H88 Fluvial Transport of Human Remains in the Sacramento River, California

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After attending this presentation, attendees will gain a better understanding of the dynamics involved in the fluvial transportation of human remains in the Sacramento River. The goals of this presentation are to examine key variables involved in the transport of human remains and to evaluate their influence on decomposition and disarticulation rates.

This presentation will impact the forensic science community by outlining a framework for future predictive modeling for search strategies of river victims.

The fluvial transport of human remains has received significant attention by paleontologists and forensic anthropologists over the past several decades.[1-4] Pioneering work with animal carcasses by Voorhies and with human crania by Boaz and Behrensmeyer have provided a preliminary framework from which to study the movement of human remains in riverine systems.[1,2] In an early forensic application, Dilen used mannikins to simulate the transport of human remains in the Chattahoochee River, Georgia.[3] More recently, Bassett and Manhein have conducted a retrospective examination of Mississippi River cases to establish a predictive model for locating human remains.[4] While fluvial transport rates for human remains have been studied within a few river systems in the eastern United States, no published research exists for the western United States. More importantly, studies must take into account the specific hydrological factors of a particular river, including seasonal variation in water discharge rates. Focusing on the Sacramento River, this project is the first step in the development of a regional river victim database to evaluate rates of fluvial transport.

The Sacramento River is California's largest river, flowing 335 miles north to south from Mount Shasta to the Sacramento-San Joaquin Delta. The annual average river discharge is 350 m^3/sec^{-1}, which derives from both precipitation and snowmelt (USGS). Discharge rates are also controlled by dams, and vary depending on flood and drought conditions. Each year, the river claims many lives, including boating accidents, drownings, and suicides. It is also a common dump site for homicide victims. An understanding of how the dynamics of this fluvial system influence the transportation of human remains can be used to establish a predictive model for narrowing down search parameters for victims who entered the river on known dates (e.g., date missing).

Modeled after Bassett and Manhein's study, data collection for this project involved two broad categories of variables.[4] The first category focuses on variables relating to the biological profile of the river victims, as well as date missing, date found, location and side of river entry and recovery, distance traveled, and the reported cause and manner of death. The second category includes data on river dynamics such as water temperature, depth, bed load, and average rainfall at the time and location of entry and recovery. Collectively, these variables have been shown to have a relationship with transport rates of human remains in different fluvial systems. Data from this study will also be compared with other rivers to explore variation in fluvial transport rates.

As part of this preliminary study, we highlight two case studies of drowning victims that demonstrate long distance fluvial transport of human remains within the Sacramento River. Case #1, an elderly male drowning victim, was transported intact approximately 180 river miles (PMI=7 months). Case #2 also involved an elderly male drowning victim, but only an intact foot (within a shoe) was recovered 46 river miles away from the where he entered the river (PMI=19 months). Using average river discharge rates for these locations, estimated fluvial transport intervals for each case were significantly less than the postmortem interval. Both cases show unusual transport distances, but the reported missing dates for each corresponded to peak discharge rates for 2005 and 2007, respectively. In this study, the hypothesis is tested that long distance fluvial transport is correlated with high discharge rates at the time a victim entered the river. The addition of known death and recovery dates from a large sample of case files from multiple counties, in conjunction with river discharge rates, will permit more precise estimation of transport rates for different sections of the river.

References:

1. Voorhies M. Taphonomy and population dynamics of an early Pliocene vertebrate fauna, Knox County, Nebraska. Laramie, University of Wyoming Contributions to Geology Special Paper, No. 1.
2. Boaz NT, Behrensmeyer AK. Hominid taphonomy: transport of human skeletal parts in an artificial fluviatile environment. Am J Phys Anthrop 1976;45:53-60.
3. Dilen DR. The motion of floating and submerged objects in the Chattahoochee River, Atlanta, GA. J Forensic Sci 1984;29: 1027-1037.
4. Bassett HE, Manhein MH. Fluvial transport of human remains in the lower Mississippi River. J Forensic Sci 2002;47:719-724.

Fluvial Transport, Taphonomy, Forensic Anthropology

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