Scientists identify burned bodies using technique devised for extracting DNA from woolly mammoths, Neanderthals

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Matthew V. Emery, Research Assistant Professor at the Department of Anthropology at Binghamton University, State University of New York, has used a technique to extract ancient DNA to help identify badly burned bodies. Credit: Binghamton University, State University of New York

A technique originally devised to extract DNA from woolly mammoths and other ancient archaeological specimens can be used to potentially identify badly burned human remains, according to a new study from Binghamton University, State University of New York.

The research is published in the *Journal of Forensic Sciences*.

Fire victims may be identified through dental records if the teeth are preserved and such records exist. Frequently, DNA testing is the only way to identify badly burned bodies. Researchers can extract usable DNA from bones subjected to conditions between 200 and 250 degrees Celsius; between 350 and 550 degrees, there is a steep drop-off in the concentration of DNA.

"In effect, there's an inverse correlation: The higher the burn temperature, the less DNA is preserved," explained Binghamton University Research Assistant Professor of Anthropology Matthew Emery, the lead author. "Part of the idea was to look at how DNA degrades systematically across different temperature ranges."

The researchers used two different techniques to extract DNA from the bones and teeth of 27 fire victims from incidents that included house fires, airplane crashes, truck fires and motor vehicle accidents.

One technique was originally devised to extract ancient DNA from Ice Age megafauna and is also used on human remains found in archaeological contexts, such as Neanderthals. The second, known as the total demineralization protocol, was devised by Odile Loreille, a forensic scientist with the FBI and one of the paper's co-authors.

Both were adequate at obtaining data up to the 350-degree mark. Below that temperature, the forensic DNA protocol may be preferable, while the ancient DNA technique allows for the amplification of shorter DNA

fragments, which makes it useful in hotter fires.

The researchers also devised a method to determine the heat of fires by looking at the bone discoloration patterns. Bones subject to temperatures below 200 degrees Celsius are typically well-preserved, while yellow and brown discoloration indicates temperatures between 200 and 300 degrees, and a black or smoked appearance range between 300 and 350 degrees. Bones subject to temperatures between 550 and 600 degrees may appear gray, with temperatures above that leading to a white or calcined appearance.

With this knowledge, forensic scientists can select which bones may be the most appropriate for DNA extraction.

"The whole point of the study is to devise a best practices approach for forensic anthropologists and forensic scientists working in the field," Emery said.

In addition to fire temperature, the type of bone also matters. Long bones—tibia, femur, ulna, and those in your hands and feet—tend to be the best reservoirs because they are thick with a hard exterior that tends to preserve DNA, he explained.

Emery is currently working on another project with Maricopa County burn remains, looking to identify cold-case victims.

"In these cases, the technology wasn't there at the time to identify them," he said. "The same techniques that are used in the field to get DNA from woolly mammoths, we're now using to get DNA from victims in cold cases."

Co-authors include Binghamton University Assistant Professor of Anthropology Laure Spake; Anne Stone, Emery's mentor at Arizona

State University, where he did a postdoctoral fellowship; Katelyn Bolhofner, Jane Buikstra, Suhail Ghafoor, Cyril Versoza, Erin Rawls, and Stevie Winingear from Arizona State; Laura Fulginiti, a forensic anthropologist with the Maricopa County Medical Examiner's Office in Arizona; and Odile Loreille, a forensic scientist with the FBI laboratory.

More information: Matthew V. Emery et al, Targeted enrichment of whole-genome SNPs from highly burned skeletal remains, *Journal of Forensic Sciences* (2024). DOI: 10.1111/1556-4029.15482

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