

Giant ground sloths' fossilized teeth reveal their unique roles in the prehistoric ecosystem

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Harlan's ground sloth fossil skeleton excavated and displayed at the La Brea Tar Pits in Los Angeles.

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Imagine a sloth. You probably picture a medium-size, tree-dwelling creature hanging from a branch. Today's sloths – commonly featured on children's backpacks, stationery and lunch boxes – are slow-moving creatures, living inconspicuously in Central American and South American rainforests.

But their gigantic Pleistocene ancestors that inhabited the Americas as far back as 35 million years ago were nothing like the sleepy tree huggers we know today. Giant ground sloths – some weighing thousands of pounds and standing taller than a single-story building – played vital and diverse roles in shaping ecosystems across the Americas, roles that vanished with their loss at the end of the Pleistocene.

In our new study, published in the journal *Biology Letters*, we aimed to reconstruct the diets of two species of giant ground sloths that lived side by side in what's now Southern California. We analyzed remains recovered from the La Brea Tar Pits of what are colloquially termed the Shasta ground sloth (*Nothrotheriops shastensis*) and Harlan's ground sloth (*Paramylodon harlani*). Our work sheds light on the lives of these fascinating creatures and the consequences their extinction in Southern California 13,700 years ago has had on ecosystems.



A two-toed sloth at the Nashville Zoo.

Larisa R. G. DeSantis

Dentin dental challenges

Studying the diets of extinct animals often feels like putting together a jigsaw puzzle with only a portion of the puzzle pieces. Stable isotope analyses have revolutionized how paleoecologists reconstruct the diets of many ancient organisms. By measuring the relative ratios of light and heavy carbon isotopes in tooth enamel, we can figure out what kinds of foods an animal ate – for instance, grasses versus trees or shrubs.

But the teeth of giant ground sloths lack enamel, the highly inorganic and hard outer layer on most animal teeth – including our own. Instead, sloth teeth are made primarily of dentin, a more porous and organic-rich tissue that readily changes its chemical composition with fossilization.

Stable isotope analyses are less dependable in sloths because dentin's chemical composition can be altered postmortem, skewing the isotopic signatures.



Drilling teeth provides a sample for stable isotope analyses.

Aditya Kurre

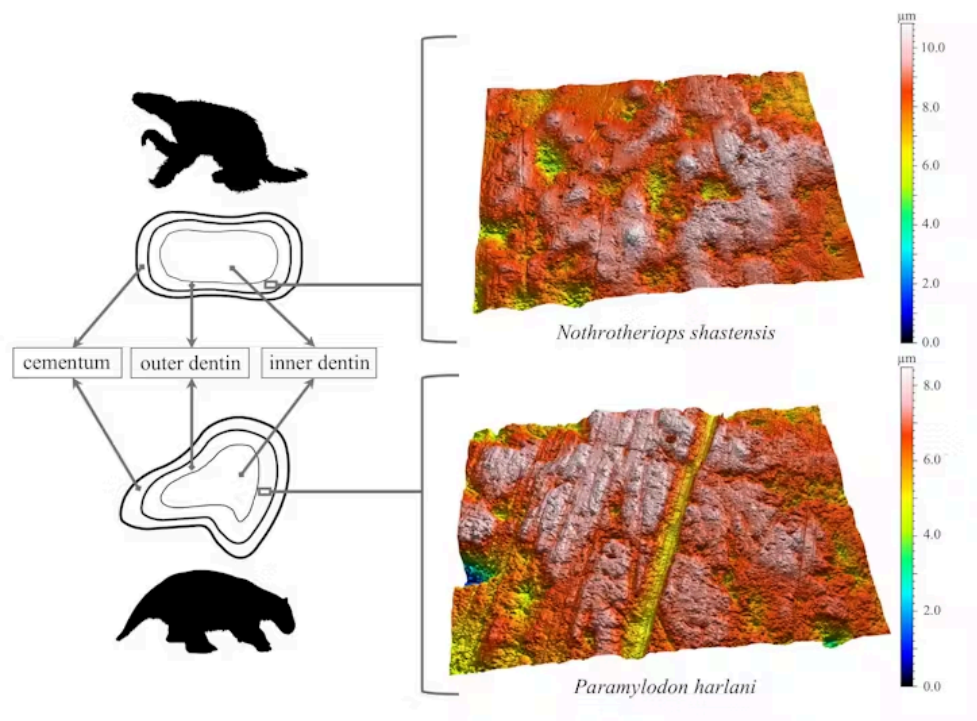
Another technique researchers use to glean information about an animal's diet relies on analyzing the microscopic wear patterns on its teeth. Dental microwear texture analysis can infer whether an animal mostly ate tough foods such as leaves and grass or hard foods such as seeds and fruit pits. This technique is also tricky when it comes to sloths' fossilized teeth because signs of wear may be preserved differently in the softer dentin than in harder enamel.

Prior to studying fossil sloths, we vetted dental microwear methods in modern xenarthrans, a group of animals that includes sloths, armadillos and anteaters. This study demonstrated that dentin microwear can reveal dietary differences between leaf-eating sloths and insect-consuming armadillos, giving us confidence that these tools could reveal dietary information from ground sloth fossils.

Distinct dietary niches revealed

Previous research suggested that giant ground sloths were either grass-eating grazers or leaf-eating browsers, based on the size and shape of their teeth. However, more direct measures of diet – such as stable isotopes or dental microwear – were often lacking.

Our new analyses revealed contrasting dental wear signatures between the two co-occurring ground sloth species. The Harlan’s ground sloth, the larger of the two, had microwear patterns dominated by deep pitlike textures. This kind of wear is indicative of chewing hard, mechanically challenging foods such as tubers, seeds, fungi and fruit pits. Our new evidence aligns with skeletal adaptations that suggest powerful digging abilities, consistent with foraging foods both above and below ground.



The fossil teeth of the Harlan’s ground sloth typically showed deeper pitlike textures, bottom, while the Shasta ground sloth teeth had shallower wear patterns, top.

DeSantis and Kurre, Biology Letters 2025

In contrast, the Shasta ground sloth exhibited dental microwear textures more akin to those in leaf-eating and woody plant-eating herbivores. This pattern corroborates previous studies of its fossilized dung, demonstrating a diet rich in desert plants such as yucca, agave and saltbush.

Next we compared the sloths' microwear textures to those of ungulates such as camels, horses and bison that lived in the same region of Southern California. We confirmed that neither sloth species' dietary behavior overlapped fully with other herbivores. Giant ground sloths didn't perform the same ecological functions as the other herbivores that shared their landscape. Instead, both ground sloths partitioned their niches and played complementary ecological roles.

Extinctions brought ecological loss

The Harlan's ground sloth was a megafaunal ecosystem engineer. It excavated soil and foraged underground, thereby affecting soil structure and nutrient cycling, even dispersing seed and fungal spores over wide areas. Anecdotal evidence suggests that some anachronistic fruits – such as the weird, bumpy-textured and softball-size Osage orange – were dispersed by ancient megafauna such as giant ground sloths. When the Pleistocene megafauna went extinct, the loss contributed to the regional restriction of these plants, since no one was around to spread their seeds.

The broader consequence is clear: Megafaunal extinctions erased critical ecosystem engineers, triggering cascading ecological changes that continue to affect habitat resilience today. Our results resonate with growing evidence that preserving today's living large herbivores and understanding the diversity of their ecological niches is crucial for conserving functional ecosystems.

Studying the teeth of lost giant ground sloths has illuminated not only their diets but also the enduring ecological legacies of their extinction. Today's sloths, though charming, only hint at the profound environmental influence of their prehistoric relatives – giants that shaped landscapes in ways we are only beginning to appreciate.

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