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Research Note

Larval aggregation on a burned human remain

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Abstract. A burned human remain was found outdoor (5º 27' N, 100º 16' E) in Penang Island. The deceased was last seen alive on 23 April 2010 at 2230 h and was found burned on 24 April 2010 at 1920 h. Larval aggregation of second instar *Chrysomya megacephala* was observed on the chest of the deceased.

In Malaysia, blow flies have been reported as primary colonizers of carcasses (Heo *et al.*, 2007 & 2008). As long as a carcass is suitable, blow flies continue to lay eggs and the larval aggregation quickly becomes a mix of sizes, ages and species, augmenting the communal output of heat (Greenberg & Kunich, 2002). These aggregations generate internal heat, presumably through exothermic digestive processes (Slone & Gruner, 2007). O'Flynn (1983) reported that temperature at which the maggots develop in a corpse is often much higher than air temperature and varies according to the state of decomposition and the location within the corpse. Thus, the ambient temperatures surrounding the corpse often do not reflect those to which maggots are exposed and have little relation to the temperatures at which maggots actually develop (Catts & Goff, 1992). The current research note explores the larval aggregation formed on a burned human remain by second instar *Chrysomya megacephala* (Diptera: Calliphoridae).

A 26-year old man was found burned on 24 April 2010 at 1920 h (5º 27' N, 100º 16' E) in Penang Island. The corpse was brought to the Department of Forensic Medicine, Penang Hospital at 0030 h on 25 April 2010 and placed into a morgue cooler at a temperature of 4 ± 2 ºC. Then, the corpse was taken out of the morgue cooler at 1020 hours on the same day and left at room temperature while waiting for an autopsy to be conducted at 1600 hours. The forensic pathologist charted the burn severity as 81.5% burned with partial thickness loss of body surface. The deceased was last seen alive on 23 April 2010 at 2230 h. The entomological specimens were sampled during autopsy. A larval aggregation was noted on the chest of the deceased (Figure 1). The volume of the larval aggregation was 208 cm^3 (16 cm x 13 cm with 1 cm of depth). The temperature of the larval aggregation was 29.2ºC, while the liver temperature of the deceased was 22.2ºC and the room temperature was 21.2ºC. The larvae sampled (40 – 50 larvae) were in second instar (6.5 cm in length) and were reared using beef meat under room temperature (29.3 ± 3.1 ºC). They pupated after 88 hours on the beef and emerged after a further 96 hours. The emerged adults were identified as *C. megacephala* using taxonomic keys provided by Kurashashi (2002). The post-mortem interval was estimated 1.4 ± 0.5 days

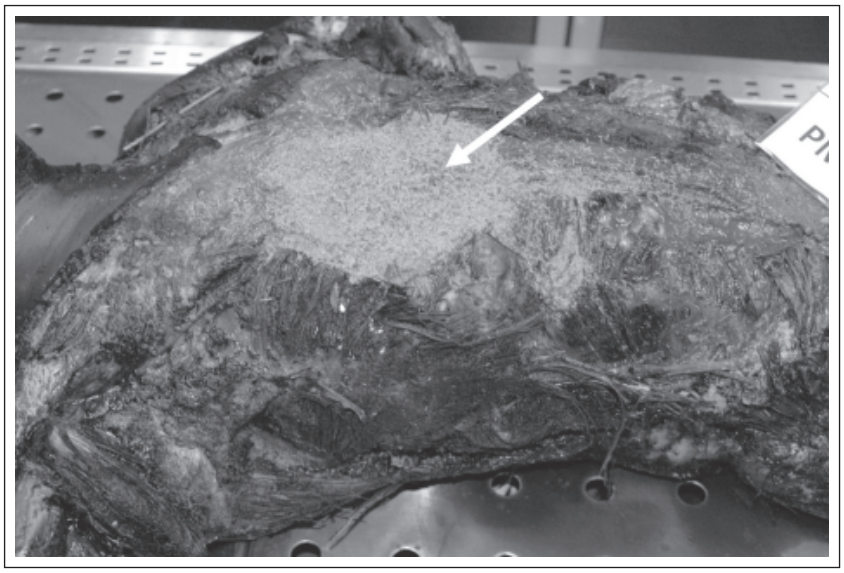

Figure 1. The formation of larval aggregation (white arrow) on the chest of the deceased

based on the larval life cycle study of *C. megacephala* done by Kumara *et al.* (2010) .

The issue regarding the burned body was, was there a delay in oviposition due to the effect of burning? In Malaysia, a succession study conducted by Heo *et al.* (2008) using a partially burned pig carcass and another unburned pig as control found no significant differences in the rate of decomposition or sequence of faunal succession. Similarly, Pai *et al.* (2007) in southern Taiwan burned a pig carcass to simulate a homicide case, and found that *C. megacephala* arrived in 5 minutes and 1st instar larvae and eggs were found 17 hours after exposure. As for the current case study, the body was found within 21 hours after the deceased was last seen alive.

Some researchers, such as Early & Goff (1986) recorded temperatures of 21°C above ambient temperature inside decomposing cat carcasses in Hawaii. Because of the differences in the temperature of the maggot mass and the ambient temperature, the larvae within maggots masses can have development rates different from the rate predicted by ambient temperatures (Slone & Gruner, 2007). Researchers found that when the density of the larval aggregation exceeded 1000 cm^3, the larvae were observed to be moving from the centre of the larval aggregation to the outside and back again, continuously. Some found the formation of larval aggregation only occurred with second and third instars after 48 hours of exposure (using *Phormia regina* larvae) (Joy *et al.*, 2002). Others recorded the temperature of maggot masses as high as 49.3 ± 1.1 °C, when ambient temperature was 32.8 ± 2.8 °C (Richards *et al.*, 2009). In the current case report, the larval aggregation formed by the second instar *C. megacephala* was 8 °C above the ambient temperature. Since the metabolic heat generated by maggot mass can be sufficient to raise their micro-environmental temperature by several degrees above ambient, it is essential to take into consideration the maggot mass temperature in determining insect development. It has been suggested that blow fly maggots may manipulate microhabitat temperature through maggot-generated heat for two reasons. First, to promote rapid growth rates, and second, it can help to dominate competing species in interspecific competition in favourable environmental condition since, difference species have different upper threshold limits (Richards *et al.*, 2009).

It is recommended for future forensic cases that need entomological assessment, that entomological specimens be sampled as soon as possible by an entomologist and if possible at scene of death. In the present case, the delay between the discovery of the body and the eventual collection of larvae allowed for considerable development of the larvae, even in the chilled morgue cooler, which increased the uncertainty of the PMI estimation.

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