H98 Seasonal Differences in Soil Chemistry and Biology Impacted by Long-Term Human Decomposition

Lois S. Taylor, MS, University of Tennessee, Knoxville, TN 37996; Allison R. Mason, BS, Univeristy of Tennessee, Knoxville, TN, TN 37996-1937; Ernest C. Bernard, PhD, University of Tennessee, Knoxville, TN 37996-4560; Mary C. Davis, MSc, University of Tennessee, Knoxville, TN 37996; Dawnie W. Steadman, PhD, University of Tennessee, Department of Anthropology, Knoxville, TN 37996; Jennifer M. DeBruyn, PhD, University of Tennessee, Knoxville, TN 37996*

Learning Overview: After attending this presentation, attendees will gain an understanding of patterns in soil chemistry as well as soil microbial and microfaunal community succession resulting from two-year-long human decomposition studies.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by improving understanding of environmental changes that occur during human decomposition in terrestrial environments and how these changes vary seasonally, introducing new indicator organisms, and discussing implications for time-since-death predictions.

Human decomposition creates dynamic biogeochemical hotspots in the soil, resulting in rapid and persistent changes in soil chemistry and biology.[1] Existing studies have largely focused on the period associated with rapid soft tissue loss (i.e., active decay) rather than later time periods; thus, it is not well known to what extent these chemical and biological changes persist. Additionally, little attention has been focused on the impacts on microfaunal members of the soil food web; nematodes in particular are sensitive to environmental disturbances, and they have been proposed as environmental indicators.

The purpose of this study was to perform a long-term, high temporal resolution assessment of changes in soil chemistry in conjunction with microbial and nematode succession beneath decomposing human bodies in order to identify patterns associated with decomposition progression. Six donated human subjects were decomposed on soil at the University of Tennessee Anthropology Research Facility, three in the spring, and three in the winter. Soil sampling consisted of 1cm interfaces and 0–15cm cores from beneath donors. Soil temperature, pH, Electrical Conductivity (EC), Dissolved Oxygen (DO), respiration (CO_2), NH_4^+-N, NO_3^--N, and extracellular enzymes were measured. Nematodes were counted and identified to family and genus level by microscopy.

In both seasonal studies, the introduction of decomposition fluids into the soil was immediately accompanied by lowered pH and elevated NH_4^+-N and CO_2. Interface (0–1cm) samples exhibited the greatest changes, the timing and magnitude of which varied by season. The spring study was marked by the onset of active decay (day 8), accompanied by an immediate increase in EC (mean 969uS cm^{-1}). DO decreased 61% by day 12 during late active decay, concomitant with a peak in NH_4^+-N (mean 6,905µg gdw^{-1}). Respiration peaked on day 27 during early advanced decay (mean 10,134ppm CO_2 day^{-1}). Unexpectedly, nematode abundances remained suppressed until day 58, after which a bloom of bacterial-feeding nematodes was observed (Rhabditidae). Nematode abundances peaked on day 86 at 29,708 nematodes per 100gdw soil. By the end of the one-year study, the disturbance was still evident: no metrics except DO had returned to control values, and nematode community composition remained shifted toward a predominance of bacterial-feeding taxa.

In contrast, donors in the winter study were marked by a lack of bloating and insect activity due to cooler temperatures. By day 55, EC, CO_2, and NH_4^+ peaked at mean values of 926.8uS cm^{-1}, 9,263ppm day^{-1}, and 2,811µg gdw^{-1}, respectively. DO decreased by only 29% by day 75, concomitant with a peak in nematode abundance of 116,248 nematodes per 100gdw soil. Nematode abundances began to increase immediately upon deposition of decomposition products into the soil, and communities were shifted toward both opportunistic bacterial and fungal feeders (Rhabditidae, *Aphelenchoides*).

Taken together, these results show that soils continued to be impacted by decomposition products after a year, and that soil microfauna provide valuable supporting information about the decomposition environment.

Funding for this project was provided by the National Institute of Justice Graduate Research Fellowship in Science, Technology, Engineering and Mathematics (GRF-STEM) to Law School Transparency (LST) (2017-R2-CX-0008).

Reference(s):

1. Keenan, S.W., Emmons, A.L., Taylor, L.S., Phillips, G., Mason, A.R., Mundorff, A.Z., Bernard, E.C., Dovoren, J., DeBruyn, J.M. (2018). Spatial Impacts of a Multi-Individual Grave on Microbial and Microfaunal Communities and Soil Biogeochemistry. *PLoS ONE*. 13(12):e0208845.

Human Decomposition, Nematodes, Soil Chemistry