A137 Location, Location, Location: Environmental Variation and Human Decomposition in Knoxville, Tennessee

William D. Cawley, MA, University of Tennessee, Knoxville, TN 37920-2605; Derek A. Boyd, MA, University of Tennessee, Anthropology, Knoxville, TN 37996*

Learning Overview: After attending this presentation, attendees will better understand how environmental variation affects human decomposition at the University of Tennessee Anthropological Research Facility (ARF) in Knoxville, TN.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by investigating a potential confound affecting research within a single microclimate that involves the estimation of the Postmortem Interval (PMI) using human subjects. Attendees will increase competency in understanding how environmental variation affects the rate of decomposition and increase performance by assisting future research designs of human decomposition studies.

The estimation of the PMI *vis-à-vis* gross evaluation of human decomposition is an essential aspect of medicolegal death investigation. Anthropological research often assumes individuals within the same microclimate will display similar rates of decomposition.[1] Underlying past studies is the assumption that minor variations in location within these microclimates have a negligible effect on the rate of human decomposition and that only large-scale climatic differences affect the estimation of the PMI. The ARF is a major center of human decomposition research and has produced studies involving the determination of PMI using gross human decomposition since the 1980s. Expansions to the ARF, now encompassing an area of approximately three acres, have facilitated projects that incorporate PMI estimation using multiple donors located throughout the property. The ARF land consists of multiple zones that vary by soil type, drainage, elevation, ground foliage, tree density, and use rates, making it a valuable study facility for environmental variation in human decomposition.

Image data from the Daily Photo Collection curated by the Forensic Anthropology Center (FAC) that were collected between 2011 and 2019 were analyzed to determine differences in the rate of human decomposition at the ARF. Using Geographic Information System (GIS) data maintained by the FAC, the ARF was divided into four regions using natural and artificial features of the property that affect watershed and elevation. Photographs of donors (n=8 donors, approximately 24 photos per donor) located in each region were examined to retrospectively assign Total Body Scores (TBS) for the date of placement, on day 5, and on day 15.[2] TBS data were recorded for donors placed in these regions according to season of the placement date (total n=128, 8 donors scored per region per season) and evaluated using a Bayesian hierarchical linear model in R to characterize variation in decomposition rates between regions and across seasons.[3] A preliminary model using a sub-sample of donors (n=24) from across three sectors of the ARF (B, E, and G), areas originally allocated by the FAC for daily operations, were scored at day 15 after surface placement in the late summer (July–August). Results show that the modal parameter values describing the affect of region on TBS score probabilistically differs between regions (β_B=-1.49 [95%CrI:-4.97-1.88]; β_E=2.04 [95%CrI:-2.96-6.89]; β_G=2.44 [95%CrI: -2.18-7.27]), suggesting the existence of spatially variable environmental differences in the rate of decomposition within the ARF. Macroscopic differences regarding sun exposure proportion, foliage density, and ground-level vegetation are also explored, given the similarity and differences of these factors between areas.

This proof-of-concept study highlights the need for careful selection of areas for donor placements within microclimates (specifically outdoor research facilities) when designing research involving PMI or gross human decomposition. More broadly, the results of this study point toward the existence of environmental heterogeneity in the extrinsic and intrinsic factors long known to affect rates of decomposition.

Reference(s):

1. Marhoff S.J., Fahey P., Forbes S.L., and Green H. Estimating post-mortem interval using accumulated degree-days and a degree of decomposition index in Australia: a validation study. *Australian Journal of Forensic Sciences* 48 (2016):24-36.
2. Megyesi M.S., Nawrocki S.P., Haskell N.H. Using accumulated degree-days to estimate the postmortem interval from decomposed human remains. *Journal of Forensic Science* 50 (2005):1-9.
3. R Core Team. *R: A language and environment for statistical computing. R Foundation for Statistical Computing*, 2019; http://www.R-project.org.

Human Decomposition, Outdoor Research Facilities, Bayesian Hierarchical Model

*Presenting Author