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THE TRUE IDENTITY OF COPELAND'S AQUATIC SCUTTLE FLY (DIPTERA: PHORIDAE) FROM INDIANA AND RECOGNITION OF A SIBLING SPECIES FROM TEXAS

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Abstract

Among the insects reported by Copeland (1989) breeding in the waters retained by treeholes in Indiana was a scuttle fly identified by W. H. Robinson as *Megaselia scalaris* (Loew). It is here reported that in fact this fly, along with fresh material from Illinois and Missouri, is *M. imitatrix* Borgmeier, whose type series was from Puerto Rico. An aquatic species reported from Texas is recognized as a sibling species of *M. imitatrix* and is named *M. hansonix* Disney, sp. nov. A single female from Brazil represents a third species of this complex, thus raising doubts about the identity of specimens from Brazil attributed to *M. imitatrix* by Benton and Claugher (2000).

Keywords

Megaselia; misidentifications; new species; voucher specimens

Copeland (1989) described the aquatic insect community of treeholes in northern Indiana. Among the Diptera were larvae whose reared adults were identified by W. H. Robinson as *Megaselia scalaris* (Loew). Recently, some specimens from Texas were attributed to the very similar aquatic species *M. imitatrix* Borgmeier (1969), whose type series came from Puerto Rico. Its larvae and eggs are very different from those of the essentially terrestrial *M. scalaris* (Hanson and Disney 2008). Furthermore, it was suggested that Copeland's *Megaselia* might in fact be *M. imitatrix*. However, RHLD had been informed 'that it appears that none of his (Copeland's) specimens have survived.' While Hanson and Disney's paper was in press, EM sent RHLD two similar, but different, males reared from water-filled buckets in Illinois and Missouri. Furthermore, following its publication RHLD was contacted by RSC, who stated that voucher material had been deposited in the Smithsonian Institution National Museum of Natural History (NMNH) in Washington, DC. The second author then arranged for this material to be sent to RHLD. From the larvae alone it was immediately apparent, at low magnification, that this material was not *M. scalaris*. Therefore, RHLD borrowed and slide mounted four paratype males of *M. imitatrix* from the NMNH and confirmed that it was the same species as RSC's material and as the specimens sent by EM. However, these were not the same species as the specimens from Texas, which is described as a new sibling species of *M. imitatrix* below. Furthermore, a single female from Brazil belongs to a third species of this complex, which raises the possibility that the aquatic species reported from Brazil and attributed to *M. imitatrix* (Benton and Claugher 2000) may be a third species in this complex.

Material and Methods

The second author's specimens were preserved in 12 small tubes of alcohol and comprised larvae, pupae, puparia, four males and 15 females. Two of these males and seven females have now been mounted on slides (Disney 2001), some being deposited in the Cambridge University Museum of Zoology. Likewise, voucher specimens of EM's material, which had been preserved in alcohol, has been slide mounted and also deposited in Cambridge.

Results

Megaselia hansonix Disney sp. nov.

Megaselia imitatrix Hanson and Disney 2008: 108. Misidentification.

Male—Frons orange brown with darker ocellar triangle, clearly broader than long, with 104–122 hairs and dense but very fine microsetae. Supra-antennal bristles (SAs) unequal, lower pair being at most two thirds length of upper pair. Antials lower on frons than anterolaterals (ALs), being about level with upper SAs, and about equidistant from upper SAs as either is from an AL bristle. Preocellars farther apart than either is from a mediolateral bristle, which is higher on frons. Cheek with four bristles and jowl with two longer ones. Subglobose post-pedicel light yellowish to greyish brown, with more than 20 subcutaneous pit sensilla (SPS vesicles), which are about as large as sockets of lower SAs. Palp pale straw yellow, with short basal segment. Apical segment with six bristles and twice as many hairs. Labrum colored as palps and at most 0.83× as wide as a postpedicel. Labella slightly darker than labrum and each with about a dozen short spinules apicolaterally. Thorax yellow apart from brown patch on pteropleuron and brown postscutellum. Two notopleural bristles and with unusually long cleft in front of these and extending beyond posterior bristle; with duct from notopleural gland discharging in front of anterior bristle (Fig. 5). Mesopleuron bare. Scutellum with anterior pair of hairs (subequal to those in middle of scutum) and posterior pair of bristles. Abdominal tergites partly brown and partly, but of variable extent, yellow, the latter being mainly along anterior and posterior margins and along median band; with hairs that are slightly longer at rear of T6 (Fig. 1). Venter whitish grey, and with hairs on segments 3–6. Hypopygium brown, with pale hypandrial lobes and pale anal tube, and as Figs. 1–2. With four rectal papillae. Legs straw yellow apart from brown tips to hind femora and patches on midcoxae. Foretarsus with posterodorsal hair palisade on segments 1–5 and 5 slightly longer than 4. Dorsal hair palisade of midtibia extends about three quarters of its length. Hairs below basal half of hind femur longer than those of anteroventral row of outer half. Hind tibia with a dozen differentiated posterodorsal hairs, but only the 7–8 in the lower two thirds are robust, the most apical being longest. Spinules of apical combs simple. Wings 1.4–1.6 mm long. Costal index 0.47–0.49. Costal ratios 4.2–4.5 : 2.4–2.8 : 1. Costal cilia (of section 3) 0.05–0.06 mm long. No hair at base of vein 3. With four axillary bristles, outer two at least being longer than costal cilia. Sc fading apically and not quite reaching R1. All veins greyish brown, but 7 is paler. Membrane lightly tinged grey (just evident to naked eye when viewed against white background). Haltere yellow to light brownish yellow.

Female—Head similar to male except there are fewer SPS vesicles and labrum is about 1.2× as wide as a postpedicel. Thorax as male except it lacks notopleural gland and cleft and anterior scutellars are about as long as hairs at rear of scutum. Abdominal tergites brown except for incomplete yellow median bands on T2 to T5 and grey median portion of T6. T5–T7 as Fig. 3. Venter grey, intersegmental bands being paler. Triangular sternite 7 with two long bristles and 6–8 hairs at rear margin. Pair of lobes at rear of sternum 8 as Fig. 14, there being 4 or 5 long bristles. Cerci are pale, about twice as long as broad and long apical hair is

clearly more robust than rest of hairs. Furca (internalized sternite 9) and associated vaginal sclerite as Fig. 4. Dufour's crop mechanism resembles that of *M. imitatrix* (Fig. 11) but is slightly shorter, being less than 0.4 mm long. With four rectal papillae. Legs similar to male except hairs below hind femur are shorter and posterodorsals of hind tibia are not quite so numerous. Wings as male except length is 1.4–1.8 mm. Costal index 0.47–0.51. Costal ratios 4.3–5.9 : 2.4–3.5 : 1. Costal cila 0.05–0.07 mm long. With 4–5 axillary bristles. Haltere as male.

Pre-adult stages—Hanson and Disney (2008) illustrated the egg (Fig. 11), larvae (Figs. 12–13) and pupa (Fig. 20). The cephalopharyngeal skeleton and mandibles are as Figs. 6–7. These are all very similar to those of *M. imitatrix*.

Type material—*Holotype male*: U.S.A., Texas, Austin, reared from aquatic larva, 28.ix. 2006, H. Hanson, deposited in the Cambridge University Museum of Zoology, England. *Paratypes*: 2 males, 6 females, as holotype except 1 28.v.2006.

Etymology—Named after the collector Harlin Hanson with the addition of a terminal x, in order to prevent confusion with *M. hansonii* Disney from Thailand.

Affinities—In the relevant section of the keys to the Nearctic species (Borgmeier 1966), this species and *M. imitatrix* run to page 4, couplet 11, lead 2, to *M. straminipes* (Malloch). Its female is immediately distinguished by T6 being shorter and narrower than T5. The male's anal tube is only about as long as the epandrium, unlike that of *M. hansonii* and *M. imitatrix*. The subsequently described *M. rettenmeyeri* Disney runs to the same couplet, but it also has a short anal tube (its female is unknown). If the haltere is regarded as being brown, as opposed to 'dusky yellow,' the males and most females run to couplet 38 on page 5, where the yellow thorax immediately rules out the species of this couplet. Females with the costal index exceeding 0.5 will either fail to run to this couplet or are clearly incompatible with the species arrived at.

Megaselia hansonii closely resembles *M. imitatrix*. The males are best distinguished by their hypopygia. The posterolateral lobes of the right side of the epandrium differ (Figs. 2, 9), and the larger (conspicuously hairy) paraphysis of the penis complex has an upwardly curved apical process in *M. hansonii* (Figs. 1–2) that contrasts with the lack of such in *M. imitatrix* (Fig. 8). The females are very similar. The lobes at the rear of abdominal sternum 8 of *M. hansonii* are more tapered and bear 4 or 5 (usually 4) long bristles (Fig. 14). Those of *M. imitatrix* are more broadly rounded and bear 3–4 (usually 3) long bristles (Fig. 15). Otherwise, the furca and associated vaginal sclerites provide a reliable distinction (cf. Figs. 4, 12), but their appearances differ when viewed from different angles.

***Megaselia* sp.**

This species may be the same as the specimens from Brazil attributed to *M. imitatrix* by Benton and Claugher (2000).

A single rather poor, but gravid, female specimen from Brazil closely resembles *M. imitatrix* and *M. hansonii*. Like them it has abdominal tergite 6 shorter but wider than T5, an elongated Dufour's crop mechanism similar to Fig. 11, and contrasting with that of *M. scalaris* (Fig. 13), and its eggs possess a subterminal plastron. It is readily distinguished at low magnifications by its more densely hairy abdominal venter. Until it can be linked to its male, apart from better specimens of females being procured, it is not being described and named. The male is likely to possess a notopleural gland and the associated, but unusually long, notopleural cleft.

Material examined—Female, BRAZIL, Amazonas, Manaus, in bathroom, 15.x.1979, L. A. Lacey, deposited in the Cambridge University Museum of Zoology, England.

DISCUSSION

Figures 16–22 provide comparable figures for *M. scalaris* that will distinguish this species from the obligate aquatic species that it superficially resembles. The truly aquatic habits of the larvae of *M. imitatrix* and *M. hansonix* contrast with those of the primarily terrestrial habits of the larvae of *M. scalaris*, whose larvae feed on a wider range of decaying organic materials than any other known insect (Disney 2008a), but have been reported as facultative invaders of the waters retained by bamboo stumps and decaying coconuts, where the larvae inhabit the meniscus region (Disney 2004). The clearest distinction between *M. scalaris* and the two obligate aquatic species dealt with above is the form of the plastron of the egg, which runs the length of the egg in the former (Fig. 23) but forms a subterminal crown at the anterior end in the two truly aquatic species (Hanson and Disney 2008, fig. 11). Among the aquatic species in the Oriental Region, *M. deningi* Disney has a floating egg with a plastron like that of *M. scalaris* (Disney 2004, fig. 2A), but the egg of *M. kovaci* Disney (*loc. cit.*, Fig. 2C) has a subterminal plastron like that of *M. hansonix*, *M. imitatrix* and the unnamed female from Brazil. These resemblances would seem to be convergent adaptations related to whether the egg is laid upright in the meniscus or floats horizontally when flooded.

In gravid females the developing eggs attain full size before the microsculpture of the chorion, and the plastron are developed just before the egg is ready for laying. Similarly, in *Drosophila* the appendages of the chorion and the microsculpture of surface of the latter are formed only just prior to oviposition (e.g., Miller 1965).

The original misidentification of *M. hansonix* reinforces the importance of voucher specimens, relating to published ecological data, being deposited in a museum (e.g., Disney 2008b).

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LITERATURE CITED

- Benton F, Claugher D. The structure and surface properties of the eggshell of *Megaselia imitatrix* Borgmeier (Diptera, Phoridae) in relation to the respiration of the embryo. *Physiological Entomology*. 2000; 25:133–40.
- Borgmeier T. Revision of the North American Phorid flies. Part III. The species of the genus *Megaselia*, subgenus *Megaselia* (Diptera, Phoridae). *Studia Entomologica*, Petropolis. 1966; 8:1–160. 1965.
- Borgmeier T. Bredin-Archbold-Smithsonian Biological Survey of Dominica: The Phoridae of Dominica (Diptera). *Smithsonian Contributions Zoology*. 1969; 23:1–69.
- Copeland RS. The insects of treeholes of northern Indiana with special reference to *Megaselia scalaris* (Diptera: Phoridae) and *Spilomyia longicornis* (Diptera: Syrphidae). *Great Lakes Entomologist*. 1989; 22:127–132.
- Disney RHL. The preservation of small Diptera. *Entomologist's Monthly Magazine*. 2001; 137:155–159.
- Disney, RHL. Insecta: Diptera, Phoridae. In: Yule, CM.; Yong, HS., editors. *Freshwater Invertebrates of the Malaysian Region*. Academy of Sciences; Kuala Lumpur, Malaysia: 2004. p. 818–825.

- Disney RHL. Natural history of the scuttle fly, *Megaselia scalaris*. Annual Review of Entomology. 2008a; 53:39–60.
- Disney RHL. Voucher specimens. Antenna. 2008b; 32:4.
- Hanson HA, Disney RHL. An aquatic scuttle fly (Diptera: Phoridae)—A need for care in identification. Antenna. 2008; 32:107–112.
- Miller, A. The female reproductive system. In: Demerec, M., editor. Biology of Drosophila. Hafner Publishing Company; New York: 1965. p. 523

Figs. 1–2.
Megaselia hansonix male hypopygium. 1, Left face. 2, Right face with only base of anal tube included. Scale bar = 0.1 mm.

Figs. 3–4.
Megaselia hansonix female, details of abdomen. 3, Tergites 5–7. 4, Furca and associated vaginal sclerite. Scale bars = 0.1 mm.

Figs. 5–7.
Megaselia hansonix. 5, Male, left notopleuron and parts of adjacent regions (*P* = propleuron, *H* = humeral bristle, *N* = notopleuron, *I* = base of intra-alar bristle). 6–7, Larva stage III. 6, Left face of mandibles and cephalopharyngeal skeleton. 7, Left mandible. Scale bars = 0.1 mm.

Figs. 8–9.

Megaselia imitatrix male hypopygium. 8, Left face. 9, Right face with only base of anal tube included. Scale bar = 0.1 mm.

Figs. 10–13.

10–12, *Megaselia imitatrix* female, details of abdomen. 10, Tergites 5–7. 11, Dufour's crop mechanism. 12, Furca and associated vaginal sclerite. 13, *M. scalaris* female, Dufour's crop mechanism. Scale bars = 0.1 mm.

Figs. 14–15.
Megaselia females, left lobes at rear of abdominal sternum 8. 14, *M. hansonix*. 15, *M. imitatrix*. Scale bar = 0.1 mm.

Figs. 16–17.
Megaselia scalaris. 16, Left face of male hypopygium. 17, Female abdominal tergites, rear of T4–T7. Scale bars = 0.1 mm.

Figs. 18–19.

Megaselia scalaris. 18, Female, furca. 19, Left face of mesopleuron and parts of adjacent regions (S = spiracle, N = notopleuron, P = post-propleural ridge, M = mid-mesopleural ridge). Scale bars = 0.1 mm.

Figs. 20–22.

Megaselia scalaris pre-adult stages. 20, Larval stage III, left face of mandibles and cephalopharyngeal skeleton. 21, Left mandible of larva. 22, Median tooth of larva. 23, Dorsal view of egg. Scale bars = 0.1 mm.