H93 Decomposition Variables: A Comparison of Skeletal Remains Recovered After Long-Term Submersion in Florida Aquatic Environments

Katy L. Shepherd, BS, and Heather A. Walsh-Haney, PhD, Florida Gulf Coast University, Division of Justice Studies, 10501 FGCU Boulevard AB3, Fort Myers, FL 33965-6565; Valerie J. Rao, MD, District 4 Medical Examiner's Office, 2100 Jefferson Street, Jacksonville, FL 32206; Khalil S. Wardak, MD, 5301 SW 31st Avenue, Fort Lauderdale, FL 33312; Predrag Bulic, MD, District 7 Office of the Medical Examiner, 1360 Indian Lake Road, Daytona Beach, FL 32124; and Christena Roberts, MD, Office of the Chief Medical Examiner of Virginia, Western District, 6600 Northside High School Road, Roanoke, VA 24019*

The goal of this presentation is to establish baseline data that will serve to determine postmortem submersion intervals from subaqueous death scenes within Florida's waterways.

This presentation will impact the forensic community by providing medical examiner personnel, law enforcement agencies, and anthropologists with resources that will enable them to collect and analyze data concerning taphonomic variables specific to aquatic submersions. The presentation also demonstrates how these data are essential for the estimation of an accurate postmortem submersion interval (PMSI) by presenting several cases involving aquatic submersion.

Subaqueous death scenes pose myriad investigative challenges including the accurate estimation of postmortem submersion interval (PMSI). The forensic standard in subaqueous PMSI has been broadly defined as one week on the ground's surface equals two weeks in the water—no matter the geographic location. Many specific extrinsic- environmental variables, however, are easily identified and data-mined from water management district environmental station websites that can yield relatively more precise estimation of PMSI specific to the geographic area of interest. To this end, both extrinsic environmental and intrinsic *corpus delicti* data were collected and analyzed to create PMSI for several forensic death scenes within Florida's waterways in order to establish a PMSI baseline for the state.

For this study, the extrinsic environmental variables included ambient and water temperature, salinity, pH level, presence or absence of flora and fauna, depth of immersion, subaqueous substrate (e.g., sand, soil, and cement), bacterial content, algal growth, water current speed, and trace mineral content. These data were easily accessed because of the State of Florida's Water Resource Act which requires water management districts (Northwest Florida, Southwest Florida, St. Johns, Suwannee River, and South Florida) to manage and protect water and related natural resources through monthly (sometimes daily) data collection. As such, most of the extrinsic environmental data was obtained through water management districts' websites (http://www.nwfwmd.state.fl.us/, http://www.swfwmd.state.fl.us/, http://sjr.state.fl.us/, http://www.srwmd.state.fl.us/, http://www.sfwmd.gov/). Additional extrinsic variables included the presence or absence of clothing, footwear, and other personal effects, as well as whether the remains were found within vehicles or other human- made structures.

Intrinsic *corpus* variables included the presence and absence of adipocere, location of adipocere, presence or absence of skin and muscle tissue, location of skin and muscle tissue, organ weights, organ histology, and skeletal inventory and analysis of bone integrity (e.g., cortical bone flaking, trabecular bone wasting, etc.).

The study materials came from forensic cases distributed through several counties across the state of Florida, including Broward, Lake, Lee, and Suwannee counties. For each case, the forensic anthropologist conducted osteological analyses of identity, trauma, and time since death and the forensic pathologist conducted his/her own analysis. Three of the victims were discovered within structures, such as vehicles or boats. The submersion intervals ranged from a few days to approximately 30 years. As such, the decomposition observed on the remains varied but provided a taphonomic baseline for PMSI to be created.

Upon analysis, the data culled from the three types of variables (extrinsic environmental, extrinsic *corpus*, and intrinsic *corpus*) were consistent with expected patterns of decomposition. Skeletal inventories demonstrated an expected negative relationship between submersion interval and percentage of body recovered, with the exception of those remains contained within structures. Remains with the shortest postmortem submersion intervals exhibited soft tissue and organ retention, while those with the longest submersion intervals exhibited bone free from soft tissue. Remains displaying extensive adipocere, and thus delayed decomposition, encountered factors conducive to adipocere formation, including neutral or mildly alkaline pH levels and warm temperatures (between 15-30° C), around the time of initial submersion, which was consistent with previous research. Bone that was exposed to adipocere evidenced greatly reduced bone integrity through cortical flaking and trabecular bone wasting. Variables which appeared to greatly impact the rate of decomposition with relation to submersion interval included the following: water temperature, pH level, depth of immersion, presence/absence of clothing, and whether the remains were submerged within a structure (protected from flora, fauna, and water currents).

Therefore, when medical examiners, anthropologists, and law enforcement recover remains after long-term aquatic submersion, the creation of a subaquatic taphonomic baseline is essential to establishing an

 ** Presenting Author*

accurate postmortem submersion interval.

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 ** Presenting Author*