Redescription of the immature stages and male genitalia of *Topomyia (Topomyia) gracilis* Leicester, 1908 (Diptera: Culicidae) from Malaysia and Indonesia

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**Abstract:** The pupa and larva of *Topomyia (Topomyia) gracilis* Leicester are described and illustrated for the first time based on specimens collected from Sarawak and Selangor, Malaysia and Bali Is., Indonesia. The male genitalia was also illustrated. The larvae of this species usually breed in the water accumulation of leaf axils (=phytotelmata) of taro plants (*Alocasia* and *Colocasia*), wild and domestic bananas (*Musa* spp.) and *Pandanus* sp. in semi-domestic environments from coastal plains to mountain forests.

**Key words:** *Topomyia gracilis*, redescription, male genitalia, immature stages, Malaysia, Indonesia

**INTRODUCTION**

*Topomyia (Topomyia) gracilis* is one of the common mosquitoes in Malaysia and neighboring countries. The larva is found in the leaf axils (=phytotelmata) of many kinds of herbal and ornamental plants in domestic and semi-domestic environments. This species was originally described by Leicester (1908) based on the male specimens collected from Kuala Lumpur, Malaysia and the male genitalia was illustrated based on the same specimens by Edwards (1922). Borel (1930) and Brug (1931) described simply the pupa and larva of this species with simple illustrations. Mattingly (1971) also illustrated partly the larval head, thorax and abdominal segments VII and VIII of the species in the illustrated keys to the genera of mosquitoes. During our mosquito studies in Malaysia and Indonesia, many specimens of *To. gracilis* were obtained in the secondary forests of Ulu Gombak, Selangor State, Peninsular Malaysia and Sarawak, East Malaysia (Miyagi et al., 1990, 2006, 2009, 2012), and Bali Is., Indonesia. The collections include a series of adult males and females, pupae and larval associated exuviae. As the earlier descriptions and illustrations of this species were brief and incomplete, the male genitalia, pupa and larva are redescribed and illustrated fully in this paper.

The examined specimens will be deposited separately in the National Science Museum, Tsukuba, Japan and Institute of Tropical Medicine, Nagasaki University, Japan.

**MATERIALS AND METHODS**

Individual rearings are essential to establish correlations between the immature and the adults and between the two sexes of the adults (Belkin, 1962). The rearings were made from fourth-instar larvae and pupae in the field laboratory. Most of the adult specimens from individual rearings were associated with immature stages, either larval or pupal excuviae and with the corresponding male genitalia. Adults were mounted on pins, and larvae, pupae, male genitalia, and larval and pupal excuviae were mounted on slides. More reliance for specific determination of *Topomyia* is placed on male genitalia than any other structure in the adults. The examined specimens were identified based on the morphological characters of male genitalia of *To. gracilis* figured in Edwards (1922). The females, pupae and larvae of the species are always identified based on the characteristics of the larval and pupal excuviae obtained by individual rearings of male *To. gracilis*. A typical and undamaged specimen in the examined specimens of *To. gracilis* was selected for detailed descriptions and illustrations of the larva and pupa in this paper.

In the specimens examined, if, for example, one male specimen was collected in habitat 1 (leaf axils) on September 23, 2006, and its larval and pupal excuviae and genitalia were prepared, the specimen was marked the specimen number (20060923-1) and individual
number (20). The adult male is mounted on pin, and its pupal (P) and larval (L) excuviae and male genitalia (genital number, G-45) are mounted on slides, respectively. One label printed these data was attached to the adult pin specimen and to the slide specimen respectively. Also, if one whole larva was collected in habitat 1 on January 20, 2008 and was mounted on slide, it was marked one whole larva (20080120-1) on slide.

Specimens examined
The specimens were collected from Sarawak, Malaysia in 2006, 2008, 2011 and 2012 by Miyagi, Okazawa and Toma.

Borneo High: 1♂ (20060923-1), individual no. (390) with adult pin specimen and with P, L excuviae and (G-45) on slides. 1♂ (20060923-1) with adult pin and with (G-26). 2♂♂ (20060923-1), individual no. (462) with L, P and G-77, individual no. (505), with L, P and (G-60). Pueh: 1♂ (20080903-1), individual no. (456) with L, P and (G-96); 1♂ (20090917-2), individual no. (273) with L, P and (G-104). Matang: 1♂ (20060922-1), individual no. (444) with L, P and (G-69). Lanjak Entenau: 1♂ (20110228-1), individual no. (250) with L, P and (G-108). 1♂ (20110228-8), individual no. (281) with adult pin and with L, P and (G-120). 3♂♂ (20110301-3) with adult pin and with (G-40), (G-42) and (G-50). 2♂♂ (20110907-1), individual no. (43) with L, P and (G-33); individual no. (114) with L, P and (G-48). 1♂ (20110907-2), individual no. (101) with L, P and (G-39). 1♂ (20110908-2), individual no. (266) with L, P and (G-131). 1♂ (20110908-3), individual no. (127) with L, P and (G-22). 3♂♂ (20110910-5), individual no. (166) with adult pin and with L, P and (G-81); individual no. (350) with adult pin and with (G-164); individual no. (202) with L, P and (G-164). 5♂♂ (20110910-6), individual no. (341) with adult pin and with (G-159); individual no. (349) with (G-163); individual no. (36) with adult pin and with L, P and (G-10); individual no. (134) with adult pin and with L, P and (G-35); individual no. (168) with adult pin and with L, P and (G-82).

The following specimens were collected from Gombak, Peninsular Malaysia by Miyagi, Okazawa and Toma:

Gombak: 2♂♂ (20031004-15), individual no. (65) with L, P and (G-189); individual no. (115) with L, P and (G-186). 1♀ (20031004-15), individual no. (66) with L, P (20031008-6), individual no. (79) with L, P and (G-197). 1♂ (20031009-7), individual no. (23) with L, P and (G-208). 1♀ (20031009-8), individual no. (82) with L, P. 2♂♂ (20031011-8), individual no. (70) with L, P and (G-203); individual no. (72) with L, P and (G-204). 2♂♂ (20031004-15) with (G-185) and (G-188). 1♂ (20031007-3) with (G-190). 1♂ (20031007-6) with (G-192). 2♂♂ (20031008-4) with (G-193) and (G-194). 1♂ (20031008-6) with (G-196). 1♂ (20031009-7) with (G-209). 3♂♂ (20040316-5), individual no. (116) with adult pin and with L, P and (G-49); individual no. (172) with adult pin and with L, P and (G-53); individual no. (710) with adult pin and with (G-52). 1♂ (20040418-30), individual no. (829) with adult pin and with L, P and (G-30). 1♂ (20040319-2), individual no. (810) with adult pin and with (G-31). 2♂♂ (20040319-3), individual no. (650) with adult pin and with (G-35); individual no. (608) with adult pin and with L, P and (G-34). 3♂♂ (20040319-9) with adult pin; individual no. (679) with adult pin and with L, P and (G-39); individual no. (677) with adult pin and with L, P and (G-40); individual no. (812) with adult pin and with (G-36). 1♀ (20040316-5), individual no. (733) with L, P. 1♀ (20040319-9), individual no. (652) with L, P. 2♂♂ (20040914-4), individual no. (144) with (G-79) and individual no. (195) with (G-80). 4♂♂ (20040924-1) with (G-83), (G-95), (G-97) and (G-103). 3 whole larvae (20040316-1, 20040319-3, 20040319-9) on slides. 2 whole larvae (20040914-4) on slides. 2 whole larvae (20040924-1) on slides.

The following specimens were collected from Bali Is. by Miyagi and Toma:

Bali: 10♂♂ (20080120-1), individual no. (1) with L, P and with (G-32); individual no. (2) with P and (G-31); individual no. (3) with pin and with P; individual no. (4) with adult pin and with L, P; individual no. (5) with adult pin and with L, P; individual no. (6), with adult and P; individual no. (7) with adult pin and with L, P; individual no. (9) with L, P; individual no. (10) with L, P; individual no. (13) with adult pin and with L. 2♀♀ (20080120-1), individual no. (8) with adult pin and with L, P; individual no. (12) with adult pin and with L, P. 5 whole larvae (20080120-1) on slides.

The terminology and abbreviation used in the paper follows basically Harbach and Knight (1980) except, dorsosomal lobe (DML) and, dorsosubapical lobe (DSL) in the male genitalia. Chaetotaxy, and siphon and trumpet indices of larva and pupa follow Belkin (1962). Measurements and drawings of pupa are made from excuviae obtained by the individual rearing. In order to compare general appearance of male genitalia in dorsal aspect, an angle of outer apical corner of gonocoxite is shown as Gc angle (Fig. 1A) (Miyagi et al., 2014).

Topomyia (Topomyia) gracilis Leicester, 1908
(Figs 1–3, Tables 1, 2)

Description

Male. Wing, 2.60–2.80 mm. Proboscis, 1.60–1.83 mm (mean 1.70 mm). Forefemur, 1.83–2.00 mm.

Head. Occiput and side of head with broad, flat velvety black decumbent scales with light green sheen at certain angles. Dorso-central part of anterior vertex with triangular or diamond-shaped silvery scale patch; postgena with silvery scale patch. Interocular and ocular setae present; erect scales absent. Clypeus oval in shape; integument brown without scales. Maxillary palpus brown, about 0.11 length of proboscis. Proboscis entirely dark dorsally, slender, elongate and slightly swollen at tip and with a distinct ventral white line from base to apex. Pedicel of antenna dark brown, without scales; flagellum as long as or little shorter than proboscis.

Thorax. Integument of scutum black, covered sparsely with light brown minute setae; a silver central line starts at anterior promontory and extending caudally to the wing roots; scutal-fossil, dorso-central, prescutellar and supraalar setae well developed. Scutellum light brown; median scutellar lobe with a patch of silver scales, lateral lobes without silver scales; 2 or 3 conspicuous setae present on all three lobes. Mesepisternum bare. Antepronotum with conspicuous silver scale patch and with a row of 6–8 prominent

Fig. 1. Male of *Topomyia (Topomyia) gracilis*. A, genitalia (ventral view) including dorsosubapical lobe (DSL), dorsomesal lobe (DML), gonostylius (Gs), gonocoxite (Gc), claspette (Cl); B, tergum IX (IX-TL); C, tip of paraproct (Ppr); D, gonostylus with enlarged tip; E, claspette with basal lobe. Gc angle, an angle of the point intersect lines a with b in dorsal view. Scales in mm.
setae on anterior side. Postpronotum covered sparsely with spatulate silver scales on lobe; single prominent seta present at middle of posterior border. Four fine prespiracular setae present. Postspiracular setae absent. Paratergite bare. A patch of about 10 well developed setae on upper mesanepimeron. Silver scales forming large patch to cover most of pleuron, including post- and subspiracular areas, most of mesokatepisternum.

Fig. 2. Pupal exuviae (A–D) of Topomyia (Topomyia) gracilis. A, metathoracic wing (MtW) and abdominal segments I–VII; B, cephalothorax (CT); C, abdominal segments VIII–IX with male genital lobe (GL) and paddle (Pa); D, abdominal segments VIII–IX with female genital lobe (GL) and paddle. T, trumpet; 1–I, seta 1 of abdominal segment I. Scales in mm.
and mesanepimeron.

**Legs.** All coxae with several setae and with a patch of silver scales; trochanters covered with silver scales. Dorsal part of all legs covered with small dark brown scales and ventral part with a white scale line extending from base of femor to tips of tarsi. Foretarsus Ta-I, shorter than Ta-I, apical tarsomeres usually elbowed, directed posteriorly. Ungues on all legs small, simple and equal.

**Wing.** Brown-scaled. Cell R, about 3 times length of its stem. Alula with a row of fine, hair-like scales; upper calypter bare. Halter: Capitellum and pedicel of its stem. Alula with a row of fine, hair-like scales; spine tapering toward and pointed at apex; apical spine setae on basal lobe and basal stem; elongated apical r5 lanceolate setae with many fine rod-like stem with 2 simple setae.

**Abdomen.** Tergum I dark dorsally with several scales laterally; terga II–VIII densely covered with small, dark brown scales, without lateral silvery scales in lateral view. Sterna II–VII entirely covered with flat pale scales; sternum VIII entirely dark scaled.

**Genitalia** (Fig. 1A–E). Tergum IX segment (IX-TL) arched, two small lobes, each with two (one pair) flattened spines tapering towards a point, situated centrally, close each other on either side of midline; usually 2 fine setae on the outer side of the spine. Gonocoxite (Gc) length about 3.0 times width at middle, narrow slightly at base and at apex and fairly broad at basal 0.7 with many long setae outer margin; Gc angle is obtuse, about 120° (Fig. 1A). Dorsoesmal lobe (DSL) situated at the center bearing a tuft of 10–15 prominent lanceolate setae with sinuously matted tips reaching at apex of gonocoxite; the tuft often divided into two groups at center (Fig 1A, DML); dorsiobalabal lobe (DSL) with a patch of seven fine simple setae. Dorsal lobe of claspette (Cl) composed of rod-like stem with 2–5 lanceolate setae with many fine setae on basal lobe and basal stem; elongated apical spine tapering toward and pointed at apex; apical spine shorter than the rod-like stem (Fig. 1E). Gonostylus (Gs) slender expanded from base to middle, curved at middle then slightly swollen at apical part; a patch of 5–8 fine simple setae at base dorsally, two fine simple setae at middle, and fine claw and 3 or 4 minute apical setae (Fig. 1D). Paraproct (Ppr) with 2 points.

**Female.** Wing. 2.80–3.0 mm. Proboscis, 1.70–2.0 mm. Forefemur, 1.70–2.0 mm. Female resembles male, except for the following characters: Whitish scale line on ventral proboscis absent. All coxae and trochanters covered with silvery scales. Remaining parts of legs uniformly covered with small dark brown scales dorsally, except for a ventral line of pale scales extending from base to apical part of femur; antenna shorter than forefemur.

**Abdomen.** Terga I–VIII densely covered with flat, dark brown scales. Lateral margin of all terga without strip of pale scales. Sterna I–VII covered uniformly by flat silver colored scales.

Pupa. Abdomen (I–VIII), ca. 2.80 mm. Trumpet length, ca. 0.29 mm. Paddle length, ca. 0.54 mm. Integument of cephalothorax and abdomen pale yellow. Chaetotaxy shown in Fig. 2 and Table 1.

**Cephalothorax** (Fig. 2B). Lightly pigmented uniformly. Trumpet (T), yellow, with distinct sculpturing; index, ca. 2.40.

**Abdomen** (Fig. 2A, C, D). Lightly pigmented; microtrichia present distinctly on segments VII and VIII. Paddle (Pa) tapering with well-developed marginal setae. Genital lobe (GL) large, extending to 0.75 of paddle in male (Fig. 2, C) and short in female, extending to 0.34.

Fourth-instar larva. Head length, ca. 0.77 mm. Siphon length, ca. 0.64 mm. Chaetotaxy of head and abdominal segments as shown in Fig. 3A–D and Table 2. Abdominal and thoracic setae conspicuous, with many branches. Setae 1-III–VII well developed,stellate, with many branches.

**Head.** Integument smooth, pale yellow in color.

### Table 1. Chaetotaxy of the pupae of Topomyia (Topomyia) gracilis.

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M: dendritic with many branches. *Aciculated. Missing setae are shown with a hyphen (—). Specimens examined: 4 pupal exuviae from Gomback, West Malaysia. First number indicates modal number of branches. Numbers in parentheses indicate the range.
Fig. 3. Larva of Topomyia (Topomyia) gracilis. Fourth-instar larva (A–D); A, head; B, thorax; C, abdominal segments I–VI; D, abdominal segments VII, VIII, X with siphon (S). MxB, maxillary brush; AT, apical teeth; LR, laciniarastrum; MxBo, maxillary body; Mplp, maxillary palp; Mx, maxilla; Dm, dorsomentum; CS, comb scale; PT, pecten; 1-S, siphonal seta 1; 1a and 2a, ventral (posterior) seta and dorsal (anterior) setae of siphon. Scales in mm.
Maxilla (Mx) as shown in Fig. 3, apical teeth (AT) not develop and maxillary horn absent. Dorosomalum (Dm) with a prominent middle tooth with 8 or 9 small regular teeth on either side. Seta 1-C single, long (ca. 0.15 mm), thick and often curved inwardly, with blunt end; setae 4–6-C single; setae 14-C prominent with usually 6 aciculated branches.

Antenna. Length ca. 0.24 mm; shaft with slight narrowing of width from base to tip. Integument smooth, without spicules; seta 1-A short and single, placed on 0.73 from base.

Thorax. Metathoracic seta 8 well developed with 5–8 aciculated branches.

Abdomen. Comb scales (CS) 12–15 in an irregular row; without marginal fringe and bluntly pointed at tip.

Segment X. Saddle incomplete, about 10 fine spicules present on caudal corner; anal papilla about 2.0 times the length of the anal segment, with round ends; setae 1–4-X long, without pectinate filaments.

Siphon (S). Pale yellow pigmentation, smooth integument. Siphon Index, 5.0–6.0 (mean 6.0). Seta 1-S long with usually 4 branches; usually 6 subventral setae (1a-S), each with 1–4 branches and 4 subdorsal setae (2a-S) with 4 branches (Fig. 3D). Pecten (PT) slender, variable in number, 2 types with 10–40 teeth, extending from base to apical 0.1 of siphon as shown in Fig. 3D.

Discussion

Topomyia gracilis is very similar to To. pilosa Brug, 1931 from Sumatra, Indonesia but the two species differ in male genitalia. In To. pilosa male genitalia, gonostylus is broad at base with a dorsal patch of several fine setae and gradually narrow and straight at apical 2/3. The gonocoxite is narrow at base and broad at distal end, with dense rows of long slightly curved setae on the outer margin. The dorsomesal lobe (DML) has slope ridge with an oblique row of long, slightly curved setae. The setae are not twisted and matted, and not separated into two seta-tufts at the middle.

The larva and pupa of To. pilosa are not yet described fully and hence comparisons with To. gracilis cannot be made. The larva of To. gracilis is characterized by long and simple often curved head seta 1-C, and slender siphonal index 6.0, usually many fine pecten teeth scattered from base to apex of siphon and 6 pairs of subventral (1a-S) and 4 pairs of subdorsal (2a-S) long setae.

Topomyia (Top.) longisetosa Gong, 1994 was described from Yunnan, China (Gong, 1994). Judging from the illustration of the larva and the genital organs, To. longisetosa is identical to those of To. gracilis Leicester, 1908 and the specimens of To. gracilis from Malaysia and Indonesia. It is, therefore, necessary to determine the current status of To. longisetosa.

Biological notes. The small and undeveloped larval maxilla indicates that the larva of To. gracilis is not predacious. The larva of To. gracilis is found commonly in association with Malaya genurostris Leicester, Aedes spp. of the Poecilius Group, Lutzia halifaxii (Theobald), Toxorhynchites splendens (Wiedemann) and Topomyia spp. in leaf axils of different kinds of herbal plants (Miyagi et al., 2012). On the general appearance, the larva and pupa of Topomyia (Topomyia) are very similar to those of Malaya and are difficult to separate them in the field. They are, however can be distinguished by the following: Malaya larva and pupa are smaller and yellowish. In the larva of Malaya, the abdominal setae 1-III–VII are long and simple, never stellate. Many pecten teeth (40–60) are in a patch and abdominal seta 1-X usually single. In the pupa of the
Malaya, the cephalothorax and abdominal segments I–III are lightly pigmented and darkened dorsally. Larvae of *Topomyia* often remain on the back at the bottom in a rigid position for a few minutes. Nothing is known of the biology of adult *To. gracilis*. The female appears to be autogenous.

**Distribution.** Malaysia, Indonesia, Thailand, Vietnam, Laos, Cambodia.

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**References**


