



Physical Anthropology Section – 2011

H102 The Relationship Between Ambient Temperature and the Temperature of Maggot Masses on Decomposing Pig and Rabbit Carcasses

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After attending this presentation, attendees will gain an understanding of the effect of maggot mass temperature on the development of Diptera larvae and will be aware of the need for a more accurate measurement of accumulated degree hours (ADH) from Diptera larval development in maggot masses.

This presentation will impact on the forensic science community by outlining the influence ambient and maggot mass temperatures have on Diptera larval development, which will aid in establishing a realistic postmortem interval (PMI) from entomological specimens originating within maggot masses at crime scenes.

Forensic anthropologists often estimate PMI by determining the accumulated degree days (ADD) to which a cadaver has been subject during decomposition. Insect activity is one of the most significant factors affecting the decompositional process. The examination of larval maturation is particularly important, as investigators have previously used the correlation of insect development rates over ADD to obtain an estimation of PMI. Diptera are of a particular forensic importance, as they are among the first insects to colonize a corpse. Temperature has a major influence on the rate of development of Diptera larvae. To date, estimating PMI from Diptera larval development has been proven to be

inaccurate. The heat generated from maggot mass formation accelerates maggot developmental rate, significantly reducing the maturation time, and therefore altering the estimated PMI.

This study was conducted in the North West of England using domestic pigs (*Sus scrofa domestica*) and European rabbits (*Oryctolagus cuniculus*). Two experimental groups, one pig group ($N=6$) and one rabbit group ($N=6$) were left to decompose on a grass surface. When maggot masses formed, a thermal probe connected to a data logger was inserted into a mass on each carcass to record the temperature generated by the maggot activity. A pig control group ($N=3$) and a rabbit control group ($N=3$) were placed outdoors in a cage constructed from a wooden frame and covered in a fine wire mesh, in order to exclude insects and therefore assess the temperature generated by non-insect mediated decomposition processes. The internal body temperatures of the control groups were recorded.

The results demonstrated that the maggot masses were comprised of three species of Diptera, *Calliphora vomitoria*, *Calliphora vicina* and *Protophormia terraenovae*. Oviposition occurred at natural creases at the limbs, in the head, and along the back of the neck in the pig carcasses.

ADD was used to standardize all calculations in order to compare groups. The ADD of the maggot masses in the experimental groups was calculated, as was the ADD of the corresponding internal temperatures in the control groups. The results were statistically analyzed against the ADD of the ambient temperature.

Analysis of the mean daily temperatures in the pig control group compared to mean daily ambient temperatures showed no significant difference (ANOVA, $p=0.07$). This would indicate that any resulting rise in temperature in the experimental pig group over ambient temperature is from maggot mass activity. The increase in the experimental pig group ADD over ambient ADD was 38.5%. An estimation of ADD from larval development, based on the ambient temperature, would have led to an overestimation of PMI by over 13 days in a 6-week period. The difference between ambient ADD and experimental pig ADD for this research can be defined as:

Difference in Ambient ADD Versus Exp. Pig ADD ($^{\circ}\text{C}$) = $(0.0461x + 0.2106)^2$ where $R^2=0.96301$: The rabbit carcasses yielded similar results, with the ADD of the rabbit experimental group showing an increase of 29.4% over the ambient temperature ADD, with no statistical difference between the mean daily ambient temperatures and the control rabbit daily temperatures (ANOVA, $p=0.8$). The difference between ambient ADD and experimental rabbit ADD for this research can be defined as:

Difference in Ambient Versus Exp. Rabbit ADD ($^{\circ}\text{C}$) = $0.4335x - 2.6092$ where $R^2 = 0.99254$: Rabbits were shown to be poor models for this type of research, as it was not feasible to visually examine the maggot masses due to the fur and the maggot masses could not be sustained due to the size of the carcasses.

Investigators must be aware of the ineffectiveness of using previous ADD calculations of Diptera larval development in order to establish a PMI. It is recommended that the investigator should determine the ADD of maggot masses as opposed to ambient ADD when establishing PMI.

Temperature, Maggot Mass, Postmortem Interval