A59 No Fly Zone: Decomposition in the Absence of Insects

Michael S. Woolf, BS, Virginia Commonwealth University, 6732 Hopton Court, Richmond, VA 23226; Tal Simmons, PhD*, Virginia Commonwealth University, Dept of Forensic Science, 1015 Floyd Avenue, Richmond, VA 23284; and Baneshwar Singh, PhD, Virginia Commonwealth University, Dept of Forensic Science, 1015 Floyd Avenue, Rm 2015, Richmond, VA 23284*

After attending this presentation, attendees will better understand how insects drive the decomposition process when all other variables are held constant.

This presentation will impact the forensic science community by providing results from a controlled experiment which compared decomposition rate and pattern between insect-access and insect-exclusion groups of pigs. These results are compared to previously published work using different animal models.

Although Accumulated Degree Days (ADD) provide a framework for comparing decomposition in disparate regions, temperature is not the sole impetus of decomposition; as many have noted, insects are one of the primary drivers of biomass removal leading to skeletonization. Previously published work compared the process of decomposition in the presence and absence of insects using a combination of previously published, experimental, and retrospective data; the results indicated that the absence of insects (whether achieved through deposition indoors, in burial, or in water) slowed the rate of decomposition in the same manner and regardless of weight.[1]

In this experiment, 12 pigs (*Sus scrofa*) weighing 22kg-32kg, killed by a .22 caliber bullet to the head, were placed in an open field at the Virginia State Police Training Center in Hanover, VA, on June 10, 2015. All pigs were placed individually in scavenger-proof wire cages, 10m apart. Six cages were also enclosed within an outer tent constructed of Polyvinyl Chloride (PVC) pipe overlaid with fine mesh netting to exclude insects. These tents were weighted with sandbags along the bottom edge and could be entered through a zippered opening in one side, the bottom of which was covered with a flap and weighted with another sandbag. To mimic the partial shade provided by the insect exclusion nets, shade cloth was placed on the top of each insect access cage. Temperature onsite was recorded hourly by a datalogger attached to one of the cages. Pigs were observed daily for the first ten days (to 296 ADD), on alternate days for the succeeding two weeks (to 575 ADD), then once a week for two more weeks (to 903 ADD) when the insect-accessed pigs had reached Total Body Score (TBS) of 26-30 on the revised 32-point scale, indicating >50% bone exposure, with mummification and some areas exhibiting greasy bone only.[2] Insects were collected and identified at each visit.

Adult flies from family Calliphoridae (*Phormia regina*, *Lucillia spp.*, and *Cochliomyia macellaria*) and beetles from families Silphidae (*Necrophila americana*, *Necrodes surinamensis*, and *Oiceoptoma novaboracense*) and Staphylinidae (*Creophilus maxillosus*) were observed in large numbers during early decomposition stages (fresh and bloat). Egg masses and larvae were also noted within 24hrs (27 ADD). In addition to those aforementioned species, beetles from family Cleridae (*Necrobia rufipes*) were noted during later decomposition stages (active decay, advanced decay, and dry). Overall, *Phormia regina* and *Creophilus maxillosus* were the most prevalent insect species throughout this study. Peak maggot masses migration occurred between days 7-8 (237 to 267 ADD).

Preliminary linear regression indicates a strong, positive linear relationship between ADD and TBS for the exclusion and access groups with R^2 values of 0.9118 and 0.9118, respectively. Slopes and intercepts for both estimated regression lines are different. The equation for the insect exclusion group is TBS=-15.6760+11.0134 ($\log_{10}$ADD) while the equation for insect access group is TBS=-30.9506+20.9872 ($\log_{10}$ADD). Analysis of Variance (ANOVA) ($p \leq$6.193e-13) and Analysis of Covariance (ANCOVA) ($p \leq$2.2e-16) indicate that the difference in group means and the effect of ADD on TBS are statistically significant. Linear mixed-effects modeling will also be used to assess TBS as the response variable and group assignment (insect access or exclusion) as a random variable.

In conclusion, this study provides further evidence that necrotizing insects function as primary colonizers that accelerate decomposition with a strong, positive linear relationship to ADD. Additionally, this study provides much-needed geographical data for the development of model-based methods for estimation of human Postmortem Interval (PMI).[2]

Reference(s):

1. Simmons T., Adlam R.E., 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.
2. Moffatt C., Simmons T., Lynch-Aird J. A new equation for TBS and ADD: establishing a reliable PMI framework for casework and experimental studies. *J Forensic Sci*, in press.

Taphonomy, Insects, Decomposition

*Presenting Author