

**NEW RECORDS OF THREE CLOSELY IDENTICAL SPECIES OF
Megaselia RONDANI (DIPTERA: PHORIDAE) FROM BANGI, SELANGOR,
PENINSULAR MALAYSIA**

Raja M. Zuha^{1,2,3*} & R. Henry L. Disney⁴

¹ Forensic Science Program,
Faculty of Health Sciences,
Basement One,
Perpustakaan Tun Seri Lanang,
Universiti Kebangsaan Malaysia,
43600 Bangi, Malaysia.

² Centre for Insect Systematics,
Faculty of Science and Technology,
Universiti Kebangsaan Malaysia,
43600 Bangi, Selangor, Malaysia.

³ Fraser's Hill Research Centre,
Faculty of Science and Technology,
Universiti Kebangsaan
Malaysia, 43600 Bangi, Selangor, Malaysia.

⁴ Department of Zoology,
University of Cambridge,
Downing Street, Cambridge CB2 3EJ,
United Kingdom.

*Corresponding Author: rmzuha@ukm.edu.my

Submission: 18 February 2022; Acceptance: 23 December 2022

ABSTRACT

Megaselia nigella Beyer, 1960, *Megaselia scabra* Schmitz, 1926 and *Megaselia shiyiluae* Disney, 1995 were described for the first time from Bangi, Selangor, Peninsular Malaysia. All three species were collected from baited white pan traps with decomposed beef liver at a secondary forest of Forensic Science Simulation Site, Faculty of Health Sciences, Universiti Kebangsaan Malaysia (UKM), Bangi, Selangor. In the laboratory, the phorid specimens were dissected and mounted on microscope slides for species identification. *Megaselia nigella*, *M. scabra* and *M. shiyiluae* looked almost similar from gross examination, based on their small, dark bodies, short costal veins in both sexes and short anal tubes of the hypopygia in males. However, these species can be distinguished, among others, according to the disposition of bristles on frons in both sexes. The discovery of these three species brings the total number of *Megaselia* from Peninsular Malaysia to 34. The results can be used as precursors to further understand the diversity of Phoridae from this region.

Key words: Scuttle flies, biodiversity, taxonomy, species

ABSTRAK

Megaselia nigella Beyer, 1960, *Megaselia scabra* Schmitz, 1926 dan *Megaselia shiyiluae* Disney, 1995 diperihalkan buat kali pertama dari Bangi, Selangor, Semenanjung Malaysia. Ketiga-tiga spesies ini disampel daripada perangkap dulang putih dengan umpan hati lembu reput yang diletakkan di hutan sekunder di Tapak Simulasi Sains Forensik, Fakulti Sains Kesihatan, Universiti Kebangsaan Malaysia, Bangi, Selangor. Di dalam makmal, spesimen lalat phorid diproses dan dilekapkan pada slaid mikroskop untuk pengecaman spesies. *Megaselia nigella*, *M. scabra* dan *M. shiyiluae* boleh dilihat hampir serupa melalui pemeriksaan kasar berdasarkan tubuh yang kecil dan gelap, vena kosta yang pendek pada kedua-dua jantina dan tiub anus yang pendek pada hipopigium jantan. Walau bagaimanapun, spesies-spesies ini dapat dibezakan, antaranya melalui kedudukan bulu kejur di bahagian frons pada kedua-dua jantina. Penemuan ketiga-tiga spesies ini menjadikan jumlah bilangan *Megaselia* dari Semenanjung Malaysia sebanyak 34 spesies. Hasil kajian ini boleh digunakan sebagai asas untuk memahami lebih lanjut kepelbagaian Phoridae di wilayah ini.

Kata kunci: Lalat phorid, kepelbagaian biologi, taksonomi, spesies

INTRODUCTION

The genus *Megaselia* Rondani is the largest group of scuttle flies (Diptera: Phoridae) with extremely diverse larval habitat (Disney 1994). At present, there are over 1700 species of scuttle flies from genus *Megaselia* recorded worldwide. At least 31 species from genus *Megaselia* have been described including 21 novel species from Peninsular Malaysia since 1932 (Zuha, unpublished data). From the records, the *Megaselia* larvae are mainly predators to other invertebrates and decomposers of organic materials including few forensically important species such as *M. scalaris* (Loew 1866), *M. spiracularis* Schmitz, 1938 and *M. curtineura* (Brues 1909) (Thevan et al. 2010).

However, the identification of species in the large genus *Megaselia* is hindered by the taxonomic complexity of this group which is mainly attributed to sexual dimorphisms in many species. Current identification of *Megaselia* from Peninsular Malaysia is included in the lists of Indo-Australian scuttle flies by Borgmeier (1966, 1967) but requires significant updates and revisions. Therefore, considerable measures have been taken to overcome the taxonomic impediment of Phoridae which includes continuous surveys, description, and curation of local species (Disney & Schroth 1989; Disney 1991, 1993, 1995a, 1995b; Disney et al. 1998; Disney & Maschwitz 2000; Gori 2014; Zuha & Disney 2018).

In this paper, we report the discovery of three closely identical species from the genus *Megaselia* collected from pan traps baited with decomposed beef liver in a secondary forest in Bangi, Peninsular Malaysia. From stereomicroscopic inspection during screening process, all three species belonged to a single dark species. Detailed examination of mounted specimens on slides revealed they were comprising of three species of *Megaselia* which are new records to Peninsular Malaysia and described herein.

MATERIALS AND METHODS

Sampling Locations

This study was conducted at Forensic Science Simulation Site, Faculty of Health Sciences, Universiti Kebangsaan Malaysia (UKM), Bangi, Selangor (2.91°N, 101.79°E) from 22 October

2021 until 8 November 2021 as part of an ongoing survey of Malaysian phorids in Bangi, Selangor, since 2014. It is an outdoor research facility, covering approximately 3600 m² secondary forest and an open area with three units of portable cabins for fieldwork activity (Figure 1).



Figure 1. Sampling area of Phoridae at the Forensic Science Simulation Site, Universiti Kebangsaan Malaysia, Bangi, Selangor (Source: Google Earth) and a baited pan trap used for sampling (inset)

Insect Sampling

A total of nine baited pan traps were used and each three were placed near a water canal, a water reservoir and outdoor area of the portable cabins. Baits consisted of approximately 20-30 g decomposed beef liver placed in a 60 ml sterile universal container (Figure 1). Openings of the containers were covered with a 2 mm gauze to allow entry of adult scuttle flies but to prevent other sarcosaprophagous insects from ovipositing on the decomposed beef liver. The baits were then placed on the ground in a 30 cm diameter white plate, half-filled with water and added with few drops of detergent. After three days, trapped specimens were collected from the water and preserved in 80% ethanol.

Insect Mounting

Slide mounting of adult Phoridae was based on Hartop et al. (2015) with modifications. Samples in 80% ethanol were dehydrated in ascending series of ethanol from 80, 90 to absolute alcohol for 20-30 minutes each. Then the specimens were cleared in clove oil for 20 minutes before transferred to microscope glass slides. The head, left wing, thorax, abdomen and legs of

scuttle flies were subsequently dissected (Disney 1994), mounted separately in Canada Balsam and each capped with 6 mm round cover slips.

Species Identification

Images were obtained by using 12-megapixel digital camera (Toupcam, China) attached to trinocular compound microscope (Labomed, USA) with ToupView software. Species identification was primarily based on the key to Australasian and Oriental Phoridae by Borgmeier (1967) and cross-referred with the second author (RHLD). All voucher specimens were registered with reference numbers and deposited in the Centre for Insect Systematics, Faculty of Science & Technology, UKM (CIS-UKM).

RESULTS

Taxonomy

Megaselia nigella Beyer (Figure 2-5)

Megaselia nigella Beyer, 1960: 113.

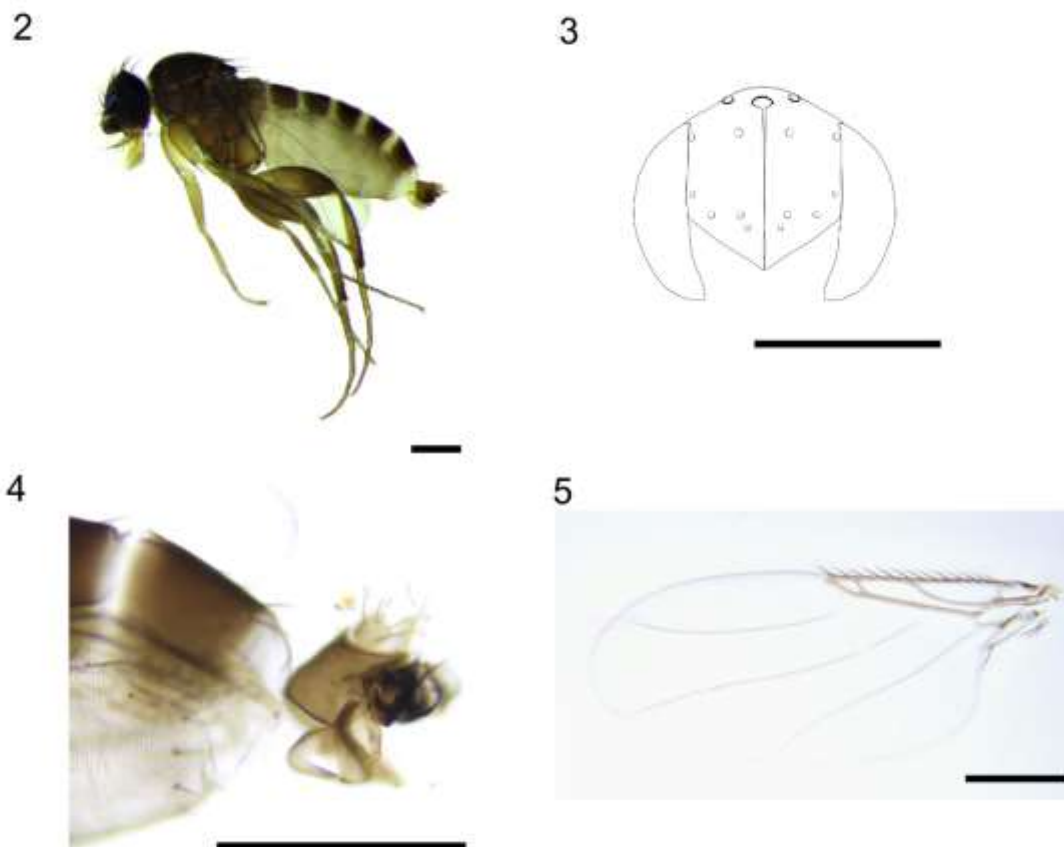


Figure 2-5. *Megaselia nigella*. 2, male habitus; 3, disposition of bristles on frons, 4, abdominal segment 6 and hypopygium; 5, dorsal face of left wing (Scale bar = 0.2 mm)

Description

Male. Body length 1.31-1.66 mm (Figure 2). Frons brown, long subequal to width, approximately 0.17-0.18 mm. Bristles on frons as Figure 3, with about 82-98 hairs and dense microtrichia (not glossy). Supraantennal bristles unequal, upper pair 2.7× longer than lower pair. Antials are midway between anterolateral bristles and upper supraantennal bristles. Anterolateral and mediolateral bristles close to eye margin. Preocellar bristles slightly higher than mediolateral bristles. Cheek 2-3 bristles and gena with 1 longer bristle. Postpedicel subglobose, slightly concave at the base of arista, widest breadth 0.07-0.08 mm, brown with black hairs. Subcuticular pit sensilla (SPS) vesicles absent. Palps only slightly longer than the widest breadth of postpedicel, yellow, with 6 bristles and 3 hairs. Labrum yellow as palps, about two-thirds as wide as postpedicels. Labella also yellow but slightly wider than postpedicels with 3 pseudotracheae, 10-12 spinules and 10-12 longer hairs on lower face. Thorax brown and mesopleuron bare. Two notopleural bristles and no cleft in front of these. Scutellum with a pair of bristles and an anterior pair of hairs. Propleuron with 2 bristles on upper margin and 3 bristles on lower margin. Abdominal tergites brown with scattered fine hairs on the posterior half of each tergite. Hairs on tergite 6 longer than the rest. Venter brownish with scattered hairs below segments 4-6. Hypopygium as Figure 4. Epandrium brown with 4-7 hairs on left face and a row of 3-5 hairs posteriorly. Anal tube pale brown and shorter than epandrium. Hypandrium slightly paler, tapered and coated with hairs. Legs all brown except front legs a bit paler. Fore tarsus with posterodorsal palisade on tarsomeres 1-4. Mid femora bare except hairs on the apical third. Dorsal hair palisade of mid tibia about 0.8× from its length. Hairs below basal half of hind femur longer than those of anteroventral row of outer half. Hind tibia with 7-8 differentiated posterodorsal hairs. Spinules of apical combs normal, not bifurcate. Wings 0.79-0.89 mm long (Figure 5). Costal index 0.43-0.45. Costal ratios 2.14-2.50:1.67-1.71:1. Costal cilia of section 3 about 0.05 mm long. Minute hair at base of vein 3 present, with 2 axillary bristles, the outer being 0.05-0.06 mm long. Thick and thin veins brown except vein 7 and subcostal vein obscure. Membrane lightly tinged grey. Haltere brown.

Materials Examined

PENINSULAR MALAYSIA: Selangor 3 ♂; Bangi, Universiti Kebangsaan Malaysia, 1 ♂, 2.91°N, 101.79°E, 15.xi.2021, 30 m asl, Coll. A.R. Nurul Nadiah, pan trap (CISUKM, Me-2021-001); Bangi, Universiti Kebangsaan Malaysia, 1 ♂, 2.91°N, 101.79°E, 8.xi.2021, 30 m asl, Coll. A.R. Nurul Nadiah, pan trap (CISUKM, Me-2021-002); Bangi, Universiti Kebangsaan Malaysia, 1 ♂, 2.91°N, 101.79°E, 25.x.2021, 30 m asl, Coll. M.N. Izzatul Ilya, pan trap (CISUKM, Me-2021-003).

Distribution

This species has been recorded from Mindanao, Philippines (Beyer 1960), Queensland, Australia (Borgmeier 1967) and Peninsular Malaysia.

Remarks

In the keys of Borgmeier (1967), *M. nigella* runs to Group VII by having bare mesopleuron, 2 bristles on scutellum and costal index 0.44 or more. The microtrichia on frons dense (frons not glossy) and therefore it leads to couplet 88 to either *M. atrita* (Brues 1915) or *M. nigella*. The current specimen has costal section 1 slightly shorter than costal section 2+3 which led to *M. nigella*. Borgmeier (1967) did not rule out the possibility *M. nigella* could be a synonym of *M. atrita* because of the striking resemblance of the bristles on the frons, wing and hypopygium. Like *M. atrita*, the *M. nigella* also has 2 bristles on notopleuron with brown or black halteres and postpedicels. The current specimen was identified as *M. nigella* on the basis that it has 2 axillary bristles on the wing as opposed to 4 in *M. atrita*. Additionally, the current specimen

has costal section 1 slightly shorter than sections 2+3, differing from *M. atrita* which costal section 1 always longer than sections 2+3 (Disney et al. 1995).

Taxonomy

Megaselia scabra Schmitz (Figure 6-12)

Megaselia scabra Schmitz, 1926: 56.

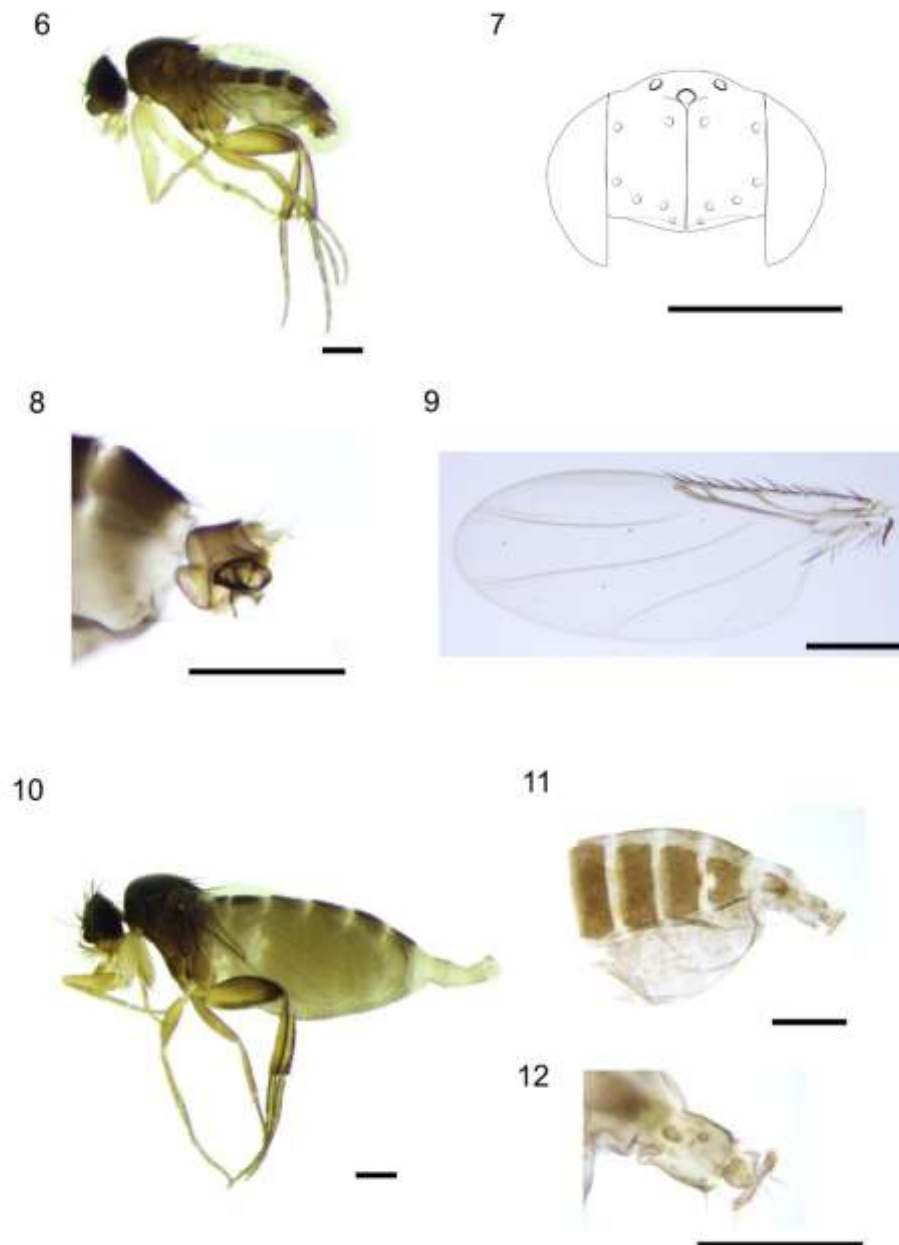


Figure 6-12. *Megaselia scabra*. 6, male habitus; 7, disposition of bristles on frons of male; 8, abdominal segment 6 and hypopygium of male; 9, dorsal face of left wing of male; 10, female habitus; 11, abdominal tergites 3-7 of female; 12, internal sternite 9 (furca) of female (Scale bar = 0.2 mm)

Description

Male. Body length 1.15 mm (Figure 6). Frons dark brown, 0.17-0.18 mm long, 0.21 mm wide. Bristles on frons as Figure 7, with about 117-123 hairs and relatively dense microtrichia (not glossy). Supraantennal bristles unequal, lower pair is thinner and upper pair about 1.7-2.2× longer than lower pair. Antials are midway between anterolateral bristles and upper supraantennal bristles, and slightly higher than the latter. Anterolateral bristles and mediolaterals close to the eye margin. Preocellar bristles about the same level as mediolateral bristles. Cheek with 2 bristles and jowls with 1 longer bristle. Postpedicel subglobose, slightly concave at the base of arista, widest breadth 0.09-0.10 mm, brown with black hairs. SPS vesicles absent. Arista stem yellow. Palps about the same length of widest breadth of postpedicel, yellow, with 6 bristles and 3-4 hairs. Labrum yellow as palps, about one-half as wide as postpedicels. Labella also yellow but as wide as postpedicels with 3 pseudotracheae, 9-10 spinules and 10-12 longer hairs on lower face. Thorax brown and mesopleuron bare. Two notopleural bristles and no cleft in front of these. Scutellum with a pair of bristles and anterior pair of hairs. Propleuron with 3 hairs on upper margin and 3 longer bristles on lower margin. Abdominal tergites brown with scattered fine hairs on the posterior half of each tergite. Hairs on tergite 6 longer than the rest. Venter brownish with scattered hairs below segments 3 to 6. Hypopygium as Figure 8. Epandrium brown with 8-9 hairs on left face and a row of 3-4 hairs posteriorly. Anal tube brown and shorter than epandrium. Hypandrium slightly paler, weakly tapered and coated with hairs. Front and mid legs yellowish brown but hind legs brown. Fore tarsus with posterodorsal palisade on tarsomeres 1-4. Dorsal hair palisade of mid tibia about 0.7× from its length. Hairs below basal half of hind femur longer than those of anteroventral row of outer half. Hind tibia with 8 or 9 differentiated posterodorsal hairs. Spinules of apical combs normal, not bifurcate. Wings 0.88 mm long (Figure 9). Costal index 0.44-0.45. Costal ratios 2.2-2.29:1.4-1.71:1. Costal cilia of section 3 about 0.03-0.06 mm long. Minute hair at base of vein 3 present, with 3 axillary bristles, the outer being 0.04-0.06 mm long. Thick and thin veins brown except vein 7 and subcostal vein obscure. Membrane lightly tinged grey. Haltere yellow.

Female. Body length 2.27 mm (Figure 10). Frons dark brown, 0.15 mm long, 0.16-0.18 mm wide, dark brown. Bristles on frons similar to male, with about 85 hairs and relatively sparse microtrichia (glossy). Supra-antennal bristles unequal, lower pair is thinner and upper pair is about 1.75× longer than lower pair. Cheek with 3 bristles and jowls with 2 longer bristles. Postpedicel subglobose, slightly concave at the base of arista, widest breadth 0.06 mm, brown with black hairs. SPS vesicles absent. Arista stem brown. Palps about the same length or longer than the widest breadth of postpedicel, yellow, with 6 bristles and 3-4 hairs. Labrum pale brown, slightly wider than postpedicels. Labella yellow slightly wider than labrum and postpedicels with 3 pseudotracheae, 9-10 spinules, 10-12 longer hairs on lower face. Thorax brown. Mesopleuron bare. Two notopleural bristles and no cleft in front of these. Scutellum with a pair of bristles and an anterior pair of hairs. Propleuron with 2 hairs on upper margin and 3 longer bristles on lower margin. Abdominal tergites brown with scattered fine hairs on the posterior half of each tergite as Figure 11. Venter brownish with scattered hairs below segments 5 and 6. Internal sternite 9 as Figure 12. Dufour's crop mechanism (DCM) was not observed, possibly missing during dissecting and slide mounting. Mid and hind legs brown but front legs paler. Fore tarsus with posterodorsal palisade on tarsomeres 1-4 and tarsomere 5 slightly longer than 4. Dorsal hair palisade of mid tibia about 0.7-0.8× from length of tibia. Hairs below basal half of hind femur longer than those of anteroventral row of outer half. Hind tibia with 8 differentiated posterodorsal hairs. Spinules of apical combs normal, not bifurcate. Wings as male, 0.79-0.85 mm long. Costal index 0.43-0.46. Costal ratios 1.75-2.33:1.13-1.67:1. Costal cilia of section 3 about 0.05 mm long. Minute hair at base of vein 3 present, with

2 axillary bristles, the outer being 0.05-0.06 mm long. Thick and thin veins brown except vein 7 and subcostal vein obscure. Membrane lightly tinged grey. Haltere yellow.

Materials Examined

PENINSULAR MALAYSIA: Selangor, 3♂: Bangi, Universiti Kebangsaan Malaysia, 1♀, 2.91°N, 101.79°E, 31.x.2021, 30 m asl, Coll. A.R. Nurul Nadiah, pan trap (CISUKM, Me-2021-004); Bangi, Universiti Kebangsaan Malaysia, 1♀, 2.91°N, 101.79°E, 15.xi.2021, 30 m asl, Coll. L.A. Amirah Hanan, pan trap (CISUKM, Me-2021-05); Bangi, Universiti Kebangsaan Malaysia, 1♀, 2.91°N, 101.79°E, 31.x.2021, 30 m asl, Coll. L.A. Amirah Hanan, pan trap (CISUKM, Me-2021-06).

Distribution

This species has been recorded from Taiwan (Schmitz 1926), Sri Lanka (Disney 1981), China (Disney et al. 1995) and Peninsular Malaysia.

Remarks

The only adequate description of *M. scabra* is by Schmitz (1926) and it was further elucidated by Disney et al. (1995). Borgmeier (1967) grouped the genus *Megaselia* based on the costal indexes and this is problematic for borderline species like *M. scabra*. It is possible that the variations of costal indexes causing both males and females keyed out differently. If costal index more than 0.44, *M. scabra* runs to group VII couplet 14. If the frons glossy (microtrichia sparse) it leads to female *M. politifrons* Brues, 1936 which differs from the current specimen by having antials very close to anterolaterals and longer costal vein. If the frons not glossy (microtrichia dense) it leads to couplet 28 which only refers to tergites of female. Couplet 47 differentiates the current specimens by having yellow halteres instead of brown halteres and this leads to couplet 48-50 in the keys of Borgmeier (1967), depending on the costal indexes. If costal index 0.44-0.45 (couplet 50) and veins dark, it leads to *M. curticauda* Borgmeier, 1967. It is only known by male and different from the current specimens by having 2 axillary bristles on the wing and bristle position on frons. If costal index 0.44-0.45 and veins pale, it leads to *M. pallidivena* Borgmeier, 1967 or *M. scabra*. The position of supraantennals and antials distinguishes the current specimen from *M. pallidivena*. Back to couplet 50 in the keys of Borgmeier (1967), if the costal index is 0.46-0.49, it will lead to couplet 54 because the current specimen has antials midway between supraantennals and eyes but it is not compatible with the descriptions of *M. semihyalina* Beyer, 1960 albeit first costal section is less than sections 2+3. If costal index is 0.43, the female runs to couplet 10 in Group VIII as *M. copiosa* Borgmeier, 1967 but the position of antials close to anterolaterals ruled out this species.

Taxonomy

Megaselia shiyiluae, Disney (Figure 13-19)

Megaselia shiyiluae, Disney in Disney et al. 1995: 335 (male only), Disney, 2008: 628 (female).

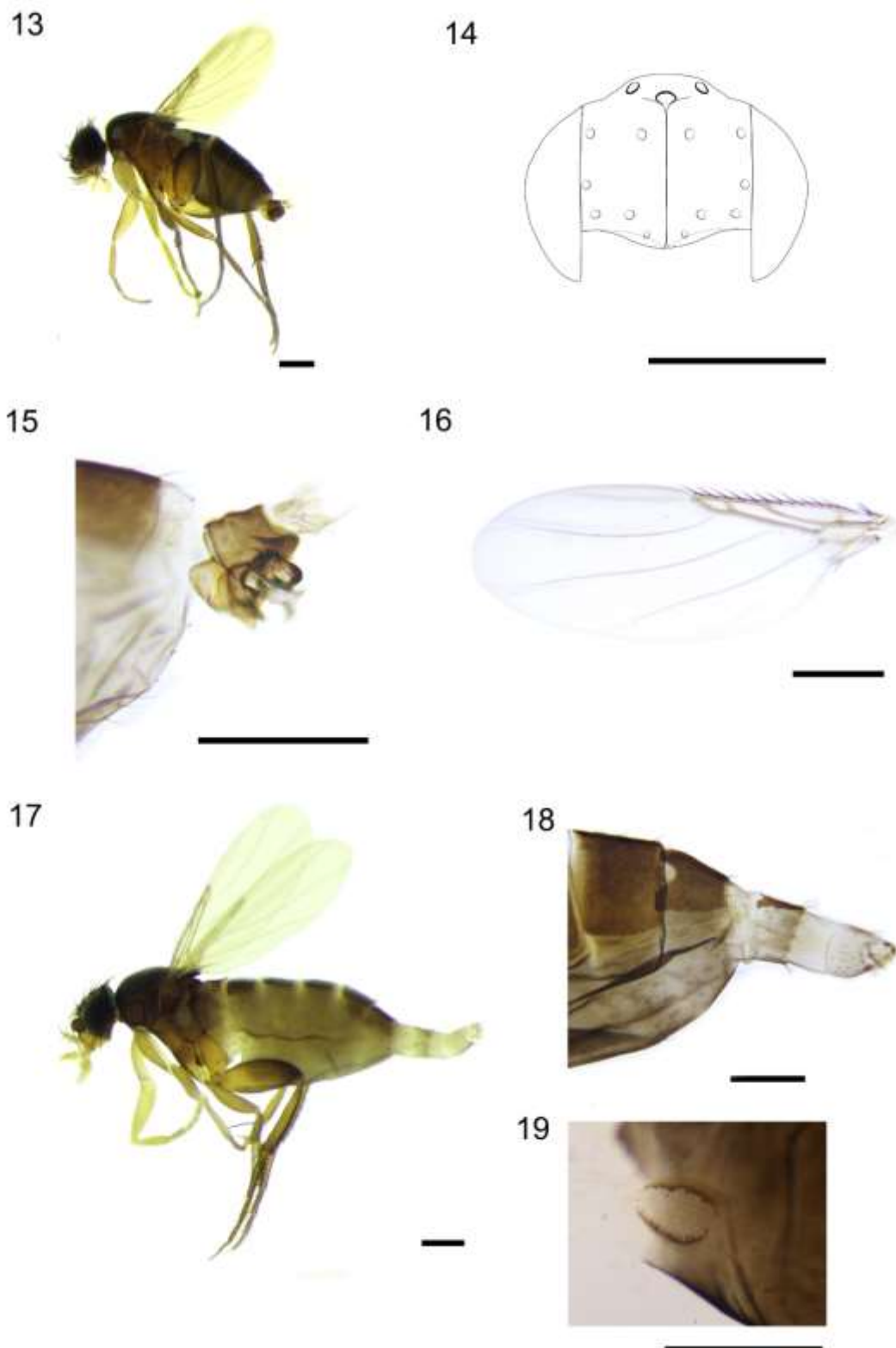


Figure 13-19. *Megaselia shiyiluae*. 13, male habitus; 14, disposition of bristles on frons of male; 15, abdominal segment 6 and hypopygium of male; 16, dorsal face of left wing of male; 17, female habitus; 18, abdominal tergites 5-7 of female; 19, Dufour's crop mechanism (Scale bar = 0.2 mm)

Description

Male. Body length 1.48 mm (Figure 13). Frons dark brown, 0.18-0.19 mm height, 0.21 mm wide. Bristles on frons as Figure 14, with about 83 hairs and relatively sparse microtrichia (glossy). Supraantennal bristles robust, upper slightly longer and thicker than the lower. Antials slightly lower than upper supraantennal bristles and located almost below the anterolateral bristles. Pre ocellar bristles about the same level as mediolateral bristles. Each cheek with a bristle and 2 stronger bristles on each jowl. Postpedicel subglobose, slightly concave at the base of arista, widest breadth 0.08-0.09 mm, brown with black hairs. SPS vesicles present mostly at the base of postpedicel. Arista stem brown. Palps about the same length of widest breadth of postpedicel, brownish yellow, with 6 bristles and 3-4 hairs. Labrum brownish yellow as palps, about one-half as wide as postpedicels. Labella also straw yellow but slightly wider than postpedicels, with 4-5 pseudotracheae, 20-22 spinules and 13-14 longer fine hairs on lower face. Thorax brown and mesopleuron bare. Two notopleural bristles and a cleft in front of these. Scutellum with a pair of bristles and an anterior pair of hairs. Propleuron with 3 bristles on upper margin and 3 longer bristles on lower margin. Abdominal tergites brown with scattered fine hairs on the posterior half of each tergite. Hairs on posterolateral margin of tergite 2 and posterior margin of tergite 6 slightly longer than the rest. Venter brownish with scattered hairs below segments 5 and 6. Hypopygium as Figure 15. Epandrium brown with 5-6 scattered hairs on left face and a longer hair on lower part. Anal tube tinged brown and shorter than epandrium. Hypandrium slightly paler and coated with hairs. Legs yellowish brown except hind femur with darker brown at the apical two thirds. Fore tarsus with posterodorsal palisade on tarsomeres 1-4. Tarsomere 5 slightly longer than 4. Near-dorsal hair palisade of mid tibia about 0.8× from its length. About 4-5 hairs below basal half of hind femur longer than those of anteroventral row of outer half. Hind tibia with 5-6 differentiated posterodorsal hairs. Spinules of apical combs normal, not bifurcate. Wings 0.92-0.94 mm long (Figure 16). Costal index 0.45-0.46. Costal ratios 2.11-2.25:1.11-1.13:1. Costal cilia of section 3 about 0.04-0.05 mm long. Hair at base of vein 3 present, with 2 axillary bristles, the outer being 0.4 mm long. Thick and thin veins brown except vein 7 and subcostal vein obscure and not reaching R1. Membrane lightly tinged brownish grey. Haltere yellow with light brown stem.

Female. Body length 2.22-2.72 mm (Figure 17). Frons dark brown, 0.21-0.23 mm long, 0.20-0.25 mm wide. Bristle positioning on frons as male, with 104-119 hairs and relatively sparse microtrichia (glossy). Upper supraantennal bristles slightly longer than lower supraantennal bristles and midway to antials which located almost below the anterolateral bristle. Pre ocellar bristles about the same level as medio-lateral bristles. Cheek with 2 bristles and jowls with 1 longer bristle. Postpedicel subglobose, slightly concave at the base of arista, widest breadth 0.08-0.09 mm, brown with black hairs. SPS vesicles present mostly at the base of postpedicel. Arista stem greyish brown. Palps about the same as the widest breadth of postpedicel or slightly longer, brownish yellow, with 5 strong bristles and 4-6 hairs. Labrum brownish yellow as palps, about as wide as postpedicels. Labella also brownish yellow but slightly wider than labrum with 3 pseudotracheae, 10-22 spinules, 10-14 longer and finer hairs on lower face. Thorax brown and mesopleuron bare. Two notopleural bristles and without a cleft in front of these. Scutellum with a pair of bristles and anterior pair of hairs. Propleuron with 2 differentiated hairs on lower margin, longer than the rest on the margin. Abdominal tergites as Figure 18, brown with scattered fine hairs on the posterior half of each tergite except tergite 6 sparsely covered with hairs. Venter brownish with scattered hairs below segments 3 to 6. DCM as Figure 19. Legs similar to male. Wings 0.71-1.44 mm long. Costal index 0.47-48. Costal ratios 2-2.64:1.43-1.82:1. Costal cilia of section 3 about 0.04-0.07 mm long. Hair at base of vein 3 present, with 2 axillary bristles, the outer being 0.04-0.08 mm long. Otherwise, wing and halteres as male.

Materials Examined

PENINSULAR MALAYSIA: Selangor, 4♂: Bangi, Universiti Kebangsaan Malaysia, 1♂, 2.91°N, 101.79°E, 15.xi.2021, 30 m asl, Coll. A.R. Nurul Nadiah, pan trap (CISUKM, Me-2021-007); Bangi, Universiti Kebangsaan Malaysia, 1♂, 2.91°N, 101.79°E, 31.x.2021, 30 m asl, Coll. A.R. Nurul Nadiah, pan trap (CISUKM, Me-2021-008); Bangi, Universiti Kebangsaan Malaysia, 2♀, 2.91°N, 101.79°E, 15.xi.2021, 30 m asl, Coll. L.A. Amirah Hanan, pan trap (CISUKM, Me-2021-009).

Distribution

This species has been recorded from Guangdong Province, China (Disney et al. 1995), Oman, Yemen, UAE (Disney 2008), Saudi Arabia (Disney 2009) and Peninsular Malaysia.

Remarks

Having 2 bristles on scutellum, bare mesopleuron and long costal index brings *M. shiyiluae* to group VII in Borgmeier (1967). It runs to couplet 52 to *M. pallidivena* and *M. scabra*. The current specimens can be differentiated from *M. pallidivena* which has yellow legs up to the entire hind femora. Male *M. shiyiluae* can be distinguished from male *M. scabra* by the presence of notopleural cleft whilst both sexes of *M. shiyiluae* also has different bristle dispositions on frons.

DISCUSSION

The female *M. nigella* is still undiscovered as the only known record based on male specimens from Philippines and Australia (Borgmeier 1967; Disney 2008). Borgmeier (1967) highlighted that *M. nigella* was closely identical to *M. atrita* and the differences were inadequate. However, the current male specimens from this study are more compatible with the original descriptions of *M. nigella* than *M. atrita* (Borgmeier 1967), mainly based on the size, wings and legs characteristics. Otherwise, it is almost similar to *M. atrita* including its ecology where the co-occurrence with *M. scabra* and *M. shiyiluae* has been previously reported from the same habitat (Disney et al. 1997). The synonymy of *M. nigella* and *M. atrita* is possible but requires more evidence including reference to the type specimens.

Previously, *M. scabra* was found in Taiwan, China and Sri Lanka but the biology of this species remains unknown (Borgmeier 1967; Disney 1981; Disney et al. 1997; Schmitz 1926). *Megaselia shiyiluae* was first reported from China but later it was more common in Arabia (Disney et al. 1997; Disney 2008; Disney 2009). The only known ecology of this species was the discovery of *Asclepiadaceae pollinia* on the proboscis of both males and females from UAE. All three species from the current research was collected from the water in pan traps but not from the decomposed beef liver used as baits. Additionally, none of the female *M. scabra* and *M. shiyiluae* collected from the pan traps were gravid to indicate their activity as decomposers.

The discovery of *M. nigella*, *M. scabra* and *M. shiyiluae* brings the number of known *Megaselia* from Peninsular Malaysia to 34. In spite of that, the list of Oriental *Megaselia* from classical works requires substantial revision considering sexual dimorphisms and extensively large members in this group. Such complexity had possibly caused the same species from previous works being named differently when described by female sex only.

ACKNOWLEDGMENTS

Authors would like to thank Forensic Science undergraduate students Miss Izzatul Ilya Mohd. Noor, Nurul Nadiah Abdul Rahman and Amirah Hanan Lutfi Amir for collecting the specimens as part of their undergraduate research projects on the diversity of Phoridae at UKM. Special thanks to Mr. Mohd Rafie Lim and Muhamad Hilmi Baba from Forensic Science Program, Faculty of Health Sciences, Universiti Kebangsaan Malaysia (UKM) for providing technical assistance during sampling.

AUTHORS DECLARATIONS

Funding Statement

Equipment used in this research was supported by RMZ's grant from UKM (GGPM-2014-018). RHLD's studies of Phoridae are currently supported by a grant from Balfour-Browne Trust Fund, University of Cambridge

Conflict of Interest

The authors declare that they have no conflict of interest to influence the work reported in this paper.

Ethics Declarations

Ethics declarations are not applicable for this research.

Data Availability Statement

Please contact corresponding author for data requests.

Authors' Contributions

RMZ was the principal investigator, processed the materials, described the specimens and prepared the first draft of the manuscript. RHLD provided cross-referencing materials and refined the final draft of the manuscript.

REFERENCES

- Borgmeier, T. 1966. Studies on Indo-Australian phorid flies, based mainly on material of the Museum of Comparative Zoology and the United States National Museum (Diptera, Phoridae). Part I. *Studia Entomologica, Petropolis* 9: 129–348.
- Borgmeier, T. 1967. Studies on Indo-Australian phorid flies, based mainly on material of the Museum of Comparative Zoology and the United States National Museum (Diptera, Phoridae). Part II. *Studia Entomologica, Petropolis* 10: 81–276.
- Beyer, E.M. 1960. Australische Phoriden des Queensland-Museums. *Broteria (Ciências Naturais)* 29: 20-40.
- Disney, R.H.L. 1981. Four new species of *Megaselia* (Diptera: Phoridae) from Sri Lanka. *Zeitschrift für angewandte Zoologie* 67: 389-398.
- Disney, R.H.L. 1991. The aquatic Phoridae (Diptera). *Entomologica Scandinavica* 22: 171–191.
- Disney, R.H.L. 1993. New species of aquatic Phoridae (Diptera) from Malaysia. *Aquatic Insects* 15(3): 149–158.
- Disney, R.H.L. 1994. Scuttle Flies: The Phoridae. London: Chapman & Hall.
- Disney, R.H.L. 1995a. Further new species of aquatic Phoridae (Diptera) from Malaysia and Brunei. *Aquatic Insects* 17(4): 205–213.
- Disney, R.H.L. 1995b. A new species of aquatic fly (Diptera: Phoridae) from Temengor Forest Reserve, Hulu Perak, Malaysia. *Malayan Nature Journal* 48: 271–279.
- Disney, R.H.L. 2001. The preservation of small Diptera. *Entomologist's Monthly Magazine* 137: 155–159.
- Disney, R.H.L. 2008. Order Diptera, family Phoridae. *Arthropod Fauna of the UAE* 1: 604–635.
- Disney, R.H.L. 2009. Scuttle flies (Diptera: Phoridae). Part II: The genus *Megaselia*. *Fauna of Arabia* 24: 249–357.
- Disney, R.H.L. & Maschwitz, U. 2000. Observations on *Megaselia persecutrix* (Diptera: Phoridae) in relation to its host *Camponotus gigas* (Hymenoptera: Formicidae). *Sociobiology* 36(3): 585–590.
- Disney, R.H.L. & Schroth, M. 1989. Observations on *Megaselia persecutrix* Schmitz (Diptera: Phoridae) and the significance of ommatidial size-differentiation. *Entomologist's Monthly Magazine* 125: 169–174
- Disney, R.H.L., Li, G.X. & Li, D. 1995. A new species and two new records of *Megaselia Rondani* (Diptera, Phoridae) from mainland China. *Giornale Italiano di Entomologia* 7: 333-338.

- Gori, M. 2014. Alcune nuove specie di Phoridae Orientali (Diptera). *Onychium* 10: 171–182.
- Hartop, E.A., Brown, B.V. & Disney, R.H.L. 2015. Opportunity in our ignorance: Urban biodiversity study reveals 30 new species and one new Nearctic record for *Megaselia* (Diptera: Phoridae) in Los Angeles (California, USA). *Zootaxa* 3941(4): 451-484.
- Schmitz, H. 1926. H. Sauters Formosa-Ausbeute: Phoriden. *Entomologische Mitteilungen* 15(1): 46-57.
- Thevan, K., Disney, R.H.L. & Ahmad, A.H. 2010. First records of two species of Oriental scuttle flies (Diptera: Phoridae) from forensic cases. *Forensic Science International* 195(1–3): e5–e7.
- Zuha, R.M. & Disney, R.H.L. 2018. Four new *Megaselia* species (Diptera: Phoridae) from animal carcasses in Bangi, Malaysia. *Zootaxa* 4508 (4): 551–561.