A45 A Multidisciplinary Validation Study of Non-Human Animal Models for Forensic Decomposition Research: A Time Series Approach

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After attending this presentation, attendees will better evaluate the validity of pig and rabbit proxies for human decomposition studies, particularly for time-since-death estimation. Attendees will also understand the applicability of time series analysis to decomposition studies.

This presentation will impact the forensic science community by demonstrating whether non-human animal data could be admissible in court when applied to human remains in forensic contexts.

Animal proxies are often utilized in decomposition studies in cases where human remains are unavailable. The most frequent animal subjects found in the literature are pigs, although rabbits, guinea pigs, dogs, and other models have been studied; however, the scientific merit of non-human models for forensic applications, including estimation of the postmortem interval, has never been formally tested.

The goal of this project is to directly compare decomposition data among three species — pigs, humans, and rabbits — in three separate trials that differ by microenvironment and season. Variables which have been documented include insect activity (fly oviposition, the developmental stage of immature insects, fly larval migration, emergence of adult arthropods, and succession), morphological changes of the body, scavenging, and climatic conditions. The results of the first trial are presented here and focus on the comparison of morphological changes over time.

On March 13, 2014, five pigs, five humans, and five rabbits were placed in a previously unused, wooded area of the Anthropological Research Facility at the University of Tennessee, Knoxville. After initial placement, the subjects were photographed twice daily and external signs of decomposition were recorded for 75 days. Total body scores as well as scavenging and insect data were determined for each subject at each observation period.[1] Temperature readings were collected from three data loggers placed approximately 1.5 meters above ground throughout the research area; body core and adjacent soil temperatures were collected as well. Data continued to be collected twice daily until 2,000 Accumulated Degree Hours (ADH) had been reached; data collection then continued once daily, then decreased to every other day until the end of the sampling period on May 27, 2014.

Insect activity and external signs of decomposition during the first trial suggest that the pattern of decay is not identical across species. The rabbits exhibited few external signs of decomposition, then appeared to decompose very rapidly with the onset of larval activity. The pigs and humans were more similar to each other in their rates of decomposition. Both species showed external signs of early decomposition, including color changes and skin slippage. Patterns of insect activity were also more similar between pigs and humans, with multiple distinct maggot masses observed on each subject, as opposed to a single mass observed on each of the rabbits. Humans exhibited greater variability with respect to both visual decomposition changes and insect activity than either pigs or rabbits. In addition, only the human subjects had any evidence of scavenging; this further distinguishes them from the pig and rabbit subjects.

Time series statistics were used to evaluate these observations with an objective, quantitative approach. In the analyses, the average daily temperature data were compared to the average daily total body scores for each species. Dynamic linear regression was chosen to build a model of how total body score changed over time, with the corresponding change in temperature incorporated as an impacting factor. Mean square error was used as a search criterion as this statistic informs whether or not the model is a good fit to the data. Preliminary results of this analysis of each species showed that the temperature data correlated more closely with the total body scores of the humans and pigs than with the rabbits (mean square error 3.68, 3.89, and 6.83, respectively). As with the visual observations, this suggests that the pattern of decomposition differs between the species and, as such, the three groups are not likely to be interchangeable in decomposition research.

Reference:

1. Megyesi MS, Nawrocki SP, Haskell NH. Using accumulated degree-days to estimate the postmortem interval from decomposed human remains. J Forensic Sci 2005;50(3):1-9.

Decomposition, Animal Models, Time Series Analysis