

To kill mammoths in the Ice Age, people used planted pikes, not throwing spears, researchers say

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Clovis points are distinguishable, in part, due to their distinctive flute or channel

flake scar near the base, as shown in these replicas. UC Berkeley researchers studied how the points functioned as part of a system and were used to bring down megafauna in the Ice Age. Credit: Scott Byram

How did early humans use sharpened rocks to bring down megafauna 13,000 years ago? Did they throw spears tipped with carefully crafted, razor-sharp rocks called Clovis points? Did they surround and jab mammoths and mastodons? Or did they scavenge wounded animals, using Clovis points as a versatile tool to harvest meat and bones for food and supplies?

UC Berkeley archaeologists say the answer might be none of the above.

Instead, researchers say humans may have braced the butt of their pointed spears against the ground and angled the weapon upward in a way that would impale a charging animal. The force would have driven the spear deeper into the predator's body, unleashing a more damaging blow than even the strongest prehistoric hunters would have been capable of on their own.

Drawing upon multiple sources of writings and artwork, a team of Berkeley archaeologists reviewed historical evidence from around the world about people hunting with planted spears.

They also ran the first experimental study of stone weapons that focused on pike hunting techniques, revealing how spears react to the simulated force of an approaching animal. Once the sharpened rock pierced the flesh and activated its engineered mounting system, they say, the spear tip functioned like a modern day hollow-point bullet and could inflict serious wounds to mastodons, bison and saber-toothed cats.

"This ancient Native American design was an amazing innovation in hunting strategies," said Scott Byram, a research associate with Berkeley's Archaeological Research Facility and first-author of [a paper](#) on the topic published in the journal *PLOS ONE*.

"This distinctive Indigenous technology is providing a window into hunting and survival techniques used for millennia throughout much of the world."

The historical review and experiment may help solve a puzzle that has fueled decades of debate in archaeology circles: How did communities in North America actually use [Clovis points](#), which are among the most frequently unearthed items from the Ice Age?

Named for the town of Clovis, New Mexico, where the shaped stones were first recovered nearly a century ago, Clovis points were shaped from rocks, such as chert, flint or jasper.

They range from the size of a person's thumb to that of a midsize iPhone and have a distinct, razor-sharp edge and fluted indentations on both sides of their base. Thousands of them have been recovered across the U.S.—some have even been unearthed within preserved mammoth skeletons.

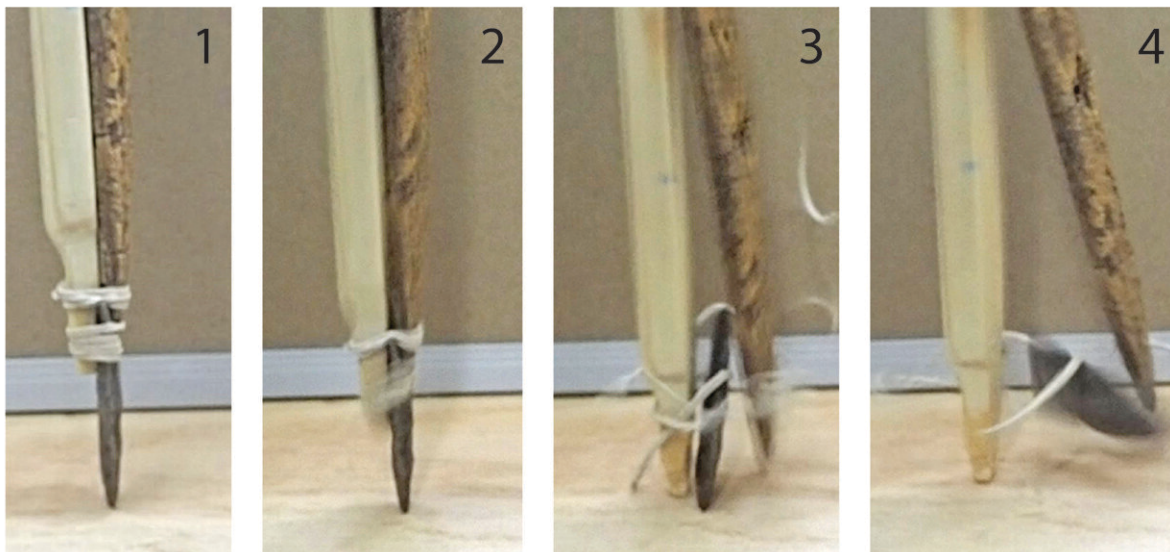
They've also been a pop culture plot point. Characters in the video game "Far Cry Primal" use spears tipped with stone points to ambush mastodons. The movie 10,000 B.C. uses a similar spear to hunt mammoths. Scholars and hobbyists reconstruct Clovis points—and some even document on YouTube the process of building them and using them to hunt bison.

Those depictions make for a good story. But they likely fail to consider the realities of life in the Ice Age, said Byram and his co-author, Jun

Sunseri, a Berkeley associate professor of anthropology.

Clovis points are often the only recovered part of a spear. The intricately designed bone shafts at the end of the weapon are sometimes found, but the wood at the base of the spear and the pine pitch and lacing that help make them function as a complete system have been lost to time.

Plus, research silos limit that kind of system's thinking about prehistoric weaponry, Jun said. And if stone specialists aren't experts in bone, they might not see the full picture.



A high-speed photo sequence during a test after an 11.34 kg weight was dropped from 35 cm shows various moments as the stone point recedes into and splinters the pike shaft. Researchers said the way the stone point could have pierced animal flesh and the wood-and-bone shaft opened up suggests that the spear as a system functioned similar to a hollow-point bullet. Credit: Scott Byram

"You have to look beyond the simple artifact," he said. "One of the things that's key here is that we're looking at this as an engineered system that requires multiple kinds of sub-specialties within our field and other fields."

Building tools as strong, effective systems was likely a priority for communities 13,000 years ago. The tools needed to be resilient. The people had a limited number of suitable rocks to work with while traversing the land. They might go hundreds of miles without access to the right kind of long, straight poles from which to fashion a spear.

So it stands to reason they wouldn't want to risk throwing or destroying their tools without knowing if they'd even land the animal, said Byram, who mined archival records, spanning anthropology to art to Greek history, to trace the arc of planted pikes as weapons.

"People who are doing metal military artifact analysis know all about it because it was used for stopping horses in warfare," Byram said.

"But prior to that, and in other contexts with boar hunting or bear hunting, it wasn't very well known. It's a theme that comes back in literature quite a bit. But for whatever reason, it hasn't been talked about too much in anthropology."

To evaluate their pike hypothesis, the Berkeley team built a test platform measuring the force a spear system could withstand before the point snapped and/or the shaft expanded. Their low-tech, static version of an animal attack using a braced, replica Clovis point spear allowed them to test how different spears reached their breaking points and how the expansion system responded.

It was based on prior experiments where researchers fired stone-tipped spears into clay and ballistics gel—something that might feel like a

pinprick to a 9-ton mammoth.

"The kind of energy that you can generate with the human arm is nothing like the kind of energy generated by a charging animal. It's an order of magnitude different," Jun said. "These spears were engineered to do what they're doing to protect the user."

The experiment put to the test something Byram had mulled for decades. When he was in graduate school and analyzing prehistoric stone tools, he crafted replica Clovis points and fashioned spears using traditional techniques. He remembered thinking how time-intensive a process it was to invest in a stone Clovis point—and how important it would be for the point to function effectively.

"It just started to make sense to me that it actually had a different purpose than some of the other tools," Byram said. "Unlike some of the notched arrowheads, it was a more substantial weapon. And it was probably also used defensively."

Conversations around a campfire early in the pandemic between Jun, a zooarchaeologist who learned from local communities during his time in Africa, and Kent Lightfoot, a Berkeley anthropology professor emeritus, prompted them to dig into the mystery. Through talks with his VhaVenda mentors, Jun learned how the engineering that went into the butt of some spears was just as critical as the work that went into the points.

"The sophisticated Clovis technology that developed independently in North America is testimony to the ingenuity and skills that early Indigenous people employed in their cohabitation of the ancient landscape with now-extinct megafauna," said Lightfoot, a co-author of the study.

In the coming months, the team plans to further test its theory by building something akin to a replica mammoth. Using a type of slide or pendulum, they hope to simulate what an attack might have looked like as a planted Clovis-tipped pike made impact with a massive, fast-moving mammal.

"Sometimes in archaeology, the pieces just start fitting together like they seem to now with Clovis technology, and this puts pike hunting front and center with extinct megafauna," Byram said.

"It opens up a whole new way of looking at how people lived among these incredible animals during much of human history."

More information: Clovis points and foreshafts under braced weapon compression: Modeling Pleistocene megafauna encounters with a lithic pike, *PLoS ONE* (2024). [journals.plos.org/plosone/arti...
journal.pone.0307996](https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0307996)

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