H132 The Applicability of FLIR® Thermal Imaging of Swine Decomposition During the Louisiana Summer

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Learning Overview: After attending this presentation, attendees will have gained insight on the use of thermal imaging in forensic entomology and taphonomic studies. The goal of this presentation is to characterize the thermal sources and effects of external (ambient and carcass surface) and internal heat units (maggot mass heat, carcass tissues) on blow fly development and postmortem estimations. This presentation will illustrate the potential differences between observed thermal heat units and those hypothetically available at Cadaver Decomposition Islands (CDIs).

Impact on the Forensic Science Community: This presentation will impact the forensic science community by demonstrating how the incorporation of FLIR® C2™ thermal imaging can provide real-time documentation of thermal units at CDIs and human remains recovery sites.

Postmortem estimations based on insect evidence are often determined by the summation of thermal units at a crime scene to predict the energy budgets required to complete specific insect life stages present on human remains. Forensic entomology studies have increasingly focused on improvements to accumulated degree day calculations and thermal summation models, with particular emphasis on: (1) biological thresholds for growth; (2) maggot mass metabolic heat; and (3) the curvilinear portion of insect development.[1,2] The aim of this research was to incorporate infrared thermal imaging to field studies of large vertebrate carrion, as well as to illustrate the potential usefulness of FLIR® thermal imaging to both decomposition research and law enforcement communities.

Louisiana has a humid subtropical climate with long, hot, humid summers and short, mildly warm winters.[3,4] Whereas, summer daily ambient temperatures typically exceed 32ºC with carcass temperatures often approaching biological maximums for blow fly development when large maggot masses are present (greater than 50ºC). FLIR® infrared thermal imaging can provide real-time documentation of carcass surface temperatures, as well as areas of elevated internal temperatures due to maggot mass metabolic heat. A preliminary study utilizing infrared imaging as a "non-invasive tool" for documenting maggot mass temperatures on swine carrion in Australia was conducted in 2014.[5] However, those authors briefly studied only one juvenile swine carcass in the field (7d) and one juvenile swine in a temperature-controlled room (9d).

This research was conducted using three fresh adult swine carcasses (~45–60kg each) placed on the ground in a hard-bottom flatwoods forest at Southeastern Louisiana University's Outdoor Classroom in July 2019. Each sampling event included manual sampling of insects, digital photography, and multiple temperature measurements within the CDI. Temperature data included: (1) FLIR® C2™ compact professional thermal imaging system (infrared camera) to document carcass surface temperatures and maggot mass activities within the carcass; (2) dual digit temperature probe for internal carcass temperatures, maggot mass heat, soil-carcass interface, soil and ambient temperatures; and (3) climatology data from Hammond Municipal Airport weather station. Accumulated degree day estimations were calculated for multiple indicator species using both observed thermal units and regional airport climatology data. Earliest blow fly colonizers for all three swine carcasses included: *Chrysomya megacephala* (F.), *Cochyliomyia macellaria* (F.), *Lucilia coeruleiviridis* Macquart, and *Phormia regina* (Meigen).

The FLIR® C2™ infrared camera provided the following for each sampling event: (1) infrared images (isotherms); (2) relative humidity isotherms; and (3) digital photographs for comparisons. All infrared images were analyzed using FLIR® Tools+ Imaging Software (2016). Nine to ten carcass and CDI regions were analyzed per sampling event: mouth (anterior), ear (dorsal head), forelimbs, abdomen, hind limbs, posterior, beneath the carcass, wounds, and adjacent ground/leaf litter (control). Thermal recordings from digital temperature probes were analyzed against the FLIR® output and isotherms were compared for humidity levels. The addition of FLIR® Tools+ output contributed valuable information to the overall understanding of the microenvironment of CDIs and the role of temperature and humidity throughout vertebrate decomposition.

Reference(s):

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2. Roe, A.L. Development modeling of *Lucilia sericata* and *Phormia regina* (Diptera: Calliphoridae). *Dissertations and Theses in Natural Resources.* 2014. 93.
3. Lemus, D.L. 2018. *Characterization of Louisiana winter carrion decomposition using FLIR® thermal imaging and its effects on accumulated degree day estimations.* Thesis, Southeastern Louisiana University, Hammond, LA.
4. Watson, E.J. 2004. *Faunal Succession of Necrophilous Insects Associated with High-Profile Wildlife Carcasses in Louisiana*. Ph.D. Dissertation, Louisiana State University, Baton Rouge, LA.
5. Johnson, A.P. and J.F. Wallman. 2014. Infrared imaging as a non-invasive tool for documenting maggot mass temperatures. *Australian J. For. Sci*. 46(1): 73-79.

***Cochliomyia Macellaria*, Thermal Imaging, Forensic Entomology**

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