The use of *Megaselia abdita* (Diptera: Phoridae) in forensic entomology

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Abstract

This case study demonstrates the importance of the Phorid, *Megaselia abdita* (Schmitz), as an indicator for post-mortem interval estimation in criminal investigations involving forensic entomology where it is usually the more frequently occurring Calliphorids that are most useful. A case example is discussed where the temperatures were low for the period of time the deceased was missing.

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One question that forensic entomologists are frequently asked as part of an enquiry is to estimate a post-mortem interval (PMI). In practice, this can differ from the estimate forensic entomologists make as it is not necessarily possible to account for the period between death and earliest oviposition. During the spring, summer and autumn months, this period is likely to be minimal, so that in many cases it may be possible to make an estimate of the PMI with a reasonable degree of accuracy, not least because it is assumed that the insects have been developing for the whole time they have been on or around their food source.

If sufficient access exists, insects are known to colonise a body in a semi-predictable manner [1] with Calliphoridae preceding those families whose larvae feed on tissues that are more decomposed, such as Muscidae or Silphidae. Other families, such as the Phoridae may feature in several stages of the succession. Thus, the larvae of some species, such as *Conicera tibialis* Schmitz, will feed on a corpse late in the so-called succession. With such species there is generally a long pre-oviposition period. Other species, such as *Megaselia rufipes* (Meigen), may oviposit within a few days of a corpse’s exposure. However, it may take longer than usual for them to lay eggs when bodies have been buried or concealed indoors [2].

In winter, not only are many carrion breeding insects no longer active as adults, but for those that are it is often assumed that the science of forensic entomology becomes less exact as behaviours such as diapause and quiescence have to be considered. For example, among phorids, *Triphleba hyalinata* (Meigen) is tolerant of winter conditions, but the last instar larva may enter a diapause lasting several weeks and it may also diapause as a pupa [3]. By contrast the related carrion-breeding *T. autumnalis* (Becker) is a winter-adapted species that frequently oviposits within a few days of exposure of meat baits. Its larvae are most prevalent from December to February, and most of the rest of the year is passed in the diapausing pupal stage [4–6].

The authors have found phorids in other cases during the winter months on bodies that have been buried or concealed indoors [7]. In this note one further case is described involving the presence of the phorid *Megaselia abdita* Schmitz.

In this case, the deceased had not been seen since 6th September. It was thought by investigating officers that he had died approximately 2 weeks after this sighting. His body was found indoors in January the following year and the scene examination conducted on the 24th January. That left up to 18 weeks that the body could have been in situ. There had been an invasion of Calliphoridae with both *Calliphora vicina* and *Calliphora vomitoria* having been present. There had also been some Fanniidae activity. The preponderant activity on the body of the deceased was, however, *M. abdita* and the majority of its
representatives were puparia. There were, however, a number of empty puparia indicating that an entire life cycle had occurred. The body of the deceased was drying out and there was little tissue remaining.

The temperature regime was reconstructed for the scene. A Tinytag Plus® data logger was placed in the room and same location in which the deceased had been found. This was removed after a 2-week period and the data extracted. The complete data from the nearest meteorological station was then obtained and a regression analysis performed using Microsoft Excel® to establish the relationship between the two sites. Once this had been established, it was possible to use data from the meteorological station for the time period that the deceased had been missing to estimate what the temperature may have been in the room. Temperatures were estimated to be low (approximately 10–11 °C) for the 18 weeks the deceased had been missing.

Both C. vicina and C. vomitoria may be expected to have passed through their entire life cycle many weeks previously, especially as large numbers of larvae had migrated away to a warmer part of the premises. It is difficult to estimate how long this time period may have been as the blowfly larvae moved from the cool room to warmer parts of the house but if they had remained within the room, one may expect adult emergence after approximately 2 months. This takes into consideration the fact that the room was slightly warmer at the beginning of the period under consideration. However, at these average temperatures it can take at least 18 weeks for M. abdita to pass through its entire life cycle (Table 1) [2], and it is very probable that the M. abdita females laid their eggs very early in the period of decomposition at a similar time that would be expected of the Calliphoridae. Behaviour of this insect altered to fit into the ecological niche.

This case emphasises that in the colder months, forensic entomology can still be of assistance in estimating post-mortem intervals. It is quite likely that there was a short interval before egg-laying commenced and that the egg-laying behaviour of this insect altered to fit into the ecological niche normally occupied only by Calliphoridae.

It is not always down to the more frequently used blowflies to provide the critical information. Indeed, in this case had the blowflies been relied upon, it would not have been possible to provide a post-mortem interval of any meaning.

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References


Table 1

Average minimum duration of the developmental stages of M. abdita [2]

<table>
<thead>
<tr>
<th>Stage</th>
<th>Rearing temperature</th>
<th>10 °C Hours</th>
<th>%</th>
<th>12.5 °C Hours</th>
<th>%</th>
<th>23 °C Hours</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Egg</td>
<td></td>
<td>120</td>
<td>4</td>
<td>45</td>
<td>3</td>
<td>23</td>
<td>6</td>
</tr>
<tr>
<td>Larvae</td>
<td></td>
<td>504</td>
<td>15</td>
<td>406</td>
<td>28</td>
<td>120</td>
<td>29</td>
</tr>
<tr>
<td>Pupa</td>
<td></td>
<td>2838</td>
<td>82</td>
<td>977</td>
<td>68</td>
<td>272</td>
<td>66</td>
</tr>
</tbody>
</table>

a Percent of total development time.
b First instar through post-feeding larvae.
c Pupariation to eclosion.