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## Cover Page Footnote

My sincere thanks to Drs. James O'Hara and Bradley Sinclair (CNC) for their assistance and suggestions. Drs. Sinclair and T. E. Moore greatly improved an earlier draft of the manuscript. I thank the Milwaukee Public Museum for generous support of my status as Curator Emeritus of Zoology. Thanks, too, to Roberta Gordon for wonderful hospitality and support at Summer Oaks, Merrimac, Wisconsin and for introducing me to the study locality.

# Parasitism of Female *Neotibicen linnei* (Hemiptera: Cicadidae) by Larvae of the Sarcophagid Fly *Emblemasoma erro* in Wisconsin

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**Abstract**

Herein it is reported an unusual case of parasitism of a female *Neotibicen linnei* (Smith & Grossbeck) (Hemiptera: Cicadidae) by the sarcophagid *Emblemasoma erro* (Aldrich) (Diptera: Sarcophagidae) in western Wisconsin. Sarcophagids typically attack male cicadas, locating them bythe latter's acoustical behavior.

Some members of the dipteran family Sarcophagidae are parasitic on male cicadas (e.g. Soper et. al. 1976, Lakes-Harlan et. al. 2000, Faris et. al. 2008, Stucky 2015). Parasitoids *Emblemasoma* species are attracted to larviposit on male cicadas by responding to the latter's acoustical signals (Tron et. al. 2016). Sarcophagids, therefore, are generally not attracted to mute female cicadas. In this brief communique, I report an unusual instance of a female of the cicada *N. linnei* being successfully parasitized by *E. erro* in western Wisconsin.

**Keywords:** Parasite, cicada, Midwest, Wisconsin, fly, zoology, larva, research

## Materials and Methods

On 22 August 2015, a live adult female of the cicada *Neotibicen linnei* (Smith & Grossbeck) was found clinging to a fence post at a residential complex near the village of Merrimac (43.3733°N, 89.6235°W), Sauk County, northwest of Madison, Wisconsin. The sex of a cicada is easily determined by the external genitalia. At the time, many males of this cicada species were calling from several large trees in the area. Several exuviae of this cicada species were found on nearby trees. As *N. linnei* is the only species of this genus occurring at this locality, it is assumed that the exuviae were those species. The unusually docile cicada was easily collected by hand and subsequently identified as *N. linnei* by matching it with several specimens in the collections of the Milwaukee Public Museum (from the western counties of Vernon and Grant) and from records for Sauk andDane counties provided by Thomas E. Moore (pers. comm. 1970). It was suspected that the female *N. linnei* had been parasitized owing to how easily it was captured. Therefore, the cicada was kept in a zip-lock plastic bag to determine if any parasitoids would emerge.

## Results

The cicada lived for five days (27 August) at the end of which five dipteran larvae were found crawling in the bag. Two days later, four reddish-brown puparia were formed, with one larva remaining. A fifth puparium was found five days later (1 September). The puparia were transferred to a plastic vial containing moistened tissue paper to prevent desiccation. The now-dead cicada was not examined for exit holes. The vial was kept in a non-heated garage over the winter and one adult dipteran eclosed on 19 June 2016, some ten months after pupation. Adults from the remaining puparia failed to emerge for unknown reasons. The dipteran specimen was sent to Drs. James O'Hara and Bradley Sinclair at the Canadian National Insect Collection (CNC) (Ottawa) for taxonomic identification.

The specimen turned out to be a male *Emblemasoma erro* (Aldrich) (Sarcophagidae) based upon barcoding and matching specimens in the CNC (Bradley Sinclair, pers. comm. March 2019). The specimen is housed in the CNC.

## Discussion

This observation constitutes an unusual published record of *E. erro* parasitizing a female *Neotibicen* cicada. Although this observation and conclusion are very preliminary, it suggests a line of further research on the interaction of dipteran parasitoids and cicadas. Sarcophagids typically attack only singing male cicadas cuing in on acoustical signals (Soper et. al. 1976). Perhaps an added caveat is that sarcophagids such as *E. erro* visually cue in on mute female cicadas in

close proximity to singing males, thereby expanding parasitism to both sexes. There have been previous reports of female cicada parasitization by sarcophagids (e.g. Super et al. 1976; Stucky 2015). One mechanism is *E. erro* female following a female *Megatibicen dorsatus* (Say) in flight and larvipositing on it. This could be the case in the present instance. Thus, visual cues play a key role in successful larvipod larviposition on female cicadas. *Emblemasoma erro* is known to attack a male cicada in flight soon after calling (Stucky et. al. 2015), unlike other *Emblemasoma* which attack stationary singing cicadas. The observation of *E. erro* attacking *N. linnei* is a new record as well. And while limited, this observation suggests a possible synchronization of the annual lifecycle of cicada sarcophagid parasitoids with the adult emergence cycles of their annual cicada hosts. While *E. erro* is widely distributed from Canada to Texas (Pape 1996), *N. linnei* is distributed across much of the eastern half of the United States (Sanborn and Phillips 2013), but not Texas. Therefore, the interaction of *E. erro* with female individuals warrants further study. While clearly very limited, this observation could be a basis for further study. Successful sarcophagid attacks on female cicadas could impact reproductive capacity.

## Acknowledgments

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