A119 Around the World in Accumulated Degree Days

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After attending this presentation, attendees will better understand how the relationship between Accumulated Degree Days (ADD) and Total Body Score (TBS) can be used to compare and contrast the rate of decomposition across geographic regions around the world.

This presentation will impact the forensic science community by providing results from a controlled experiment conducted simultaneously in five locations in four countries. This presentation will broaden the understanding of how temperature and insects drive the decomposition process, while exploring the effect of local climate and ecosystems.

The vast majority of previously published studies, using either human cadavers or animals, explored specific variables and how these affected the decomposition process; these investigated the effects of individual variables within a single site, with no comparison across different sites. This experiment investigated surface decomposition in five localities in four countries. Research sites included Nakhon Nayok province, Thailand; Ankara, Turkey; Lancashire, England; and Massachusetts and Nebraska in the United States. Average daily temperatures, climatic and geographic conditions, and insect communities varied widely among these sites.

The experiment was initiated in all five localities during the first week of June 2014. Each facility used ten pigs and, with the exception of the Turkish site where pigs were killed by lethal injection, all animals were killed with a captive bolt within one to two hours of being placed at the site. The agreed protocols specified that the pigs should be in the weight range 20kg-40kg in order to minimize body mass differences, as these are known to affect the rate of decomposition.[1] Unfortunately, several sites deviated. Neither Massachusetts nor Nebraska could comply with scavenger proofing and scavenging was observed to some extent at both sites; Nebraska and Thailand clustered at the low end of the specified weight range (21kg and 25kg average weight, respectively), while the other three exceeded the high end (England=43kg; Massachusetts=45kg; Turkey=51kg). As a result of these differences, it is important to note that the data are quite sensitive to the statistical method used and how weight is dealt with within the statistical model.

At all sites, pigs were monitored and observations were recorded approximately every 50 ADD. Observers recorded TBS as well as insect diversity and activity. The pigs were also photographed and scores cross-checked for inter-observer error and internal consistency. Insect taxa were identified by local entomologists working with the observers.

A mixed-effects linear model with TBS as the response variable was used, which took into account the effect of weight as a random variable. The maximum likelihood method was used to produce estimates and their errors. The effects of log10ADD ($F_{1,1086}=18400$, $p<0.0001$) and location ($F_{4,1086}=90.6$, $p<0.0001$) were both significant as was the interaction between log10ADD and location ($F_{4,1086}=224$, $p<0.0001$). The rate of decomposition at different locations was as follows: Nebraska and Massachusetts were similar in rate ($t=1.90$, $df=1087$, $p=0.058$), but different to all others ($t>4.5$, $df=1087$, $p<0.0001$). England was also similar to Massachusetts ($t=1.82$, $df=1087$, $p=0.07$), but different to all others ($t>4.5$, $df=1087$, $p<0.0001$). Turkey and Thailand are also similar ($t=1.61$, $df=1087$, $p=0.11$), but different to all others ($t>13.5$, $df=1087$, $p<0.0001$). The hierarchy in rate was Nebraska > Massachusetts > England >> Thailand > Turkey.

There is much to be considered based on these data, including whether: (1) the rate at which temperature is accrued temperatures (e.g., Massachusetts and Nebraska) affects decomposition rate more than simply the sum of temperatures; (2) the role of fluctuating temperatures affected ADD and insect development; (3) the role of scavenging impacted the unprotected sites; (4) differences in insect communities accounted for varied decomposition rates; and, (5) drug residues in the Turkish animals accounted for slower decomposition.

Reference(s):

1. Simmons T., Adlam R., Moffatt C. Debugging decomposition data – comparative taphonomic studies and the influence of insects and carcass size on decomposition rate. *J Forensic Sci* 2010;55(1):8-13.

Taphonomy, Accumulated Degree Days, Decomposition

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