E26 Hyperspectral Remote Sensing: Detection of an Experimental Mass Grave Over Time and at Different Scales in a Temperate Environment

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After attending this presentation, attendees will have a better understanding of hyperspectral remote sensing applications in clandestine mass grave detection at different spatial scales and of its limitations in a temperate ecosystem.

This presentation will impact the forensic science community by offering insights on the temporal changes in spectral reflectance of an experimental mass gravesite and will illustrate the utility of these results for the detection of deep clandestine gravesites to narrow down search areas.

Worldwide events such as war crimes and human rights abuses can result in the death of people who have historically been buried in mass graves. Common methods used for gravesite location, such as witness testimony, geophysical resistivity, magnetometry, or ground penetrating radar, can be time consuming and cover small geographical areas. Novel advances using remotely sensed data and techniques to detect changes in both soils and vegetation characteristics due to cadaver decomposition provide an alternative tool to detect buried remains.[1-3]

The goal of this study is to determine, through the integration of field data, spectrometry, and airborne hyperspectral imagery, how an experimental mass gravesite's surface reflectance changes over time. The study consisted of the establishment of three experiment study sites, at a depth of approximately one meter, in June 2013: one experimental mass gravesite containing 20 pig carcasses (*Sus scrofa*) and disturbed soil; one reference containing only disturbed soil; and one undisturbed control site. To investigate the changes in the spectral reflectance of the experimental mass gravesite and its distinction from the non-gravesites, hyperspectral data was collected at different spatial scales over two growing seasons. Airborne hyperspectral imagery covering the Visible Near Infrared (VNIR) range (376nm to 1,048nm) and the near to shortwave infrared wavelength range (870nm to 2,500nm), was collected over the research area. A full-range spectroradiometer, (350nm to 2,500nm) was used to collect vegetation spectra in the field. In addition, leaf pigmentation (chlorophyll and carotenoids), and soil chemistry (e.g., C, N, Ca, Mg, Na) are used to inform the spectral analyses to differentiate between the gravesite and non-gravesite (disturbance and control).

Preliminary results show that burial depth and site age play an important role in the detectability of a mass gravesite in terms of changes in soil and vegetation. In the early stages of the study, differences in spectral signatures between the gravesite and the non-gravesite are a result of the overall disturbance effects rather than attributed to changes in soil and vegetation characteristics due to cadaver decomposition.

References:

1. Kalacska M., Bell L.S., 2006. *Remote Sensing as a tool for detecting clandestine graves. Canadian Society of Forensic Sciences Journal 39: 1-13.*
2. Kalacska, M., Bell, L.S., Arturo Sanchez-Azofeifa, G., & Caelli, T. 2009. The Application of Remote Sensing for Detecting Mass Graves: An Experimental Animal Case Study from Costa Rica. *Journal of Forensic Sciences*, 54:159-166.
3. Leblanc G., Kalacska M., Soffer R. Detection of Single Graves by Airborne Hyperspectral Imaging. *Forensic Science International*. 2014.

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