably shorter, internal sac is attached to the phallus only by a complex stiffness plate (e.g., Figs 3, 4; Liu *et al.* 2022: figs 1A–C, G).

Included species (in the *M. ilyai* species group). *Mesolycus shelfordi* Bourgeois, 1906; *M. obscurus* Pic, 1912; *M. discoidalis* Pic, 1912; *M. ilyai* Kazantsev, 2000; *M. pacholatko* Bic, 2002; *M. bolavensis* Bic, 2002; *M. jendeki* Bic, 2002; *M. rubromarginatus* Kazantsev, 2013; *M. fedorenkoi* Kazantsev, 2013; *M. baoi* sp. nov.; *M. latidentatus* sp. nov.; *M. clausus* sp. nov.; *M. hainanensis* sp. nov.

Distribution (for the *M. ilyai* species group). China (Fig. 1), Myanmar, Laos, Vietnam, Myanmar, Thailand, Malacca and Sumatra.

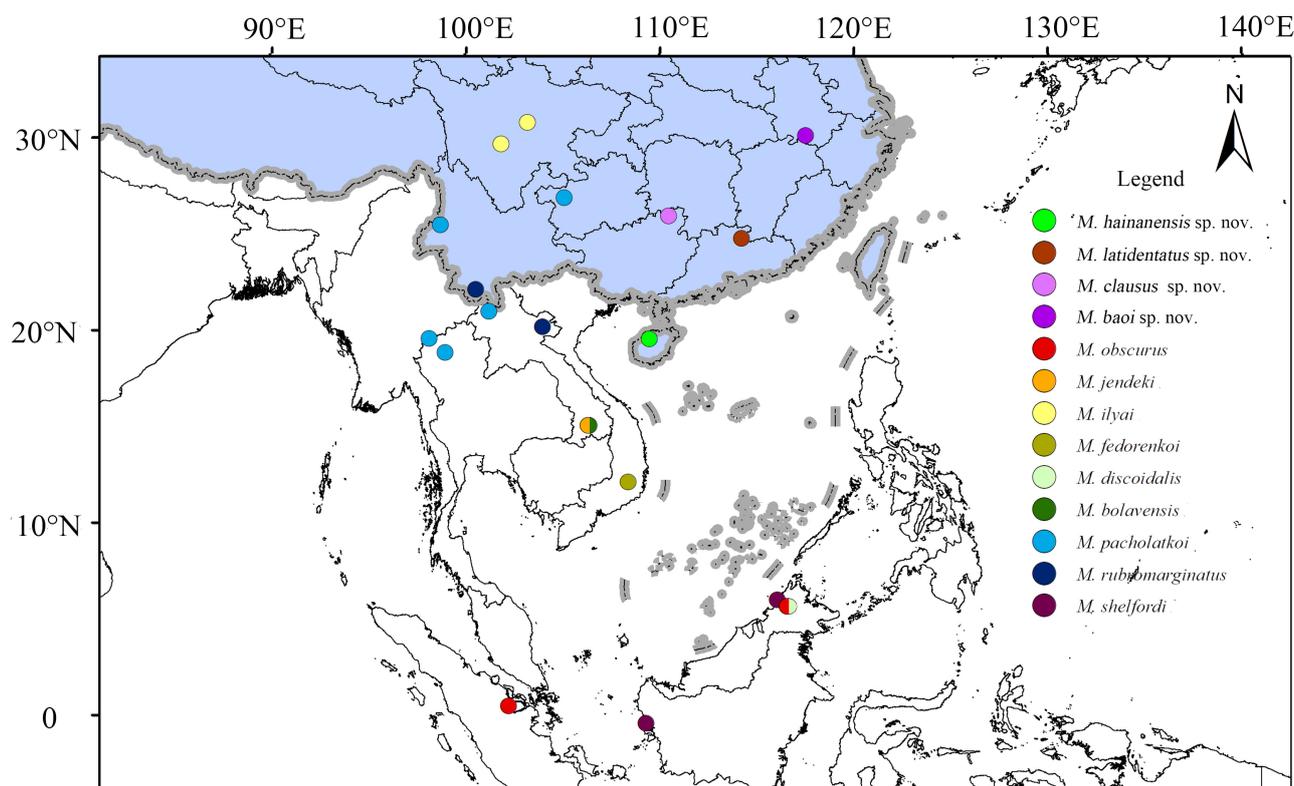


FIGURE 1. Distribution map of the *Mesolycus ilyai* species group.

***Mesolycus baoi* Y. Yang, Du et Liu, sp. nov.**

Chinese common name: 包氏中红萤
(Figs 2A–B, 3A–D)

Type material. HOLOTYPE: CHINA: ♂ (MHBUS), Anhui, Chizhou, Shitai, Guniujiang, 750 m, 14.IV.2023, Y. Bao leg. **PARATYPES: CHINA:** 2 ♂, 2 ♀ (MHBUS), same as the holotype.

Diagnosis. This species is similar to *M. rubromarginatus* Kazantsev, 2013 in the shape of aedeagus, but differs from the latter in the following characters: black pronotum and dark red elytra (Fig. 2A); internal sac of aedeagus with a pair of teeth exposed to cavity of apical ring (Fig. 3B), which is trapezoidal (Fig. 3A). In comparison, both pronotum and elytra are red in *M. rubromarginatus* (Kazantsev 2013: fig. 16); internal sac of aedeagus without any tooth in cavity of apical ring (Liu *et al.* 2022: fig. 1G), which is circular (Liu *et al.* 2022: fig. 1B).

Description. Length 6.0–6.2 mm (both sexes, 6.0 mm in holotype), width at humeri 1.2–1.3 mm (both sexes, 1.2 mm in holotype).

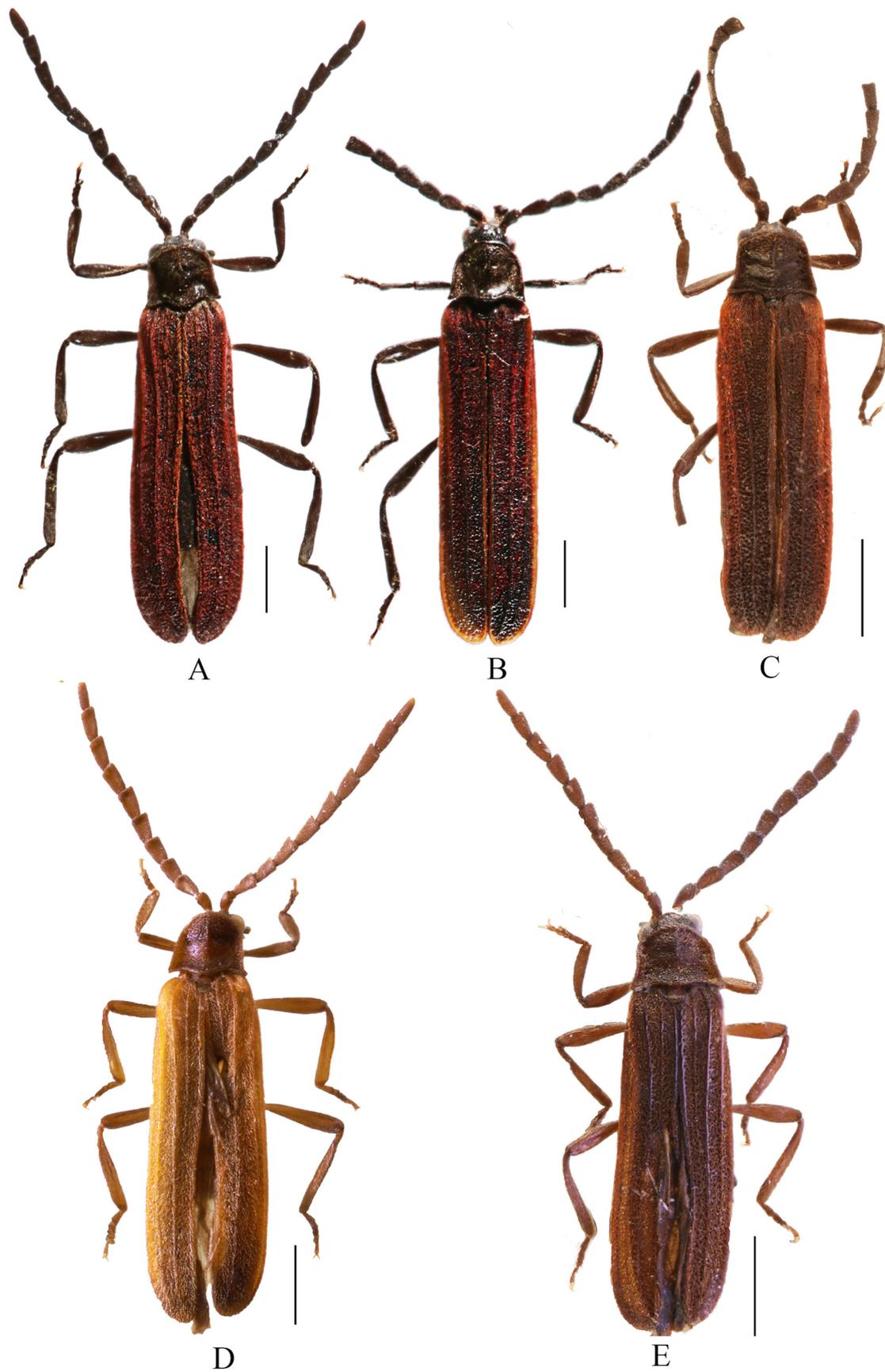


FIGURE 2. Habitus of *Mesolytus* species, dorsal view. A–B. *M. baoi* sp. nov. C. *M. latidentatus* sp. nov. D. *M. hainanensis* sp. nov. E. *M. clausus* sp. nov. Scale bars: 1.0 mm. A, C–E. Males. B. Female.

Male (Fig. 2A). Body brown to black, elytra dark red. Surface covered with decumbent red pubescence.

Head relatively small, width across eyes narrower than anterior margin of pronotum. Vertex flat, with median line. Eyes relatively small, interocular distance 1.6 times greater than diameter of an eye. Antennae serrate and extending to apical fourth length of elytra when inclined. Antennomere II compressed, shorter than wide of apices, III–X long-triangular and subequal in length, XI parallel-sided and pointed at apex (Fig. 2A).

Pronotum trapezoidal, 1.2 times wider than long, disc with a median longitudinal keel extending from anterior margin to middle part. Anterior margin round, lateral margins straight and posterior margin bisinuate; anterior angles round and posterior angles sharply projecting. Scutellum trapezoidal, feebly emarginate at apex (Fig. 2A).

Elytra slender, 4.0 times longer than humeral width, with lateral margins subparallel and sutures extremely dehiscent at apical two-thirds. Elytral costae I weak and reaching elytral mid-length, II and III strong (Fig. 2A).

Phallus stout (Fig. 3A, B), apical hood about 2/5 length of phallus (Fig. 3C). Internal sac relatively large, twice wider than and about half length of phallus (Fig. 3A–C), apical ring trapezoidal, feebly wider than long (Fig. 3A) and opening dorsally (Fig. 3D), with a pair of stout and apically rounded teeth located latero-basally on ventral side (Fig. 3B–D), and another pair of relatively narrow digitiform teeth feebly bent to each other and exposed to cavity (Fig. 3A, B, D); the length of lateral processes feebly shorter than apical ring (Fig. 3A, B), rounded at apical margins and hook-like protuberant at apical third part of latero-ventral sides (Fig. 3C).

Female. Similar to males, but body larger, antennae thinner and shorter, reaching apical third length of elytra when inclined, elytral sutures nearly parallel-sided and close to each other (Fig. 2B).

Etymology. The specific name is derived from the surname of Mr. Yu Bao, who is the collector of the type series.

Distribution. China (Anhui).

Mesolycus latidentatus Y. Yang, Du et Liu, sp. nov.

Chinese common name: 宽齿中红萤
(Figs 2C, 3E–H)

Type material. HOLOTYPE: CHINA: ♂ (MHBUS), Guangdong, Chebaling, 24.71°N, 114.25°E, 398.17m, 11.VII.2018, X. M. Wang and J. B. Tong leg. PARATYPES: 1 ♀ (MHBUS), Guangdong, Chebaling, 6.VIII.2022, C. Fang leg.

Diagnosis. This species looks like *M. baoi* sp. nov. in the shape of aedeagus, but it can be distinguished from the latter by the smaller eyes, with interocular distance 1.8 times greater than diameter of an eye (Fig. 2C); internal sac with a pair of thin and sharp teeth located latero-basally on ventral side (Fig. 3F–H), and another pair of relatively broad digitiform teeth directing to each other and exposed in cavity (Fig. 3E, F, H). In *M. baoi* sp. nov., eyes are larger and interocular distance is 1.6 times greater than diameter of an eye (Fig. 2A); internal sac with a pair of stout and apically rounded teeth located latero-basally on ventral side (Fig. 3B–D), and another pair of relatively narrow digitiform teeth feebly bent to each other and exposed in cavity (Fig. 3A, B, D).

Description. Length 4.7–4.3 mm (both sexes, 4.3 mm in holotype), width at humeri 1.2–1.0 mm (both sexes, 1.0 mm in holotype).

Male (Fig. 2C). Body brown, Pronotum black, elytra dark red, darkened at inner half part of disc, almost black at apices. Surface covered with red pubescence (Fig. 2D).

Head relatively small, width across eyes as wide as anterior margin of pronotum. Vertex flat, with median line. Eyes relatively small, interocular distance 1.8 times greater than diameter of an eye. Antennae serrate. Antennomere II compressed, shorter than wide of apices, III–X nearly long-triangular and subequal in length (Fig. 2C).

Pronotum trapezoidal, 1.3 times as wide as long, disc with a median longitudinal keel extending from anterior margin to mid-length. Anterior margin extremely rounded, lateral margins nearly straight and posterior margin bisinuate; anterior angles round and posterior angles sharply projecting. Scutellum trapezoidal, feebly emarginate at apex (Fig. 2C).

Elytra slender, 3.6 times longer than humeral width, with lateral margins subparallel and without sutures. Elytral costae I weak and extending to basal third length, II and III strong (Fig. 2C).

Phallus stout (Fig. 3E, F), apical hood about 2/5 length of phallus (Fig. 3G). Internal sac relatively large, twice wider than and about half length of phallus (Fig. 3E–G); apical ring inverted trapezoidal, feebly wider than long (Fig. 3E) and opening dorsally (Fig. 3H), with a pair of thin and sharp teeth located latero-basally on ventral side

(Fig. 3F–H), and another pair of relatively broad digitiform teeth directing to each other and exposed to cavity (Fig. 3E, F, H); the length of lateral processes feebly shorter than apical ring (Fig. 3E, F), rounded at apical margins and hook-like protuberant at apical third part of latero-ventral sides (Fig. 3G).

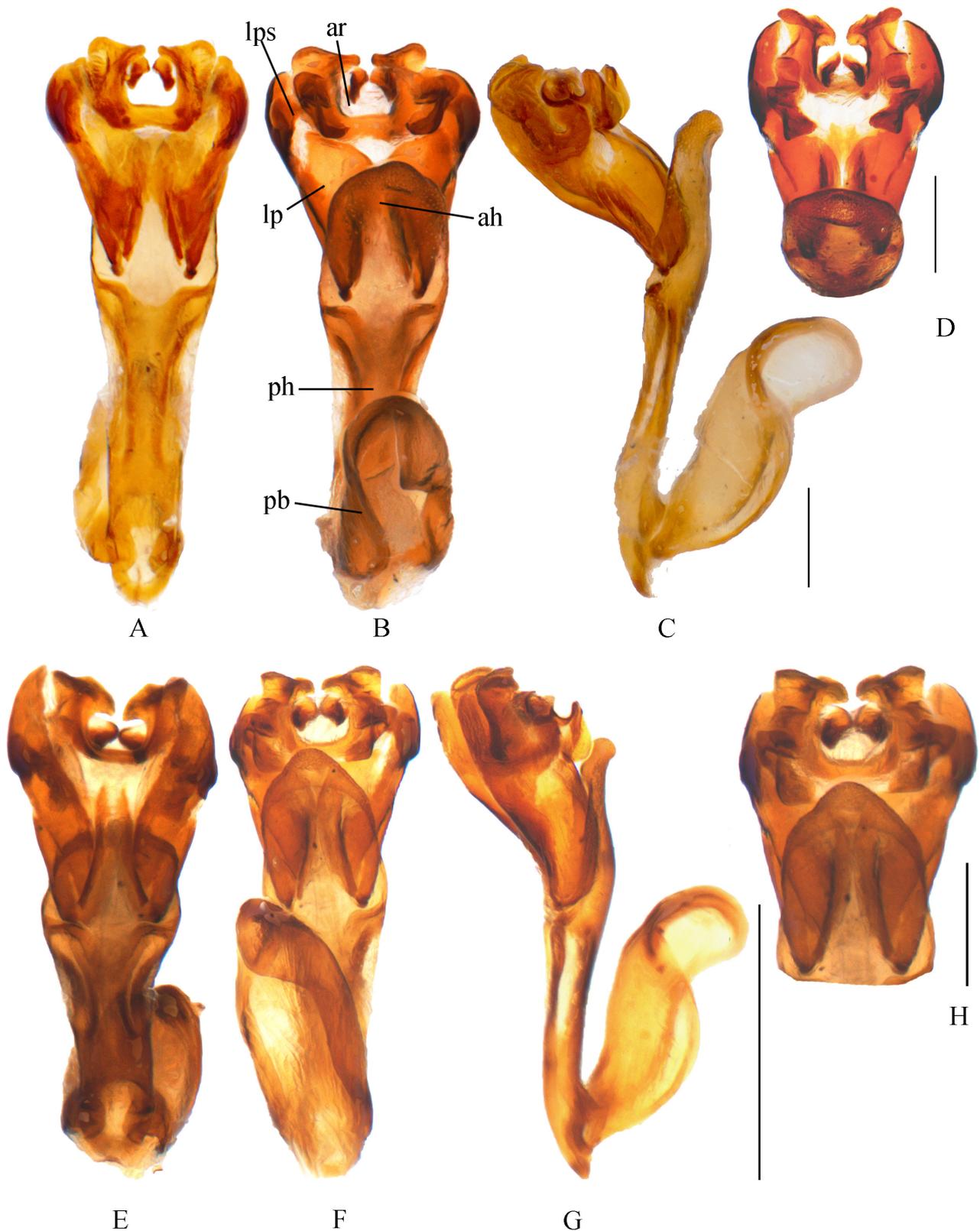


FIGURE 3. Aedeagi of *Mesolycus* species. **A–D.** *M. baoi* sp. nov. **E–H.** *M. latidentatus* sp. nov. **A, E.** Dorsal view. **B, F.** Ventral view. **C, G.** Lateral view. **D, H.** Apical view. Scale bars: **A–C, E–G.** 0.5 mm; **D, H.** 0.2 mm. pb: phallobase; ph: phallus; lp: lower plate; ar: apical ring; ah: apical hood; lps: lateral processes.

Female. Similar to males, but body larger.

Etymology. The specific name is derived from the Latin *latus* (broad) and *dentatus* (toothed), referring to the broad teeth exposed in cavity of apical ring of internal sac.

Distribution. China (Guangdong).

Remarks. The left antennomere XI and right IX–XI, left meta-tarsi and right meta-leg of the holotype are missing.

***Mesolycus hainanensis* Y. Yang, Liu et X. Yang, sp. nov.**

Chinese common name: 海南中红萤

(Figs 2D, 4A–D)

Type material. HOLOTYPE: CHINA: ♂ (IZAS), Hainan, Danzhou, Hot Work Liangyuan Botanical Garden, 10.IV.2008, L.Y. Jiang leg.

Diagnosis. This species is similar to *M. jendeki* Bic, 2002 in the shape of aedeagus, but can be distinguished by the following features: red-orange elytra and brown apically (Fig. 2D); scutellum straight apically (Fig. 2D); antennae overlapping two-third length of elytra when inclined (Fig. 2D); apical hood of phallus relatively short, about 1/4 length of phallus (Fig. 4C). Unlike in *M. jendeki*, elytra are dark brown, feebly infusate at humeri; scutellum is emarginate apically; antennae reach elytral mid-length when inclined; and apical hood of phallus is longer, about 1/3 length of phallus (Bic 2002: fig. 17).

Also, it resembles *M. rubromarginatus* in the shape of aedeagus, but differs from the latter in the internal sac about 1/3 length of phallus and provided with two teeth dorsally, while internal sac about half length of phallus and provided with four teeth dorsally in the latter (Liu *et al.* 2022: figs 1B, G).

Description. Male (Fig. 2D). Length 5.2 mm, width at humeri 1.2 mm. Body dark brown, pronotum dark brown, elytra red-orange and darkened apically. Surface covered with red-orange pubescence.

Head relatively small, width across eyes narrower than anterior margin of pronotum. Vertex flat, with median line. Eyes relatively large, interocular distance 1.2 times greater than diameter of an eye. Antennae serrate, reaching apical third length of elytra when inclined. Antennomere II compressed, shorter than wide of apices, III–X nearly long-triangular and subequal in length, XI parallel-sided and pointed at apex (Fig. 2D).

Pronotum trapezoidal, 1.3 times as wide as long, disc with a median longitudinal keel extending from anterior margin to posterior margin. Anterior margin extremely round, lateral margins straight and posterior margin bisinuate; anterior angles confluent with anterior margin and posterior angles sharply projecting. Scutellum trapezoidal, straight at apex (Fig. 2D).

Elytra slender, 3.6 times longer than humeral width, with lateral margins subparallel and sutures extremely dehiscent at apical two-thirds length. Elytral costae I weak and extending to mid-length, II and III strong (Fig. 2D).

Phallus stout (Fig. 4A, B), apical hood relatively short, about 1/5 length of phallus (Fig. 4C). Internal sac relatively small, feebly wider than and about 1/3 length of phallus (Fig. 4A–C); apical ring narrowly trapezoidal, about twice as long as wide (Fig. 4A) and opening dorsally (Fig. 4D), present with a pair of extremely thin and sharp teeth located latero-basally on ventral side (Fig. 4B–D); the length of lateral processes as long as apical ring (Fig. 4A, B), truncate at apical margin and triangularly protuberant at apical 1/3 part of latero-ventral sides (Fig. 4D).

Female. Unknown.

Etymology. The specific name is derived from the type locality, Hainan Island, China.

Distribution. China (Hainan).

***Mesolycus clausus* Y. Yang, Du et Liu, sp. nov.**

Chinese common name: 环囊中红萤

(Figs 2E, 4E–H)

Type material. HOLOTYPE: CHINA: ♂ (MHBUS), Guangxi, Xingan, Maoershan, 21.VII.2015, L. M. Li leg.

Diagnosis. This species resembles *M. fedorenkoi* Kazantsev, 2013 in the shape of aedeagus, but differs from the latter in the black pronotum and elytra (Fig. 2E); aedeagus: apical hood bent ventrally, about 2/5 length of phallus

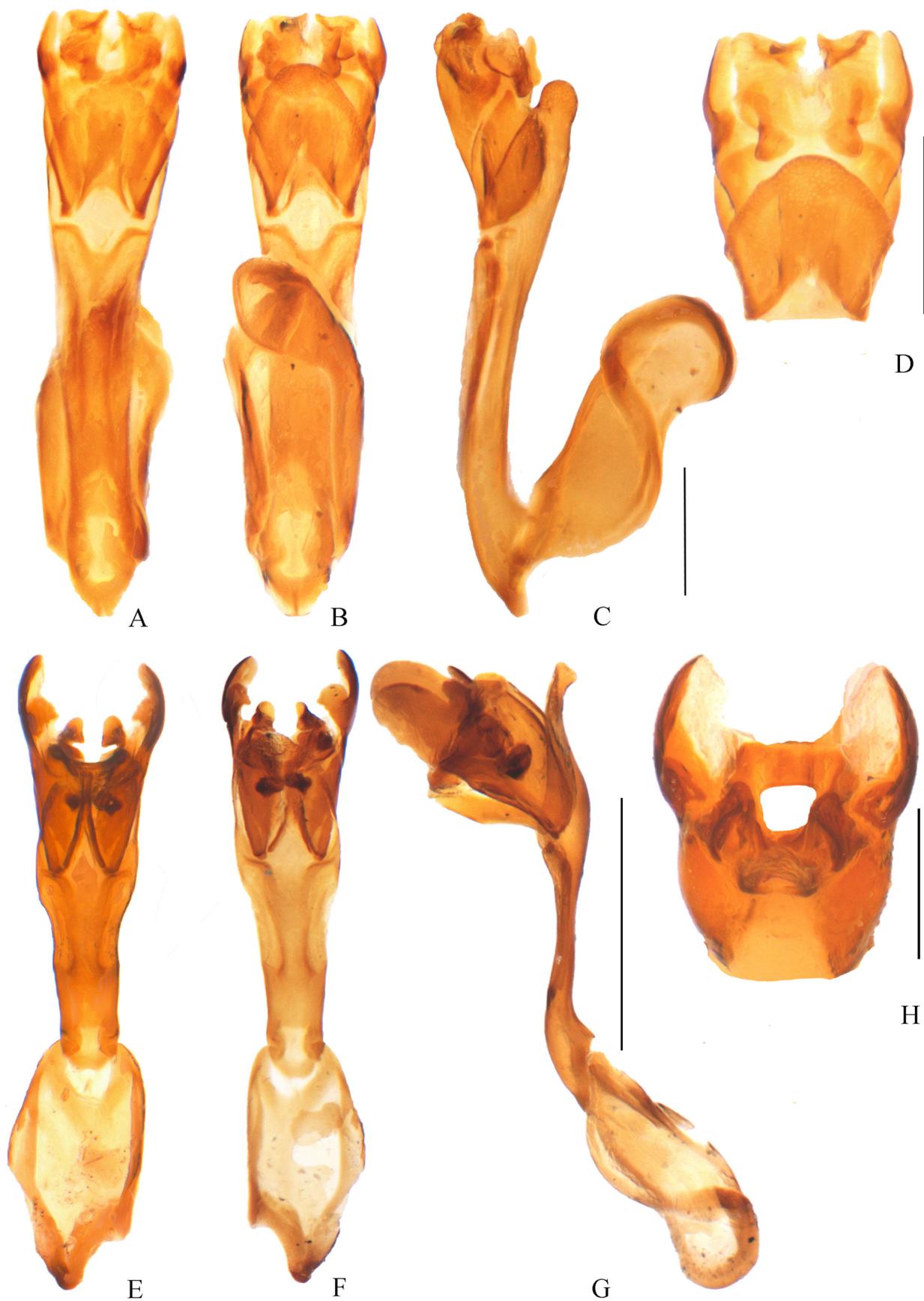


FIGURE 4. Aedeagi of *Mesolycus* species. A–D. *M. hainanensis* sp. nov. E–H. *M. clausus* sp. nov. A, E. Dorsal view. B, F. Ventral view. C, G. Lateral view. D, H. Apical view. Scale bars: A–D, H. 0.2 mm; E–G. 0.5 mm.

4.	Aedeagus: apical ring of internal sac about twice wider than long (Bic 2002: fig. 19)	<i>M. ilyai</i> Kazantsev, 2000
	Aedeagus: apical ring of internal sac nearly as long as wide or twice longer than wide (e.g., Figs 3A, E, 4E; Bic 2002: fig. 20; Liu <i>et al.</i> 2022: fig. 1B)	5
5.	Aedeagus: internal sac without any tooth exposed to cavity of apical ring (e.g., Bic 2002: fig. 20)	6
-	Aedeagus: internal sac with a pair of teeth exposed in cavity of apical ring (e.g., Figs 3A, E, 4E; Kazantsev 2013: figs 13, 19; Liu <i>et al.</i> 2022: fig. 1B)	7
6.	Eyes moderately large, with interocular distance about as 1.4 times as diameter of an eye; pronotum black.	<i>M. pacholatko</i> Bic, 2002
-	Eyes very large, with interocular distance at most 1.1 times greater than diameter of an eye; pronotum red (Kazantsev 2013: fig. 16)	<i>M. fedorenko</i> Kazantsev, 2013
7.	Aedeagus: phallus with apical hood bent ventrally, internal sac with lateral processes longer than apical ring (Fig. 3G) and with three conspicuous teeth on dorsal side (Fig. 3H)	<i>M. clausus</i> sp. nov.
-	Aedeagus: phallus with apical hood straight, internal sac with lateral processes as long as or feebly shorter than apical ring and with four conspicuous teeth on dorsal side (e.g., Figs 3D, 4H)	8
8.	Pronotum and elytra red (Kazantsev 2013: fig. 16); aedeagus: internal sac present with a pair of teeth located at basal margin of apical ring (Kazantsev 2013: fig. 19; Liu <i>et al.</i> 2022: figs 1B, G), which is circular (Liu <i>et al.</i> 2022: fig. 1B)	<i>M. rubromarginatus</i> Kazantsev, 2013
-	Pronotum black and elytra dark red (e.g., Fig. 2A, E); aedeagus: internal sac with a pair of teeth exposed to cavity of apical ring, which is trapezoidal (e.g., Figs 3A, 4E; Bic 2002: figs 16, 17; Kazantsev 2004: figs 36, 37)	9
9.	Eyes moderately large, with interocular distance 1.6 times greater than diameter of an eye (Fig. 2A); aedeagus: internal sac with the teeth located on latero-basal sides stout apically (Fig. 3C) and those exposed to cavity of apical ring slender (Fig. 3D)	<i>M. baoi</i> sp. nov.
-	Eyes small, with interocular distance 1.8 times greater than diameter of an eye (Fig. 2E); aedeagus: internal sac with the teeth located on latero-basal sides slender apically (Fig. 4G) and those exposed to cavity of apical ring stout (Fig. 5H)	<i>M. latidentatus</i> sp. nov.
10.	Aedeagus: internal sac simple on ventral side (Kazantsev 2004: figs 36, 37)	<i>M. discoidalis</i> Pic, 1912
-	Aedeagus: internal sac with complex structures on ventral side (e.g., Fig. 4B; Bic 2002: figs 16, 17)	11
11.	Elytra orange (Fig. 2D); aedeagus: internal sac hardly extending 2/3 length of apical hood of phallus (Fig. 4B)	<i>M. hainanensis</i> sp. nov.
-	Elytra red; aedeagus: internal sac hardly extending beyond apex of phallus (e.g., Bic 2002: figs 16, 17)	12
12.	Aedeagus: phallus about 3.0 times longer than internal sac (Bic 2002: fig. 17)	<i>M. jendeki</i> Bic, 2002
-	Aedeagus: phallus about 5.0 times longer than internal sac (Bic 2002: fig. 16)	<i>M. bolavensis</i> Bic, 2002

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中国中红萤属 *Mesolycus* 伊利亚种团四新种记述 (鞘翅目: 红萤科)

杜若兰^{1,4}, 杨玉霞^{1,2,5*}, 杨星科^{3,6}, 刘浩宇^{1,2,7*}

¹河北大学生命科学学院动物系统学与应用重点实验室, 保定 071002, 河北, 中国

²河北大学河北省生物互作基础研究中心, 中国保定071002

³中国科学院动物研究所动物系统学与进化重点实验室, 北京 100101, 中国

⁴✉ 20218017193@stumail.hbu.edu.cn;  <https://orcid.org/0009-0003-8774-4001>

⁵✉ yxyang@hbu.edu.cn;  <https://orcid.org/0000-0002-3118-6659>

⁶✉ yangxk@ioz.ac.cn;  <https://orcid.org/0000-0003-3676-6828>

⁷✉ liuhy@hbu.edu.cn;  <https://orcid.org/0000-0003-1383-5560>

*通讯作者

摘要: 记述中国产中红萤属 *Mesolycus* 伊利亚 *M. ilyai* 种团4新种, 即包氏中红萤 *M. baoi* **sp. nov.**、宽齿中红萤 *M. latidentatus* **sp. nov.**、海南中红萤 *M. hainanensis* **sp. nov.** 和环囊中红萤 *M. clausus* **sp. nov.**; 提供了成虫整体和雄性外生殖器特征图; 总结了中红萤属属征, 更新了伊利亚种团检索表与分布地图。

关键词: 红萤科; 中红萤属; 分类; 新种; 中国