



Discovery of the subfamily Lycoriniinae Cushman & Rohwer, 1920 (Hymenoptera: Ichneumonidae) from Indonesia, based on *Lycorina longicauda* Shimizu, sp. nov., with a key to the Oriental *Lycorina* species

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Abstract

The subfamily Lycoriniinae Cushman & Rohwer 1920 is discovered from Indonesia based on a single new species, *Lycorina longicauda* Shimizu, sp. nov., which can be easily distinguished from any other *Lycorina* species by its longer ovipositor sheath and colour pattern. We also provide a key to the five species of *Lycorina* known from the Oriental region.

Key words

Oriental region, parasitoid wasps, taxonomy.

INTRODUCTION

The enigmatic ichneumonid subfamily Lycoriniinae Cushman & Rohwer 1920 comprises a single genus, *Lycorina* Holmgren 1859, and 34 extant species that are distributed in almost all biogeographical regions (Rousse & van Noort 2013, 2014; Yu *et al.* 2016). This subfamily is morphologically isolated from all other subfamilies of Ichneumonidae (Gauld 1984), but its phylogenetic position is still unclarified (Gauld *et al.* 1997; Quicke *et al.* 2009). *Lycorina* species are koinobiont ectoparasitoids of various concealed micro-sized Lepidopteran caterpillars (Coronado-Rivera *et al.* 2004; Shaw 2004).

In the Oriental region, the following four *Lycorina* species have been recorded: *L. borneoensis* Momoi 1966 from Malaysia; *L. clypeatuberculla* Wang 1985 and *L. inareolata* Wang 1985 from China; and *L. ornata* Uchida & Momoi 1959 from China and Japan (Uchida & Momoi 1959; Momoi 1963, 1966, 1970; Wang 1985; He *et al.* 1996). However, no *Lycorina* species have so far been recorded from Indonesia (Yu *et al.* 2016).

Recently, the second author had an opportunity to conduct a field investigation in Indonesia using Malaise traps. Subsequently, the first author examined the sample, and discovered the new *Lycorina* species described below. Thus, we report herein the subfamily Lycoriniinae for the first time from Indonesia. In addition, a key to the Oriental species of *Lycorina* is provided.

MATERIALS AND METHODS

Field collection

The field collection was performed under a research visa from the Ministry of State for Research and Technology, Indonesia (No.322/SIP/FRP/SM/VIII/2013) for RO. A Malaise trap was set between 16 March and 24 April 2014 in a primary tropical rainforest on Mt. Mekongga, North Kolaka, Sulawesi Tenggara, Indonesia (3° 38' 40" S, 121° 7' 32" E; about 700 m alt.) (Fig. 1).

Repositories

The specimens examined are preserved in the following repositories:

MZBI	Museum Zoologicum Bogoriense, Bogor, Indonesia
NIAES	Institute for Agro-Environmental Sciences, NARO, Tsukuba, Japan

Morphological observation

A stereoscopic microscope (SMZ1500, Nikon, Tokyo, Japan) was used for morphological observation.

Multi-focus photographs for Figure 2 were taken using a single lens reflex camera (D7100, Nikon, Tokyo, Japan) with micro-lens (AF Micro-Nikkor 60 mm f/2.8D, Nikon, Tokyo, Japan) and teleplus teleconverter (N-AFD 2× Teleplus MC7,

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Early view version of record published on 20 July 2018.



Fig. 1. Collection site of *Lycorina longicauda* Shimizu, sp. nov.: a highly nature-rich tropical rainforest on Mt. Mekongga, North Kolaka, Sulawesi Tenggara, Indonesia ($3^{\circ} 38' 40''$ S, $121^{\circ} 7' 32''$ E; about 700 m alt.).



Fig. 2. Habitus of *Lycorina longicauda* Shimizu, sp. nov., holotype female.

Kenoko, Tokyo, Japan), and Figures 3a–d, 5a,b were taken using a digital microscope (VHX-600, Keyence, Osaka, Japan). The multi-focus photographs were stacked by Zerene Stacker.

Figure 4a–f was taken using a scanning electron microscope (SEM) (JSM-6010LV, JEOL, Tokyo, Japan). The specimen for SEM observation was not coated and was observed under high vacuum and an accelerating voltage of 10 kV.

All figures were edited by Adobe Photoshop© Creative Cloud and Illustrator© Creative Cloud.

Measurements were made using a micrometre mounted on the stereoscopic microscope under $\times 100$ magnification.

Terminology and abbreviations

The morphological terminology mainly follows Gauld (1991), and the terminology for surface microsculptures follow Eady (1968). Style of the new species description follows Gauld (1984) and Gauld *et al.* (1997).

The following abbreviations are used: HT – holotype, IOD – inter-ocular distance (shortest distance between inner margin of lateral ocelli), LOD – lateral-ocular diameter (maximum diameter of lateral ocelli), OOD – orbito-ocular distance (shortest distance between outer margin of lateral ocellus and orbit of eye), POD – post-ocular distance (shortest distance between posterior margin of lateral ocellus and occipital carina), S – metasomal sternite, T – metasomal tergite.



Fig. 3. *Lycorina longicauda* Shimizu, sp. nov., holotype female: (a) head in frontal view, (b) head and mesosoma in dorsal view, (c) metasoma in dorsal view and (d) hind leg in profile.

RESULTS

A total of two *Lycorina* specimens from Indonesia were collected representing a single morphospecies (Fig. 2). The species was easily distinguishable from any other *Lycorina* species by its longer ovipositor sheath and colour pattern (cf. below for details), hence, the authors describe it as a new species. In this study, the first author examined the ichneumonid collection at the following institutions: Canadian National Collection of Insects, Ottawa, Canada (CNC); Utah State University Insect Collection (= American Entomological Institute), Department of Biology, Utah State University, Logan, Utah, USA (EMUS); Ehime University Museum, Matsuyama, Japan (EUM); Kanagawa Prefectural Museum of Natural History, Odawara, Japan (KPMNH); NIAES; Natural History Museum, London, England (NHM); Osaka Museum of Natural History, Osaka, Japan (OMNH); the Laboratory of Systematic Entomology, Hokkaido University, Sapporo, Japan (SEHU); Taiwan Agricultural Research Institute Council of Agriculture, Executive Yuan, Taichung, Taiwan (TARI); and Tochigi Prefectural Museum, Utsunomiya, Japan (TPM). However, no additional specimens of *Lycorina* from Indonesia were found.

TAXONOMY

Lycorina Holmgren 1859

Lycorina Holmgren 1859: 126 (type species: *Lycorina triangulifera* Holmgren, by monotypy).

Amyx Schiødte 1839: 309 (type species: *Amyx flavilabris* Schiødte, by original designation).

Toxophoroides Cresson 1874: 406 (type species: *Lycorina apicalis* Cresson, by original designation).

Chlorolycorina Cushman 1920: 9 (type species: *Glypta scitula* Cushman, by original designation).

Gonioglyphus Seyrig 1932: 22 (type species: *Lycorina fici* Seyrig, by monotypy).

Diagnosis

Lycorina is easily distinguishable from any other Ichneumonidae by the T1–4 with the characteristic grooves delineating a central triangular area (Figs 2, 3c, 4e, f) and the postero-dorsal corner of metanotum with a hook engaging antero-lateral projection of propodeum (Fig. 4d). Similar metasomal grooves are also known in the tribe Glyptini

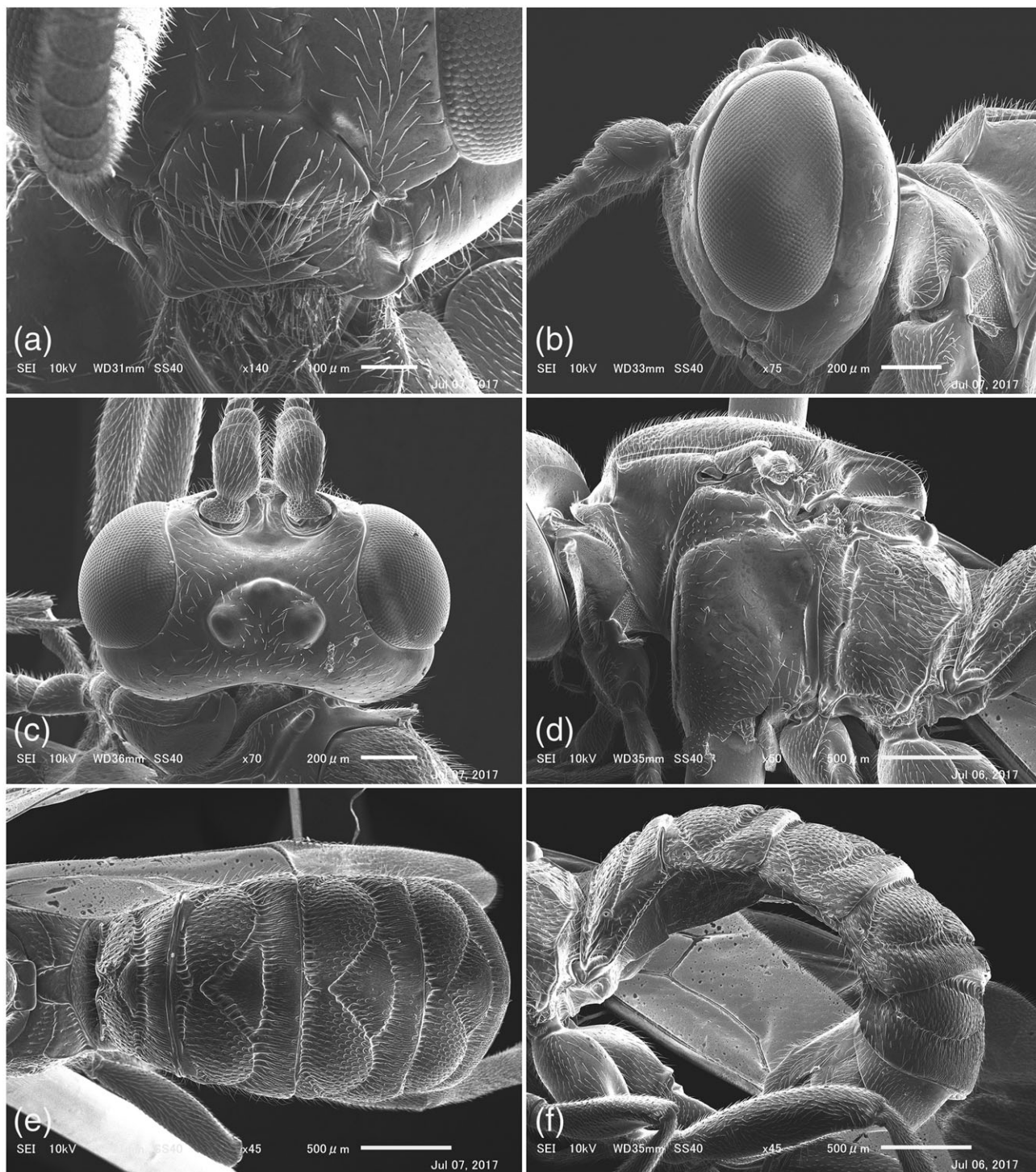


Fig. 4. Scanning electron microscope images of *Lycorina longicauda* Shimizu, sp. nov., paratype female: (a) lower part of head in frontal view, (b) head in profile, (c) head in dorsal view, (d) mesosoma in profile, (e) propodeum and metasoma in dorsal view and (f) metasoma in profile.

(Banchinae) and some taxa of Pimplinae, but Glyptini has only the oblique grooves in a chevron pattern (the transverse, groove at the posterior of each segment is lacking) and the oblique grooves in some Pimplinae are more lateral, extending to the lateral edges of each tergite and generally not meeting anteromedially.

Description

Small to medium sized. Clypeus flat to convex (Fig. 4b), separated from face by a groove (Figs 2, 3a, 4a,b), and its lower margin sometimes with a median concavity (Figs 3a, 4a); mandible weakly evenly tapered, bidentate (Fig. 4a); malar space

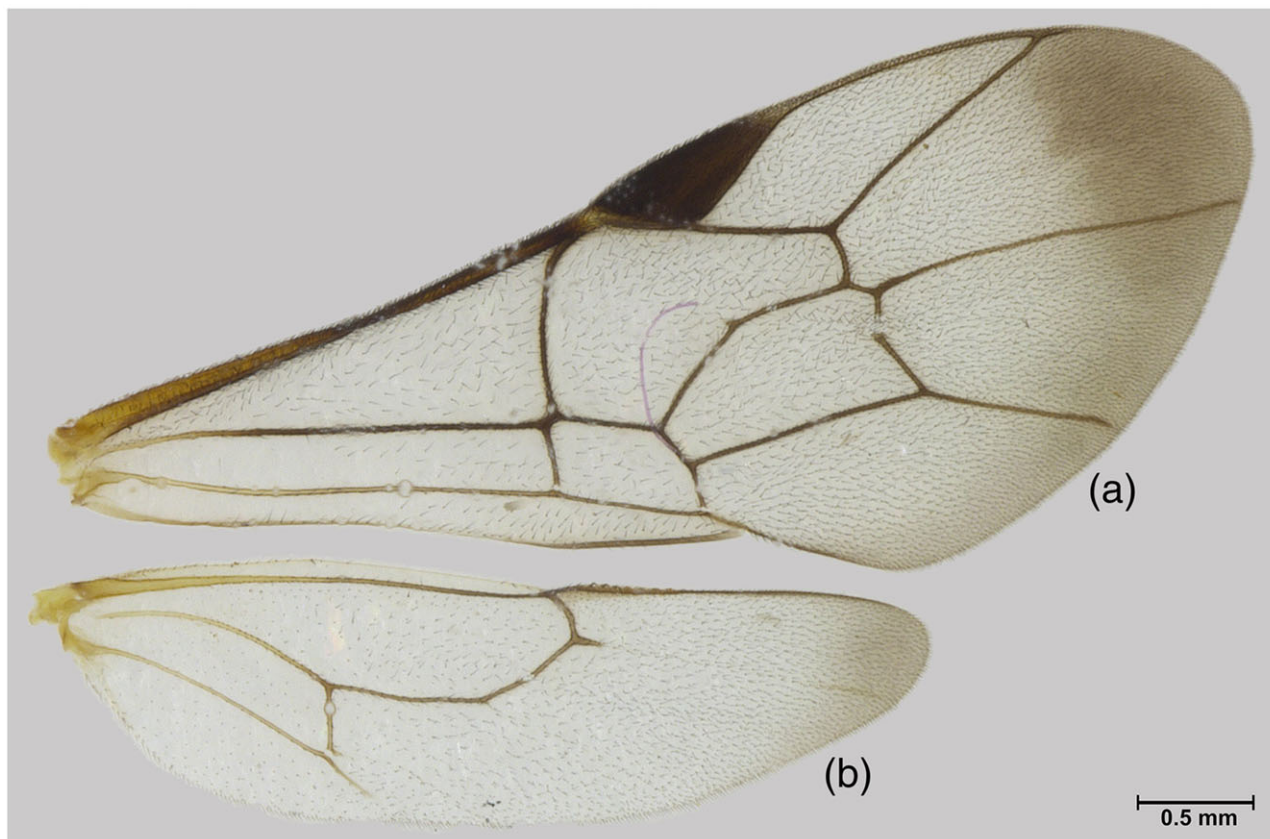


Fig. 5. *Lycorina longicauda* Shimizu, sp. nov., paratype female: (a) fore wing and (b) hind wing.

broad; sub-ocular sulcus deep (Figs 2, 3a, 4a, b); ocelli rather small; occipital carina complete or interrupted mediodorsally; genal carina joining oral carina above base of mandible; flagellomeres unspecialised (Fig. 2). Epomia strong with upper end strongly produced like a tooth (Figs 3b, 4b, d); notauli absent or vestigial (Figs 2, 3b, 4b, d); scutellum with lateral longitudinal carina; epicnemial carina present, its upper end not reaching anterior margin of mesopleuron; sternaulus absent; postpectal carina absent; submetapleural carina strongly broadened anteriorly and forming a lobe (Figs 2, 4d); antero-lateral corner of propodeum with a projection and engaging a metanotal hook (Fig. 4d); propodeum with or without carina. Fore tibia without a tooth on outer distal end. Fore wing with vein 3rs-m absent; 2rs-m longer than abscissa of M between 2rs-m and 2m-cu; 2m-cu with a single bulla; pterostigma triangular. Metasoma depressed; T1 entirely broad with spiracle in front of the centre (Figs 2, 3c, 4e, f); T2–4 with grooves delineating a central triangular area (Figs 2, 3c, 4e, f); female subgenital plate large and triangular in profile (Figs 2, 3d); ovipositor moderately long and 1.0 or more times as long as hind tibia (Fig. 2), with a distinct apical nodus.

Remarks

The taxonomic position of this genus has frequently changed over the years. It was originally classified in the subfamily

Pimplinae Wesmael, 1845 *sensu lato* (e.g. Förster 1869; Ashmead 1900; Cushman & Rohwer 1920), and was subsequently transferred to the subfamily Banchinae Wesmael, 1845 (Townes & Townes 1951). However, Townes (1970) finally classified them into the isolated subfamily Lycorinae. Gauld (1984) suggested that the lycorinine species are morphologically isolated from other ichneumonid subfamilies.

Quicke *et al.* (2009) examined the phylogenetic relationship of this genus within Ichneumonidae using a combined molecular and morphological analysis but failed to get a clear result. Hence, the phylogenetic position of this genus is still unclear (Gauld *et al.* 1997; Quicke *et al.* 2009). However, this genus is considered to be a member of the ophoniformes based on the anchored eggs and the divided upper ovipositor valve with interlocking halves (Quicke *et al.* 2009).

Distribution

Afrotropical, Australasian, Nearctic, Neotropical, Oriental and Palearctic regions (Yu *et al.* 2016).

Biology

Various concealed micro-sized Lepidoptera families have been recorded as the hosts of this genus (e.g. Minamikawa 1969; Chao 1980; Shaw 2004), but according to Shaw (2004), most

of their host records need confirmation, except for the records from Tortricidae as well as well-substantiated rearings from Crambidae (Gauld *et al.* 1997; Coronado-Rivera *et al.* 2004) and Ethmiidae (Coronado-Rivera *et al.* 2004).

Coronado-Rivera *et al.* (2004) indicated that *L. apicalis* Cresson 1874 is a koinobiont and its larva finishes development as an ectoparasitoid, but they could not observe the early larval stages of the wasp. However, Shaw (2004) indicated that the egg of *Lycorina triangulifera* Holmgren 1859 is oviposited through the anus of the host. Coronado-Rivera *et al.* (2004) mentioned that the early development could possibly occur as an ectoparasitoid in the hindgut. None of the studies was able to reveal the exact location of oviposition and early development.

Key to the Oriental species of *Lycorina*

- 1 Ovipositor sheath long, 2.2 times as long as hind tibia (Fig. 2). Medial triangular area of metasomal tergites yellow. Indonesia.....*Lycorina longicauda* Shimizu, sp. nov.
- Ovipositor sheath of moderate length, 1.2–1.8 times as long as hind tibia. Medial triangular area of metasomal tergites black, except yellow in *L. inareolata*..... 2
- 2 Medial triangular area of metasomal tergites yellow. Hind tarsus as long as hind tibia. Hind femur entirely black. Temple 0.8 times as long as eye in profile. Hind coxa yellow. China. *L. inareolata*
- Medial triangular area of metasomal tergites black. Hind tarsus shorter than hind tibia. Hind femur entirely reddish brown or black with apical part yellow. Temple 0.6 times as long as eye in profile. Hind coxa black. 3
- 3 Second tarsomere of hind leg rather slender, 3.0 times as long as its width. Ovipositor sheath 1.5 times as long as hind tibia. Hind trochanter blackish. China..... *L. clypeatuberculla*
- Second tarsomere of hind leg rather stout, 2.0–2.4 times as long as its width. Ovipositor sheath 1.2–1.3 or 1.8 times as long as hind tibia. Hind trochanter reddish or blackish..... 4
- 4 Hind femur entirely reddish brown. Hind second tarsomere 2.0 times as long as wide. Ovipositor sheath 1.8 times as long as hind tibia. Apical 0.3 of hind tibia black. China and Japan. *L. ornate*
- Hind femur yellow basally and black apically. Hind second tarsomere 2.4 times as long as wide. Ovipositor sheath 1.2–1.3 times as long as hind tibia. Apical 0.4 of hind tibia black. Malaysia..... *L. borneoensis*

Lycorina longicauda Shimizu, sp. nov.

(Figs 2, 3a–d, 4a–f, 5a,b)

<http://zoobank.org/urn:lsid:zoobank.org:act:B14653C3-0CF1-4B42-8923-C353767F8BD3>

Material examined

Holotype

♀, '[WAWO: INDONESIA] / Mt. (Gunung) Mekongga, North / Kolaka, Sulawesi Tenggara / 3° 38' 40" S, 121° 7'

32" E / 16. III–24. IV. 2014 [ca. 700 m] / Ryo Ogawa leg. (Malaise Trap) (white label) // A research visa from the Ministry / of State for Research and / Technology, Indonesia / No.322/SIP/FRP/SM/VIII/2013 / JSPS KAKENHI / Grant Number 14J07309 (white label) // HOLOTYPE / [*Lycoriniinae*] / *Lycorina longicauda* Shimizu, 201* / *Austral Entomol.* **: **_**. (red label)' (MZBI) (Figs 2, 3a–d).

Paratype

♀, label data same as holotype (NIAES) (Figs 4a–f, 5a,b).

Diagnosis

The ovipositor sheath of virtually all other *Lycorina* species is less than 1.8 times as long as the hind tibia, whereas it is 2.2 times in the new species. Thus, the new species is distinguishable from virtually all other species by the longer ovipositor. Two New World species, *L. apicalis* Cresson 1874 and *L. glaucomata* (Cushman 1920), have an ovipositor which is more than 1.8 times as long as the hind tibia, but they can be distinguished from the new species by a strongly infumate apex of fore wing (fore wing with apical margin moderately infumate in the new species) and the black distal 0.3 of hind tibia (distal 0.7 of hind tibia black in the new species). Hence, the new species is easily distinguished from all other *Lycorina* species by combination of the longer ovipositor and its colour.

Description

Female. Body length ca. 6.0–6.5 (HT: 6.0) mm (Fig. 2).

Head entirely strongly polished and smooth (Figs 2, 3a, b, 4a–c). Lower face as wide as high, with sparse and fine setae (Figs 2, 3a, 4a,b). Clypeus 1.9–2.0 (HT: 1.9) times as wide as high, with rather stout and long setae, flat in profile, its ventral margin acute and medially concave in frontal view (Figs 2, 3a, 4a,b). Malar space 0.7 times as long as basal width of mandible (Figs 2, 3a, 4a,b). Occipital carina interrupted or weak mediodorsally. IOD 1.4 times as long as LOD, OOD 1.0–1.1 (HT: 1.1) times as long as LOD, POD 1.9 times as long as LOD (Figs 3a, 4c). Antenna with 28 flagellomeres (Fig. 2). First flagellomere 4.5–4.8 (HT: 4.5) times as long as wide and 1.6 times as long as second one.

Mesosoma entirely strongly polished with setae (Figs 2, 3b, 4b,d,e). Pronotum smooth, mediodorsally with a longitudinal bridge connecting the raised anterior and posterior margins (Figs 2, 4b,d). Mesoscutum 1.3 times as long as wide in dorsal view (Fig. 3b), moderately punctate (Figs 3b, 4d), evenly rounded in profile (Figs 2, 4d). Scutellum smooth, moderately convex in profile, with the lateral longitudinal carinae on its anterior 0.8 (Figs 3b, 4d). Epicnemial carina almost straight and weakly inclined to anterior margin of mesopleuron (Fig. 4d). Mesopleuron entirely smooth with scattered setae (Figs 2, 4d). Metapleuron moderately punctate (Figs 2, 4d). Submetapleural carina complete, strongly broadened anteriorly and forming a lobe (Figs 2, 4d). Propodeum short, anterior transverse carina incomplete medially, posterior transverse carina complete, lateromedian longitudinal carina present from

anterior margin of propodeum to posterior transverse carina (Figs 2, 4d–f).

Wings (Fig. 5a,b). Fore wing length ca. 5.0 mm (Fig. 5a). Fore wing with 2rs-m 1.6–2.3 (HT: 2.3) times as long as M between 2rs-m and 2m-cu; Rs+M distal to cu-a (Fig. 5a). Hind wing with Cu1 absent; R1 with seven distal hamuli (Fig. 5b).

Legs (Fig. 3d). Hind femur 4.0–4.1 (HT: 4.1) times as long as wide and 0.7 times as long as hind tibia (Fig. 3d). Ratio of hind tarsomeres 1:2 = 2.9, 2:3 = 1.4, 3:4 = 1.4, 4:5 = 0.5 (Fig. 3d). Tarsal claws with long strong pectinae.

Metasoma (Figs 2, 3c, 4e,f). T1 0.9 times as long as maximum width and 1.4 times as long as T2 (Figs 2, 3c, 4e,f). T2 0.6 times as long as maximum width (Figs 3c, 4e). A median transverse area of T1 and an anterior area of T2–5 longitudinally punctate crenulate (Figs 3c, 4e,f). An anterior area of T1, a central triangular area of T1–5, and a posterior area of T1–5 longitudinally striate or strigose (Figs 3c, 4e,f). T6–8 entirely finely coriaceous (Fig. 4f). Ovipositor sheath 2.2 times as long as hind tibia (Fig. 2).

Colour (Figs 2, 3a–d, 5a,b). Head yellow, but the following parts black: apex of mandible, upper margin of clypeus, median part of frons, interocellar area and posterior surface of head; and antennae dark-brown (Figs 2, 3a,b). Mesosoma black, but the following parts yellow: upper margin of pronotum, a pair of longitudinal marks on mesoscutum, scutellum, median part of postscutellum, antero-median mark and upper margin of mesopleuron, posterior part of metapleuron, and all of propodeum except a postero-median mark and anterior margin (Figs 2, 3b). Wings hyaline, but its distal margin moderately infusate, and its venation dark to light brown (Figs 2, 5a,b). Fore and mid legs entirely yellow (Fig. 2). Hind coxa and femur black (Figs 2, 3d). Hind trochanter, hind trochantelli and basal 0.3 of hind tibia yellow (Figs 2, 3d). Distal 0.7 of hind tibia and hind tarsomeres dark brown (Figs 2, 3d). Metasomal tergites black, but the following parts yellow: a basal transverse area of T1, a central triangular area of T1–4, and a posterior transverse band of T1–5 (Figs 2, 3c,d). Metasomal sternites yellow, but the posterior part of subgenital plate black (Figs 2, 3d). Ovipositor amber and sheaths brownish (Figs 2, 3d).

Male. Unknown.

Remarks

Gauld (1984) proposed the following two species-groups from Australia: the *L. turneri* species-group characterised by a carinate propodeum and long tarsal pectinae; and the *L. canberra* species-group characterised by a smooth propodeum and short tarsal pectinae. The former group resembles some Indo-Papuan species, and the latter group resembles the Neotropical species (Gauld 1984). In addition, Gauld *et al.* (1997) proposed the following two species-groups from Costa Rica: the *L. apicalis* species-group characterised by a longitudinal ridge connecting the raised anterior and posterior margins; and the *L. artavia* species-group characterised by a deep transverse furrow across the pronotum, without a longitudinal keel or bridge traversing this furrow mediodorsally.

The new species is similar to the *L. turneri* species-group on a carinate propodeum and long tarsal pectinae, and also similar to the *L. apicalis* species-group on a longitudinal ridge connecting the raised anterior and posterior margins. However, the New World groups are distinguishable from the Old World groups by lacking propodeal carinae (Gauld *et al.* 1997). Hence, the new species possibly belongs to the Old World group, the *L. turneri* species-group.

Etymology

The specific name is derived from its long ovipositor.

Distribution

Indonesia (Sulawesi).

Biology

Almost unknown. However, the collection site of the type series is a highly nature-rich tropical rainforest on Mt. Mekongga, North Kolaka, Sulawesi Tenggara, Indonesia (3° 38' 40" S, 121° 7' 32" E; about 700 m alt.) (Fig. 1), and the type series was collected by Malaise traps on 16 March to 24 April 2014.

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