Original Article

**Description of a new species of *Topomyia* (Diptera: Culicidae) from Mount Murud, Sarawak, Malaysia**

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**Abstract:** A new mosquito species, *Topomyia (Topomyia) murudensis* Miyagi, Toma and Okazawa is described from Mount Murud, Sarawak, Malaysia. The adult male and female, pupa, and larva are described in detail. Illustrations of the male genitalia, the pupa, and fourth instar larva of the species are also provided. *Topomyia murudensis* sp. nov. is a highland mosquito, presently known to breed only in leaf axils of the highland orchids *Cymbidium* sp. and *Eria* sp.

Key words: *Topomyia murudensis*, new species, Culicidae, description, Sarawak, Malaysia

**Introduction**

In 2013, in connection with a collaborative research project “Study on taxonomy and bionomics of two winged flies, Diptera in Sarawak” with the Sarawak Museum in Kuching, mosquito larvae were collected from leaf axils of many kinds of herbaceous plants along the way from Pa Rabata (1,200 m in elevation) to Mount Murud (2,400 m in elevation, N 03°55.607’E115°30.865’) in the Kelabit Highlands. A majority were reared to adulthood in the field laboratory. About 200 *Topomyia* specimens including adults, pupae, larvae, and their associated exuviae were preserved in 90% ethyl alcohol for taxonomic study.

In the course of sorting and classifying these specimens, we found an interesting species of subgenus *Topomyia*. After careful examination of the specimens and comparison with descriptions of the described species of the subgenus from Malaysia (Edwards, 1922; Thruman, 1959; Ramalingam and Banu, 1987; Ramalingam and Ramakrishna, 1988; Miyagi et al., 1989, 1990; Miyagi et al., 2012, 2014; Miyagi et al., 2017), we concluded that these specimens were of an undescribed species with characteristic of male genitalia. In this paper, we describe *Topomyia (Topomyia) murudensis* Miyagi, Toma and Okazawa as a new species with illustrations of male genitalia, pupa, and larva.

**Materials and Methods**

The terminology and abbreviation used for adult, pupa, larva, and male genitalia essentially follow Harbach and Knight (1980, 1981) and Harbach and Peyton (1993) except for the dorsomesal lobe (DML) and dorsosubapical lobe (DSL) of the male genitalia. DML and DSL are synonymous with ventro-medial lobe of basistyle (V-ML) and ventro-apical lobe of basistyle (V-AL) of Thruman 1959. Siphon index is the ratio of length to width at the midpoint of the siphon (Belkin, 1962). Trumpet and paddle indices are the ratio of length to width at the midpoint of the trumpet and at the widest point of the paddle respectively. In order to compare the general appearance of the male genitalia in dorsal aspect, an angle of the outer apical corner of the gonocoxite is shown as Gc angle (Fig. 1) (Miyagi et al., 2014). Setal branches of larva 5 (4–8) means that 5 indicates the modal number and (4–8) indicates the range of variation. Uncountable (more than 10) setal branches are shown as numerous branches.

**Type deposition.** The holotype and some paratype specimens have been deposited in the National Museum of Nature and Science, Tsukuba, Japan (NMNS). Other paratypes have been deposited in the University Museum (Fujukan), University of the Ryukyus, and in Sarawak Museum (SM), Malaysia.
Specimens examined have been deposited in the University Museum (Fujukan), University of the Ryukyus.

**Taxonomy**

*Topomyia (Topomyia) murudensis* Miyagi, Toma and Okazawa sp. nov

**Male.** Wing, 3.09–3.47 mm \((n=4)\). Proboscis, 1.66–2.14 mm \((n=4)\). Forefemur, 2.14–2.61 mm \((n=4)\). **Head.** Occiput and side of head with broad, flat velvety black spatulate scales sheening light green at certain angles; dorsocentral part of anterior vertex with triangular silvery scale patch, posterior vertex with spatulate dark scales and without erect scales; postgena with indistinct silvery scale patch. Interocular and ocular setae present. Clypeus quadrilateral in shape, integument brown without scales. Maxillary palpus brown, about 0.12 times as long as of proboscis. Proboscis entirely dark dorsally, slender, elongate and slightly swollen at tip. Ventral white line extending from base to distal part of prementum; the line apparently conspicuous at basal half. Pedicel of antenna dark brown without scales; antenna as long as proboscis. **Thorax.** Integument of scutum black, covered sparsely with dark piliform scales; silver central line starting at anterior promontory and extending caudally to prescutellar; scutal-fossal, dorsocentral, prescutellar and supraalar setae well developed. Scutellum brown; median scutellar lobe with a patch of silver scales and 2 or 3 conspicuous setae; lateral lobes without silver scales and with 2 or 3 conspicuous setae. Antepronotum with conspicuous silver spatulate scales and with a row of 6–8 prominent setae on anterior side (or margin). Postpronotum covered sparsely with spatulate silver scales on lobe; single prominent setae present at middle of posterior border. Four fine prespiracular setae present. Postspiracular with spatulate silvery scales and without setae. Paratergite bare. Mesanepimeron with a row of about 7 well developed setae on upper part. Post- and subspiracular areas and most of mesokatepisternum and mesanepimeron covered with silver scales forming large patch. **Legs.** All coxae with several setae and 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 femora to tips of tarsi; tarsomeres 3 to 5 in fore- and midlegs with obvious white lines; tarsomere 2 in foreleg slightly shorter than tarsomere 3; apical tarsomere 5 in all legs usually not always elbowed, directed posteriorly. Ungues on all legs small, simple and equal. **Wing.** Brown-scaled. Cell \(R_2\) about 3.6 times as long as length of its stem \((R_{2+3})\). Alula with a row of fine, hair-like scales; upper calyerb bare. **Halter.** Capitellum and pedicel covered with dark brown scales, scabellum light brown without scales. **Abdomen.** Terga I–IX dark-scaled with indications of pale-scaled lateral margins; conspicuous setae on only tergum I dorsally and laterally; integuments of sterna II–VII apparently pale with pale scales sparsely; sternum VIII entirely dark scaled. **Genitalia.** (Fig. 1). Gonocoxite \((Gc)\) narrowed basally and expanded apically; shape of gonocoxite equilateral triangular (Fig. 1A, C), about the same length of maximum width at distal end; \(Gc\) angle acute, about 45°; a row of 12–15 strong setae on apical corner, these setae conspicuous and curved inward; a row of about 15 well developed setae along outer baso-lateral margin;
in the ventral aspect, gonocoxite covered thickly on the whole surface by many scales. Dorsomesal lobe (DML) with a tuft of numerous straight setae, the setae not reaching distal margin of gonocoxite. Basal lobe of claspette (Cl) (Fig. 1E) with 1–3 prominent setae and many fine setae; basal rod-like stem long, slightly curved with elongated spine and curved fine filament on apex; the stem 1.8 longer than spine. Gonostylus (Gs) (Fig. 1D) expanded in base half and narrowed apically, with many fine setae in basal half and 3 fine setae apically; apical claw simple with several fine setae. Tergum IX (IX-T) (Fig. 1F) broad, with two lobes close to each other; each lobe with 4 fine setae laterally and 1 stout pointed seta medially.

**Female.** Wing, 3.05–3.76 mm. Proboscis, 2.10–2.20 mm. Forefemur, 2.14–2.28 mm. Resembles male except for following characters. Antenna shorter than forefemur. Whitish scale line on ventral proboscis absent. All coxae and trochanters covered with silvery scales; tarsomere 2 in foreleg longer than tarsomere 3; apical tarsomere 5 in all legs usually straight. **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** (Fig. 3A–C). Abdomen (I–VIII), ca. 3.22 mm. Trumpet length, ca. 0.32 mm. Paddle length, ca. 0.53 mm. **Cephalothorax** (Fig. 3B). Lightly pigmented in median keel (MK). Trumpet (T) brownish yellow, with distinct sculpturing; index, ca. 3.25. Metathoracic wing (MtW) lightly pigmented. **Abdomen.** Lightly pigmented, segments VII and VIII (10×40) with microtrichia indistinctly. Paddle (Pa) tapering with well developed marginal setae, paddle index, ca. 2.07. Genital lobe (GL) lightly pigmented, wider than width of paddle, extending to ca. 0.71 of paddle length in male, and short, extending to ca. 0.33 in female.

The following descriptions were based on 4 whole larvae (paratypes) from the same collection as the holotype.

**Fourth instar larva** (Fig. 4A–C). Head length, 0.73–0.74 mm (mean=0.74 mm); width, 0.88–0.92 mm (mean=0.90 mm). Siphon length, 0.77–0.85 mm (mean=0.81 mm); width, 0.12–0.13 mm (mean=0.12 mm); index 6.0–6.53 (mean=6.23).

**Head.** Integument smooth, pale yellow in color. Maxilla (Mx) with a prominent collection of brush (MxB), lanceolate setae and a row of several conspicuous spicules (LR: laciniarastrum); maxillary horn absent, apical teeth (AT) small; seta 4 single, extending over tip of MxB; seta 6 well developed, 2 or 3 branched. Dorsomentum (Dm) with a prominent middle tooth with 9 to 11 small regular teeth on either side. Seta 1-C single, prominent, thick and
slightly curved, with blunt end; setae 4–7-C long, usually single; 5-C placed well behind 4-C; 8, 9, 10-C weak, usually double; 11-C usually 5 (4–6) branched; 12, 13-C single or double; 14-C prominent, 7 (4–7) branched; 15-C weak, single. Antenna. Integument smooth, without spicules; length about 0.27 mm, about 0.33 of head; width of shaft slightly narrow from base to tip. Seta 1-A single, placed on 0.78 from base of antenna. Thorax. Long pleural setae 5-P, 8-M, 7-T and 9-T with acicula. Prothorax (P): Setae 0, 1, 3, 4, 5, 8-P with numerous branches; 2, 6, 10 and 12-P single; 7, 14-P usually 5 branched; 9-P usually double. Mesothorax (M): Seta 1-M 5 branched; 2, 4-M 2 or 3 branched; 3, 5, 6, 7, 10, 12-M single; 8, 14-M usually 7
Fig. 4. *Topomyia (Topomyia) murudensis* sp. nov., 4th instar larva in dorsal and ventral aspects—A, thorax and abdominal segments I–VI; B, head; C, abdominal segments VII–X with siphon. Dm, dorsomentum; 1-A, antennal seta; CS, comb scale; Pt, pecten; S, siphon; 1-S, siphonal seta; 1a-S, ventral (posterior) setae of siphon; 2a-S, dorsal (anterior) setae of siphon; Sa, saddle; AT, apical teeth; Mx, maxilla; MxB, maxillary brush; MxBo, maxillary body; MPLp, maxillary palpus; LR, laciniaastrum. Scales in mm.
branched; 9-M double; 13-M with numerous branches. Metathorax (T): Setae 1-T usually 7 branched; 3, 5-T numerous; 2, 4, 6-T fine, 2–4 branched; 7, 13-T usually 8 branched; 9-T usually 7 branched; 11-T missing; 12-T double. **Abdomen.** Setae I–VIII with numerous branches, and setae I–III–VII more developed than setae I, II and VIII. Setae 2-1, II with numerous branches; 2-III–VII 3–5 branched; 2-VIII single. Seta 3-I moderately long, single; 3-II usually 7 branched; 3-III–VII single or double, very long in VII. Seta 4-I numerous; 4-II–VII 2 or 3 branched; 4-VII, VIII single, long. Setae 5-I–VI 4–8 branched, 5-VII obsolete or missing; 5-VIII usually 3 branched. Setae 6-I–VI very long; 6-I 6 branched and 6-II usually 6 branched; 6-III, IV 2 double; 6-V 3 branched; 6-VI single; 6-VII 3 weakly developed. Setae 7-I very long, 3 branched; 7-II very long, single; 7-III–VII weak–4–7 branched; 7-VII moderately developed, single. Setae 8-II–V weakly developed, often obsolete in VI; 8-VII 5 branched. Setae 10-I–V weak, 1–3 branched; 10-VI, VII obsolete. Setae 11-I, II moderately long with numerous branches; 11–III–VII obsolete; 11-VII weak, 2 or 3 branched. Setae 12-I, II obsolete; 12-III–V, VII weakly developed, single; 12-VI double. Setae 13-I, II well developed with numerous branches; 13–III–VI well developed with 6–9 branches; 13-VII usually 5 branched. Comb scales (CS) 15 (15–25) in irregular double rows, individual scales large, pointed and with a fringe at base (Fig. 4C). **Siphon.** Pale yellow pigmentation, smooth integument, slender, widest at base, narrowed to apex; pecten (Pt) 14 (5–25) scattering from base to apex, with 2 or more teeth together at base. Seta 1-S 3 or 4 branched; sub-ventral tufts (1a-S) usually 8 (7–9) tufts in pair, each 2–4 branched, apical 2 tufts small; subdorsal tufts (2a-S) usually 5 (5–7) tufts in pair, each 2–8 branched. **Segment X.** Saddle incomplete, lightly pigmented, with about 10 small spines on distal margin; anal papilla long and rounded apically, length 0.69 mm, about 1.7 times as long as the length of anal segment (saddle). Setae 1–4-X very long without acicula; setae 1, 4-X with 3 branches, seta 2 with 5 branches; seta 3-X single; seta 4-X a little shorter than anal papilla. **Type specimens.** **Holotype.** ♀ (20130612-1), individual number (146) mounted on pin with L (fourth instar larva) and P (pupa) exuviae and genitalia (G-46) mounted on slide, Church Camp (2,000 m elevation) of Mount Murud, Sarawak, Malaysia, 12 June, 2013, I. Miyagi. **Paratypes.** 2♂♂ (20130611-1, -3), individual no. (92 and 120) mounted on pin and with L and P and genitalia (G-35 and G-38) on slides, respectively. 2♂♂ (20130612-1), individual no. (70 and 163) mounted adult, L, P and (G-34 and G-51) on slides. 1♂ (20130614-1), individual no. (33) on pin with P and (G-12) on slide. 1♀ (20130612-1) mounted adult and P on slide. 2♂♂ (20130613-3), individual no. (119 and 129) on pins with L, P and (G-37 and G-40). 3♂♂ (20130613-3), individual no. (21, 41 and 68) on pins with P and (G-5, G-15 and G-21). 1♂ (20130614-1), individual no. (49) on pin with P and (G-16), 4 whole larvae on slides (20130613-3). All specimens were collected in same place as holotype by Miyagi. **Specimens examined.** ♀♀ (20130614-2), individual no. (100 and 167) mounted on pin with P and L on slides. 1♀ (20130613-3), individual no. (142) mounted on pin with P and L on slides. **Etymology.** The species name murudensis refers to Mount Murud, the second highest mountain (2,400 m elevation) in Sarawak, where this species was found. **Taxonomic discussions.** The present new species can be easily distinguished from known species of the subgenus *Topomyia* from Malaysia and Indonesia by its unique characteristic male genitalia as in the descriptions (Figs. 1A and 2A, B). *Topomyia (Topomyia) danaraji* Ramalingam, 1987 from Selangor, Malaysia has a somewhat similar equilateral triangle-shaped gonocoxite, but the gonostylus, claspette, and tegum IX of *To. danaraji* are quite different from *To. murudensis* sp. nov. In *To. danaraji*, a flattened and pointed seta present about 1/4 distant from the tip of the gonostylus, the claspette with an expanded spear shaped filament, and the IX tergite with a distinctive arrangement of spines (Ramalingam, 1987). The larva of *To. murudensis* resembles *To. sabahensis* Ramalingam and Ramakrishna, 1988 in the chaetotaxy of the head, thorax and abdomen. However, it differs from *To. sabahensis* by having long seta 4-X and seta 14-C 4–7 branched, whereas the latter has seta 4-X apparently smaller than the anal papilla and seta 14-C 2–4 branched. Most exuviae of the larval specimens examined were fully compressed, therefore it was difficult to determine variation in the branching of the abdominal setae. **Bionomics.** *Topomyia murudensis* is a highland mosquito species, presently known only from Mount Murud, Sarawak’s second highest mountain. The larvae were collected from leaf axils of orchids *Cymbidium* sp. and *Eria* sp. (Fig. 2C, D) in the mossy forest of Mount Murud, about 2,000 to 2,400 m in elevation. No other mosquito species associated with *To. murudensis* were found in the leaf axils of these plants. Many kinds of pitcher plants such as *Nepenthes* *hurrelliana* Cheek, and Lamb, *N. lowii* Hook, *N. murudensis* Culham ex Jebb and Cheek were found in the forest. These pitchers contain water-filled cavities (phytotelmata) that have a water temperature of about 5°C in the daytime. A variety of mosquito larvae, such as *Uranotenia, Tripterooides, Aedes* and *Culex* spp., were collected from the pitcher plants, however no *Topomyia* larvae were found among them. **Distribution.** Malaysia (Sarawak).
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