H106 Modeling Core and Peripheral Processes in Human Decomposition: A Conceptual Framework

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After attending this presentation, attendees will understand the difference between: (1) systemic "core" ecological processes that drive soft tissue decomposition and on which the prediction of the postmortem interval is based; and, (2) more stochastic "peripheral" phenomena that can significantly deflect the modal decomposition process and thus introduce error into the prediction process.

This presentation will impact the forensic science community by encouraging forensic taphonomists to replace their regionally specific decay models with a more systemic perspective that emphasizes the underlying continuity of decay across different ecozones.

The decomposing corpse is a complex mini-ecosystem. Nutrients and raw materials that once sustained the living body become available to a host of micro- and macro-organisms, including bacteria, fungi, molds, and invertebrates. The chemical and biological processes that drive this biomass conversion (autolysis, enzyme activity, bacterial replication, and insect growth) all depend, in part, on temperature. As ambient temperature increases, chemical and biological reactions occur more rapidly. As a result, the corpse releases energy and molecules into the surrounding environment, to be exploited by other organisms. The result of this process is soft tissue decay.

The relationship between temperature and insect growth was well understood by at least the 1940s. Although anthropologists recognized that human decomposition occurs more rapidly in hot environments, historical research focused on defining qualitative "stages" of human decomposition that could be tied only loosely to postmortem intervals. Over a decade ago, the University of Indianapolis began to explore the relationship between accumulated temperature and soft tissue decomposition. In three major studies, accumulated temperature explained 73% to 87% of the observed decomposition.[1-3] Time since death fared worse, explaining only 45% to 65% of the observed variation. Despite being drawn from different regions of the U.S., the three samples display remarkably similar decomposition curves. Each curve has a steep initial portion representing wet decay driven by active insect and bacterial breakdown, followed by a plateau where decay slows considerably and the tissues dehydrate. The curves are so alike that the initial equation describing the cross-sectional human sample requires no further modification when subsequent longitudinal pig and human datasets are applied.[1-3] Seasonal variation slightly alters the slopes of these curves and their plateau points, with cool-weather curves being flatter and hot-weather curves being steeper, but seasonality itself does not seem to change the essential form of the curves.

In these studies, accumulated temperature and the dependent biochemical and metabolic processes emerge as the primary determinants of systematic soft tissue decay. When one accounts for temperature, most if not all of the differences observed in the rate of decomposition in different latitudes and regions disappear. It is useful, then, to treat temperature-dependent organismal and biochemical processes as "core" processes that drive decomposition. Because there is a systematic, mathematical relationship between accumulated temperature and decay, methods for predicting the postmortem interval must rely primarily on these core processes. Tables that attempt to relate observed decay status directly to time intervals without incorporating temperature should be abandoned, and studies purported to display regional differences in decay rates should be re-evaluated if they did not explicitly control for differences in temperature.

Clearly, factors other than temperature and invertebrate necrophagy, such as an abundance or absence of water and vertebrate scavenging, can significantly affect decomposition in specific cases. These factors, however, are qualitatively different from core metabolic processes that vary systematically with temperature. It should be difficult, if not impossible, to quantify the effects of these more stochastic variables in most environments, and it is likely that they vary much more randomly across short distances within ecological zones or geographical regions. At best, postmortem interval predictions can be informed by, but not based on, these "peripheral" processes.

References:

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Decomposition, Temperature, Taphonomy

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