D37 Applications of Side Scan Sonar Technology to the Detection of Human Remains in Underwater Environments

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The goal of this presentation is to introduce a baseline data set of acoustic images that illustrate the feasibility of using side scan sonar to detect submerged human skeletal remains in various stages of disarticulation. Preliminary data suggest that the uniformity versus irregularity of the substrate that supports the remains, the configuration of the remains projecting above this substrate, and the presence or absence of associated clothing and personal effects are all significant variables that can affect overall image resolution and therefore the relative utility of this technology in forensic investigations.

This presentation will impact the forensic community and/or humanity by assisting federal, state, and local agencies tasked with locating and processing underwater scenes that contain human skeletal remains in various stages of disarticulation.

Side scan sonar, and other acoustic imaging technologies, have become an increasingly valuable search tool for first responders and law enforcement personnel engaged in locating submerged targets, such as automobiles, downed aircraft, shipwrecks, and even drowning victims (Fish and Carr 1990; Dupras *et al*. 2006). Nearly all acoustic systems fall into the category of passive or active. Side scan sonar is an active system that uses a transducer mounted inside a torpedo-shaped “towfish” to generate and transmit signals through the water column in the form of high frequency acoustic energy bursts. The reflected echoes of these signals are sensed by the transducer and passed along a tow cable to a view screen and recorder where they are translated into a plan image of the floor surface. Objects and other features with a significant profile above the floor may also be detected in these images. When deployed correctly, by an experienced operator, side scan sonar can be used to systematically cover large search areas in a noninvasive manner, identify targets of potential forensic interest, and preserve their depositional integrity prior to a diver reconnaissance survey and/or recovery operation.

Previous studies have shown that there is a general sequence of skeletal disarticulation that follows the disappearance of soft tissue from remains submerged in aqueous environments, provided that they are not rapidly introduced to anoxic or anaerobic conditions (e.g., burial in sediment) prior to the onset of advanced decomposition (Haglund 1993; Sorg *et al*. 1997; Boyle *et al*. 1997; Martin 1999; Haglund and Sorg 2002). Given this information, the key question then becomes: at what point in the disarticulation sequence can side scan sonar no longer be used effectively to determine the presence or absence skeletal remains? And what types of scene formation processes result in remains deposits that are best suited for acoustic imaging? This initial project, which is still ongoing, attempted to image a fully articulated skeleton, a partially disarticulated skeleton, and isolated skeletal elements (both with and without associated clothing and personal effects) using a MarineSonic Neptune Side-Scanning Active Sonar. Each of these experimental scenes were laid out in the same configuration along three different types of seafloor composition—i.e., hard sand, suspended silt over sand, and coral. Preliminary results indicate that skeletal configurations with a significantly exposed horizontal surface area and vertical profile, on a relatively uniform substrate, can be effectively imaged using underwater acoustic technology.

References:

1. Fish, J.P. and H.A. Carr, 1990, *Sound Underwater Images: A Guide to the Generation and Interpretation of Side Scan Sonar Data*. Lower Cape Publishing, Orleans, MA.
2. Dupras, T.L., J.J. Schultz, S.M. Wheeler, and L.J. Williams, 2006, *Forensic Recovery of Human Remains: Archaeological Approaches*. CRC Press, Inc., Boca Raton, FL.
3. Haglund, W.D., 1993, Disappearance of Soft Tissue and the Disarticulation of Human Remains from Aqueous Environments. *Journal of Forensic Sciences* 38 (No. 4): 806-815.
4. Sorg, M.H., J. H. Dearborn, E.I. Monahan, H.F. Ryan, K.G. Sweeney, and E. David, 1997, Forensic Taphonomy in Marine Contexts. In W.D. Haglund and M.H. Sorg (eds.) *Forensic Taphonomy: The Postmortem Fate of Human Remains*. CRC Press, Inc., Boca Raton, FL.
5. Boyle, S., A. Galloway, and R.T. Mason, 1997, Human Aquatic Taphonomy in the Monterey Bay Area. In W.D. Haglund and M.H. Sorg (eds.), *Forensic Taphonomy: The Postmortem Fate of Human Remains*. CRC Press, Inc., Boca Raton, FL.
6. Martin, R.E., 1999, *Taphonomy: A Process Approach*. Cambridge University, Cambridge, UK.
7. Haglund, W.D. and M.H. Sorg, 2002, Human Remains in Water Environments. In W.D. Haglund and M.H. Sorg (eds.), *Advances in Forensic Taphonomy: Method, Theory, and Archaeological*

Perspectives. CRC Press, Inc., Boca Raton, FL.

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