Merope tuber Newman (Mecoptera: Meropeidae) Collected in Association with Carrion in Greene County, Ohio, USA: An Infrequent Collection of an Elusive Species

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Notes and Discussion

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ABSTRACT.—Collections of the earwigfly, *Merope tuber* Newman (Mecoptera: Meropeidae), have been sparse. Little is known about the life history, behavior or ecology of this elusive mecopteran species. Found only in North America, within eastern forests, increased trapping records have recently demonstrated a previously undetected western expansion for this species. This paper is the first documentation of *M. tuber* on carrion and in Greene County, Ohio, USA and the second record of specimens collected in western Ohio. Four specimens (two males and two females) were caught using glue traps during Aug. 2010 at a carrion resource, a first trapping occurrence of this type for *M. tuber*.

INTRODUCTION

Mecoptera is a holometabolous order of insect consisting of nine families with more than 600 extant species and a world-wide distribution (Whiting, 2002). The most speciose families are Panorpidae and Bittacidae, which contain 90% of the species within this order (Byers and Thornhill, 1983; Dunford and Somma, 2008), while the family Meropeidae consists of two species (Byers, 1973; Dunford *et al.*, 2008). *Merope tuber* Newman, or the earwigfly, is primarily found in eastern regions of North America (Byers, 1973; Dunford *et al.*, 2007). Fossil records indicate *Merope* is approximately 280 million y old and closely related to the extinct *Boreomerope antiqua* Novokschonov from the Middle Jurassic period from Siberia (Byers, 1973; Somma and Dunford, 2007; Dunford *et al.*, 2008). The only other extant species within the family, *Austromerope poultoni* Killington, is found exclusively in Australia (Byers, 1973; Byers, 1991; Abbott *et al.*, 2007; Somma and Dunford, 2007; Dunford *et al.*, 2008).

Collections of adult *Merope tuber* are infrequent (Byers, 1973). The first recorded *M. tuber* specimen collected was a female from Trenton Falls, New York in 1837 (Barber, 1904) and subsequently described by Newman in 1838 (Westwood, 1846; Byers, 1973). The holotype is housed in the British Museum of Natural History (Barber, 1904). In the period from 1838–1953, *M. tuber* had been collected from the District of Columbia and eight states, as follows: Georgia, Maine, Maryland, New Jersey, North Carolina, Pennsylvania, Virginia and West Virginia (Byers, 1954). The current species distribution extends as far north as Ontario (Paiero *et al.*, 2010) to the west into Kansas (Byers, 1993; Dunford *et al.*, 2007; Dunford *et al.*, 2008) and as far south as the Florida panhandle (Dunford *et al.*, 2007; Somma, 2011). The emigration rate of *M. tuber* is thought to be approximately 148 m per y (Byers, 1973), suggesting limited dispersal.

Little is known about the life history and ecology of *Merope tuber* (Byers, 2005). However, the morphology of *M. tuber* has been extensively documented. Both male and female internal anatomy and external morphology are well known (Potter, 1938; Byers, 1962). Males have elongated genitalia claspers consisting of a basistyles and a distyles (Byers, 1973; Skelley *et al.*, 2007). Claspers size has a biomodal distribution with ''large'' and ''small'' classifications (Johnson, 1995). The importance of clasper size dimorphism is unknown, as function of the claspers has yet to be determined. One hypothesis suggests the claspers function in combat for females, but there is no evidence to support this explanation (Byers and Thornhill, 1983).

There have been no reports on the life cycle, reproductive behaviors, feeding preferences or habitat selection of *Merope tuber* (Thornhill and Johnson, 1974; Byers and Thornhill, 1983; Johnson, 1995). The larvae of all Meropeidae are completely unknown (Byers, 1973; Byers and Thornhill, 1983; Dunford *et al.*, 2008).

Mecopteran species utilize a variety of resources for nutrition. Adult Bittacidae are predacious on other arthropods (Byers and Thornhill, 1983). *Panorpa* (Panorpidae) adults feed on soft-bodied, usually moribund, arthropods (Byers and Thornhill, 1983). Various species of Panorpidae have also been recorded on carrion and feeding on nectar, herb pollen, and fruit juices (Byers and Thornhill, 1983), and recently the elusive eomeropid, *Notiothauma reedi* MacLachlan (Mecoptera: Eomeropidae), was found in large numbers on carrion (Jara-Soto *et al.*, 2007). However, Meropeidae have never been

reported on carrion. It has been suggested that *Merope tuber* are possibly phytophagous (Thornhill and Johnson, 1974).

Merope tuber specimens have been collected in a variety of habitats. Primarily, species are found in wooded areas (Byers, 1973; Dunford *et al.*, 2007) and near water (Byers and Thornhill, 1983; Johnson, 1995); they have also been collected in the Appalachian mountains (Dunford *et al.*, 2007) and North American tallgrass prairies (Paiero *et al.*, 2010). *Merope tuber* is nocturnal (Johnson, 1995) and seeks shelter under rocks or logs during diurnal periods (Barber, 1904; Byers, 1973). Adults have been collected at light sources (Barber, 1904) and with several passive trapping methods including Malaise traps, carbon dioxide traps and molasses traps (Byers, 1973). Malaise traps have shown the highest specimen collection rates (Byers, 1973; Johnson, 1995). There is a single record of consistent trapping success of *Merope* using Malaise traps in Lancaster, Ohio, USA from 1992–1993 (Johnson, 1995). Out of 163 specimens collected, 102 were females, demonstrating a biased female sex ratio when using this technique (Johnson, 1995). No record exists of collecting *M. tuber* on sticky traps, nor associated with carrion. Despite increased trapping rates in recent years, *M. tuber* has been infrequently collected throughout the USA over the past 170 y (Somma and Dunford, 2007).

MATERIALS AND METHODS

Research using glue traps to document insects associated with carrion was conducted near Xenia, Ohio, USA (39°38′14.83″N, 84°1′37.82″W) in a Midwestern temperate forest surrounded by agricultural fields. The dominant flora in the habitat consisted of oak (*Quercus* spp.) and maple (*Acer* spp.) trees with numerous fallen logs in the surrounding area. Trapper® max glue traps were used as a passive trapping method to study invertebrate succession patterns on swine, *Sus scrofa* L., carrion over time as part of a larger study addressing decomposition ecology. Six male carcasses ranging from 10.4–30.1 kg were randomly placed, with heads oriented in a northerly direction, approximately 10 m apart along two transects on private property with permission to access. Carcasses were labeled alphabetically (''A'' through ''F''). A single glue trap was located approximately 0.15 m from the anterior and posterior region of each carcass. Glue traps were replaced every 12 h. NexSens DS1923 micro-T temperature loggers (Fondriest Environmental, Inc., Beavercreek, Ohio, USA) were used to record temperature every 0.25 h for the duration of the study, and were approximately 0.45 m away from the glue traps. All *Merope tuber* specimens were collected within 48 h of invertebrate access to the carcass, while the carcass was in either the fresh or bloat stage of decomposition (Payne, 1965). Male and female voucher specimens have been deposited as number 686 in the TAMU insect collection (Texas A&M University, College Station, Texas, USA).

Specimens were measured under a Meiji Techno model EMZ-8TR microscope (Meiji Techno America, Santa Clara, California, USA) fitted with an Infinity 1–3 C digital camera (Lumenera Corporation, Ontario, Canada). An image of each specimen was taken using the Infinity Analyze Version 4.4 software package (Lumenera Corporation, Ontario, Canada). The Caliper tool was used in the Infinity Analyze program to accurately measure the specimen to the nearest millimeter. Total stylus length was measured by following the curvature of the basistyles and dististyles (Johnson, 1995).

RESULTS

Merope tuber specimens were captured at three of the six carcasses. Two male specimens (Fig. 1) were caught on consecutive nights from a single carcass (''B''). The first male was collected over night (19:00–7:00) on 5 Aug. 2010. The temperature ranged from 17.5–29.5 C. This specimen was caught near the posterior end of the carcass, which was oriented in a southerly direction. Total stylus length was 6.2 mm. The second male was collected 6 Aug. 2010 on a trap near the anterior portion of the carcass during the night with the temperature ranging between 15.0–24.0 C. Total stylus length was 4.3 mm. Female specimens were also caught on consecutive nights, however, from two different carcasses. The first female was collected over night on 10 Aug. 2010 near the posterior end of carcass ''C.'' The temperature ranged between 25.0–31.0 C. The second female was collected from the posterior end of carcass ''D'' on 11 Aug. 2010 during the night with the temperature ranging between 21.0–26.0 C.

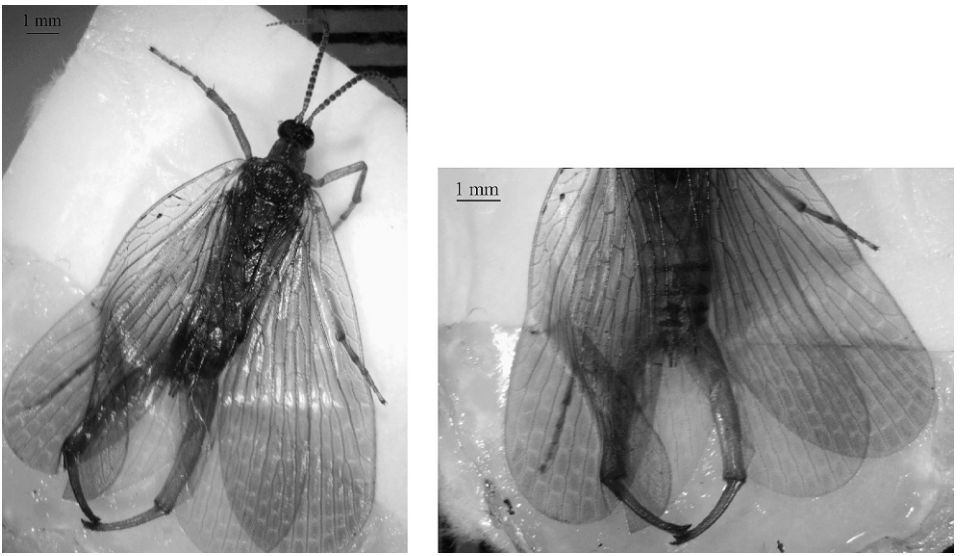

FIG. 1.—Left panel is the male *Merope tuber* specimen collected 5 Aug. 2010. The right panel shows the structure of the claspers

DISCUSSION

This is the first documentation of *Merope tuber* in Green County, Ohio, USA and only the second record of *M. tuber* collection in western Ohio. Mecopteran species have yet to be documented in surveys of insect fauna associated with vertebrate mammalian carrion. However, the related *Panorpa* spp. have been recorded to feed on snail, frog and toad carrion (Byers and Thornhill, 1983), and *Notiothauma reedi* also has been found on carrion (Jara-Soto *et al.*, 2007). Due to the paucity of knowledge about the feeding habits and life history traits of *M. tuber*, the significance of its presence at carrion is not clear. *Merope tuber* specimens were collected at three of the six carcasses, suggesting this species may be attracted to carrion. Males may have been attracted to the carrion to find females and/or as a food resource, or the occurrence of *M. tuber* was merely incidental. Nonetheless, four captures of this secretive species associated with carrion merits documentation within the context of carrion decomposition ecology and suggests that future collection efforts for *M. tuber* consider using carrion as an attractant or bait.

Invertebrate succession patterns on carrion has been well documented for over 150 y (Benecke, 2001). Diptera are among the first to colonize carrion with seres of blow flies (Diptera: Calliphoridae), flesh flies (Diptera: Sarcophagidae) and muscid flies (Diptera: Muscidae) present throughout the early stages of decay (Payne, 1965; Byrd and Castner, 2010). Coleopterans secondarily colonize the resource and include species from the following families: Histeridae, Staphylinidae, Silphidae and Dermestidae (Payne, 1965; Byrd and Castner, 2010). Incidental taxa utilize carrion as an extension of the environment (Smith, 1986). A variety of invertebrate incidentals have been documented to be associated with carrion including: Chilopoda (Payne, 1965), Diplopoda (Payne, 1965), Isopoda (Payne, 1965), Collembola (Catts and Goff, 1992), spiders (Catts and Goff, 1992), mites (Reed, 1958; Payne, 1965), ants (Hymenoptera: Formicidae) (Reed, 1958; Payne, 1965), yellow jackets, *Vespula macuifrons* (Buyss.) (Hymenoptera: Vespidae) and Lepidoptera (Reed, 1958; Wolff *et al.*, 2001). There is no previous record of *M. tuber* collected at a carrion resource.

Studying the decomposition ecology of carrion is important for elucidating species interactions and mechanisms driving this ecosystem process. Carrion may attract a wide range of species with a variety of life history traits that bring them to the remains. Therefore, there needs to be a continuation of

surveying invertebrates found at carrion, and as a result there may be an increased potential, as documented here, to record additional species that may otherwise go undetected. In forensics, identification of species and their distribution is important for determining if remains have been moved (Anderson, 2001). *Merope tuber* could be an indicator of such activities due to its limited distribution range. In addition, this report provides new information on potentially where, when and how this rare and understudied species may be documented and collected in future studies.

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