A125 Spatial Analysis and Animal Activity: A Taphonomic Study Using Geographic Information Systems (GIS) to Document Animal Modification to Human Bone at Outdoor Crime Scenes

Jessica Yopak, BA, Mercyhurst University, 739 E Grandview Boulevard, Erie, PA 16504; Dennis C. Dirkmaat, PhD, Mercyhurst University, Dept of Applied Forensic Sciences, 501 E 38th Street, Erie, PA 16546; and Luis L. Cabo, MS, Mercyhurst University, Dept of Applied Forensic Sciences, 501 E 38th Street, Erie, PA 16546*

After attending this presentation, attendees will be familiar with the utility of a standardized approach to document and analyze taphonomy on forensic cases using GIS, including its usefulness in answering questions beyond forensic significance.

This presentation will impact the forensic science community by providing an experimentally derived protocol for documenting and answering taphonomic questions concerning outdoor crime scenes and a test of their applicability in order to broaden the community's understanding of scientifically derived answers to taphonomic questions.

Forensic anthropologists are commonly asked to assist with outdoor crime scenes that involve badly decomposed or skeletonized remains. Remains encountered at these scenes are generally exposed to numerous taphonomic agents, especially if the remains were deposited on the surface. Besides environmental variables, such as climate, wind, water, etc., animals are one of the more commonly encountered taphonomic agents. Carnivores are known to chew on remains, not only leaving signature marks on the bones, but also commonly scattering the bones or removing elements from the immediate scene. Rodents gnaw on the skeletal remains and can also move smaller elements. Although general patterns in carnivore and rodent modification have been described, these patterns have not been objectively analyzed.

In this study, GIS was used to analyze rodent and carnivore modification from a total of 51 Mercyhurst University Forensic Anthropology Laboratory (MFAL) forensic cases. The current practices of documenting taphonomic modification of human tissues is typically conducted through photographs and written notes. When collecting data from these cases, all the notes and photographs were standardized into a diagram format using a homunculus jpeg in Adobe® Photoshop® CC. A separate database was created to identify the case type, bone counts, and any information that was known about the Postmortem Interval (PMI). Individual layers representing carnivore modification and rodent modification were saved as jpegs, entered into GIS, and vectorized. The vectors give exact locations and quantities of taphonomic alteration on the skeleton. Density maps of locations of animal activity on the human skeleton were created. All of this was conducted following a prescribed and detailed protocol. For further analysis of these skeletal maps, four categories of modification based on location and animal type were created: epiphyses, diaphyses, rodent, and carnivore. This allowed the specific areas and timing of animal modification to be identified in order to test established taphonomic interpretations found in the forensic literature.

Using location and animal type categories, basic statistics were run on the data. Chi-square (<0.05) tests revealed there was a significant difference between animal gnathic modification location on the bones. With respect to the long bones, carnivores more frequently chewed on epiphyses, while rodents gnawed on diaphyses. For example, carnivore modification of the epiphysis of the humerus was noted 32.6% of the time and the diaphysis only 2.3% of the time. Rodent activity was noted on the fibula epiphyses 17.6% and the diaphysis 41.1% of the time. This provided a test of the accepted pattern in the forensic literature and illustrated through density maps and statistics that the identified patterns of animal modification on the skeleton are accurate: carnivores tend to modify the long bone epiphyses first while the rodents were more active on the diaphysis.[1-3] Additionally, forensic literature PMI interpretations were compared to the new findings. The average PMI for carnivore gnawing to be exhibited in the MFAL cases was 22 months, while the rodents was 76 months. Performing a *t*-test demonstrated that these means were significantly different. When trying to identify a specific timing of gnawing by animal type using logistic regression, no significant relationships were identified. These results are consistent with the accepted sequence of gnawing found in the forensic literature and indicate that carnivores modify remains while they are in an earlier state of decomposition, as compared to rodents.

This protocol used for mapping the animal modification can be expanded to analyze any taphonomic agent that results in physical alteration of skeletal material. If other variables were analyzed using this method, a larger regional expression of taphonomy could be created to better understand what happens at a crime scene from the time remains are deposited to when they are analyzed in a laboratory. A database of taphonomic human skeletal modification could be created in order to aid forensic archaeological recovery efforts and outdoor scene interpretations.

Reference(s):

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3. Lisa Nagaoka. Differential carnivore damage as a potential indicator of resource availability and foraging efficiency. *Journal of Archaeological Method and Theory.* 22 (2015): 828-856.

GIS, Taphonomy, Documentation

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*Presenting Author