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CASE REPORT

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The Black Soldier-fly, *Hermetia illucens* (Diptera, Stratiomyidae), Used to Estimate the Postmortem Interval in a Case in Amapá State, Brazil*

ABSTRACT: The black soldier-fly (*Hermetia illucens*) is a generalist detritivore which is commonly present in corpses in later stages of decomposition and may be useful in forensic entomology. This paper describes the estimation of the postmortem interval (PMI) based on the life cycle of the black soldier-fly in a case in northern Brazil. A male child was abducted from his home and 42 days later his corpse was found in an advanced stage of decay. Two black soldier-fly larvae were found associated with the body. The larvae emerged as adults after 25–26 days. Considering the development cycle of *H. illucens*, the date of oviposition was estimated as 24–25 days after abduction. Since *H. illucens* usually (but not always) colonizes corpses in more advanced stages of decay, this estimate is consistent with the hypothesis that the child was killed immediately after abduction.

KEYWORDS: forensic science, black soldier-fly, postmortem interval, *Hermetia illucens*

The black soldier-fly, *Hermetia illucens* (L.) (Diptera, Stratiomyidae), is a generalist detritivore which colonizes a wide variety of decomposing plant and animal matter (1). It is a cosmopolitan species, but was originally restricted to the New World (2). Similar to other stratiomyids of the subfamilies Hermetiinae and Sarginae, *H. illucens* can be classified as opportunistic or secondary necrophagous and may be important for forensic entomology, especially in estimation of the postmortem interval (3,4). It is a very common species in Brazil, where it occurs both in natural and man-modified habitats. The biology of *H. illucens* has been studied by several authors (1,5–9). In this paper, we describe a forensic entomology case in northern Brazil in which *H. illucens* was used to estimate a minimum postmortem interval.

Case Description

On May 10, 2005 a male child, approximately 8 months old, was abducted from his home in the city of Macapá, State of Amapá, Brazil (0°02′N 51°04′W, elevation 16 m). On June 21, 2005 (42 days later), a corpse in advanced stage of decomposition was found in a vacant lot near his home. The cadaver and associated objects were transported on June 21 to the department of forensic medicine of the state police, Macapá, Brazil. The remains were skeletonized (Fig. 1), partially enclosed in a torn plastic bag, and dressed with some pieces of infant clothing: a pair of socks (synthetic fiber), cotton diaper, and pants. The temperature inside the bag was not measured. Remains included the skull, facial tissue, four limbs, thorax, teeth, scalp, and hair. All clothing had a large amount of yellowish and malodorous organic matter. All remains were above ground and there were no signs of burial. The bones were found inside the clothing and therefore the victim was apparently dressed when left at the body recovery site. On June 23, during the necropsy, two insect larvae were found associated with the body and clothing (Fig. 2). The larvae were white-yellow and 2.3 cm in length. On June 24, one of these larvae was placed in an unrefrigerated plastic container (80 mL) with vermiculite and sent by surface mail to the Laboratory of Forensic Entomology of the University of Brasília, where it arrived on June 28. The larva was transferred to a BOD incubator at 30°C and 70% relative humidity in a small container with beef-based feeding medium (2 g every 48 h). Two days later (June 30), the larva moulted and after another 4 days (July 4) it stopped moving and entered the pupal stage. On July 11 its eyes were empty, indicating that it had become a pupa. Four days later (July 15) an adult female emerged. The other larva was kept at the forensic laboratory in Macapá, at room temperature and on the same diet, and emerged one day later than the one sent to Brasília (July 16). The species was identified as *Hermetia illucens* (L.) (Fig. 3). Similar to most Stratiomyidae, this species undergoes six larval instars, and the pupa is enclosed by the cuticle of the last larval instar. Therefore, since the larva moulted only once, it was in its 5th instar (L5) when it arrived at the laboratory.

Estimate of the Minimum Postmortem Interval

We considered 42 days as the best estimate of the development time for *H. illucens* from oviposition to adult in this case (see

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FIG. 1—*Remains of the victim, a male child, at the laboratory during the necropsy.*

FIG. 2—*Clothing found on the corpse, as seen at the laboratory during the necropsy. A larva of* Hermetia illucens *is near the center of the picture (arrow).*

FIG. 3—*Hermetia illucens (L., 1758), and empty puparium. Specimen recovered from the remains of a male child.*

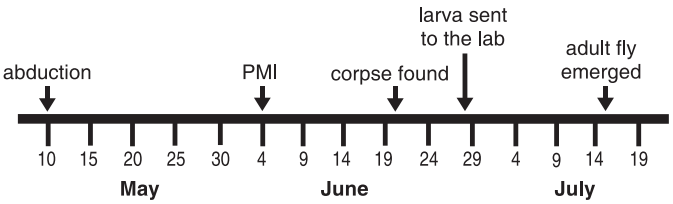

FIG. 4—*Time line indicating the main events: abduction (May 10); corpse found (June 21); larva arrived at the laboratory (June 28); adult fly emerged at the lab (July 15); estimated minimum PMI (June 4).*

Discussion). Based on the difference between the measured time and the total development time of this species, we estimated that the oviposition by *H. illucens* on the corpse occurred on June 4, which corresponds to the minimum estimated postmortem interval (PMI) (Fig. 4). We also estimated the PMI in accumulated degree days (ADD). We used temperature data (daily averages) from the meteorological station of Macapá, which is located about 15 km from the body recovery site. These data are publicly available at the website of the National Institute of Meteorology (10). Based on data from the literature (4,5) and a development threshold temperature of 10°C, we calculated that 811 ADD were required for this species to develop from egg to adult. The ADD method indicated June 3 as the most likely day of oviposition.

Discussion

The black soldier-fly can be useful in estimating the PMI for corpses in advanced stages of decomposition when most calliphorids and sarcophagids have finished their cycles (4). In this case, we estimated the minimum PMI based on the development time of *H. illucens*, which was the only insect species collected from the remains of the victim.

According to the literature, the time of development of *H. illucens* from larva to adult varies from 38 to 43 days (1,5,8,9,11). However, one study indicates that the rate of larval development may be affected by diet, and may be much longer in some cases (9). The study conducted at the highest temperature (29.3°C) (11) reported the shortest development time (38 days). We considered the period of 38 days as the most conservative and also the most likely due to the high average temperatures recorded at Macapá. Egg development takes an additional 4 days (7), which results in a total of 42 days from oviposition to adult.

Macapá is located at low elevation and very close to the equator. Temperature and humidity are constantly high and daily variation is much higher than seasonal variation. The absolute minimum temperature is above 20°C. Under these conditions, biological activity is intense and decomposition is fast. Also, the development rate of insects tends to be more uniform and predictable than in temperate regions.

Because *H. illucens* usually colonizes corpses in more advanced stages of decomposition (4), the demise of the victim probably happened a couple of weeks before the estimated date of oviposition; other evidence also indicates that the victim was killed immediately after abduction. However, there are published records of colonization by this species within the first week after death (9) and the third author (AUR, unpublished data) observed *H. illucens* laying eggs on a pig carcass after only 3 days near Manaus, Brazil. Thus, this species may also be present in early stages of decomposition in this region. Further studies on the biology of the black soldier-fly in the Amazon region are necessary to improve its use as a PMI indicator. This is the first record of the use of *H. illucens* in a forensic entomology case in South America.

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