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Elephants continue to shape the savanna even after death

Elephants shape the African savanna. They consume huge amounts of forage, dig for water, topple trees and undoubtedly affect all the animals around them. So, what happens to their outsized presence after these iconic animals pass away?

That's the question posed by an international team of researchers who studied the sites of elephant carcasses in South Africa's Kruger National Park. The scientists documented soil chemistry, microbiology, biodiversity and animal grazing around elephant remains. They discovered that decomposition creates nutrient hotspots that can persist on the landscape for years, possibly decades. This flush of nutrients fuels microbial activity and plant vigor, which attracts herbivores to the site long after the visual signs of the elephant have disappeared. Ironically, this same cascade that energizes plants and soil microbes actually reduces their diversity.

"We know that these really charismatic megafauna have strong impacts on ecosystems while they're alive, but until now we haven't really understood how those impacts continue after they die," said former UC Santa Barbara postdoc [Courtney Reed](#), lead author of the [paper](#) published in the Proceedings of the National Academy of Sciences.

The passing of Alexander

In 2009, one of Kruger National Park's great tuskers — a large, lone bull elephant called Alexander — died of natural causes. His body lay just off one of the main roads that senior author Dave Thompson frequently traveled on for another project. "Watching the decomposition of that carcass over just a couple of months, got me curious," recalled Thompson, a biodiversity scientist at the South African Environmental Observation Network. He shared his observations with his colleague, UC Santa Barbara's [Deron Burkepile](#), and the two gradually developed ideas and hypotheses about the carcass's effect on the soil, possible knock-on effects across the food web and how these might change over the years.

Early explorations quickly revealed how dynamic these carcass sites truly are. Soon the pair were enlisting the help of Kruger's rangers to find sites and applying for grants to study the phenomenon in earnest.

An elephant's legacy

When a large animal dies, it immediately alters the spot where it falls. "At first, the elephant carcass just wipes out all the biomass at the center," said Reed, now at Princeton, "leaving these huge bare spots." The animal's immense size flattens vegetation, and the activity from throngs of scavengers scrapes the surrounding ground bare.

"It essentially resets the plant communities to zero," explained senior author Burkepile, a professor of ecology, evolution and marine biology.

"My intuition was that, since the carcass was only physically present for a relatively short period, its effect would also be rather muted and transient," added co-author Izak Smit, a senior scientist at South African National Parks. "However, a very different picture emerged when the lab results came back."

Nutrients from elephant remains percolate into the ground, affecting the soil chemistry and microbial community. And these effects rise back above ground to influence plant growth and the animals that graze there. Reed had suspected that nutrient levels might be higher under a carcass, but the magnitude was jaw dropping. "At really fresh carcass sites, soil nitrogen concentrations can be up to 3,000 times higher," she said. "That's just insane."

“That amount of ammonium was not on my bingo card,” added co-author Tercia Midzi, a senior manager in scientific services in Kruger National Park.

However, the spike in nutrients doesn’t initially promote regrowth. Rather than acting like a bag of Miracle-Gro spilled on a lawn, the influx of compounds like ammonium causes nutrient toxicity, initially preventing plants from growing back

Meanwhile, the flood of nutrients also impacts the soil microbiome. “Microbes at the elephant carcass, they're sprinting,” Burkepile said. “Their metabolism's cranking.” But while activity was up, diversity was down, likely because just a few, fast-growing species had become dominant.

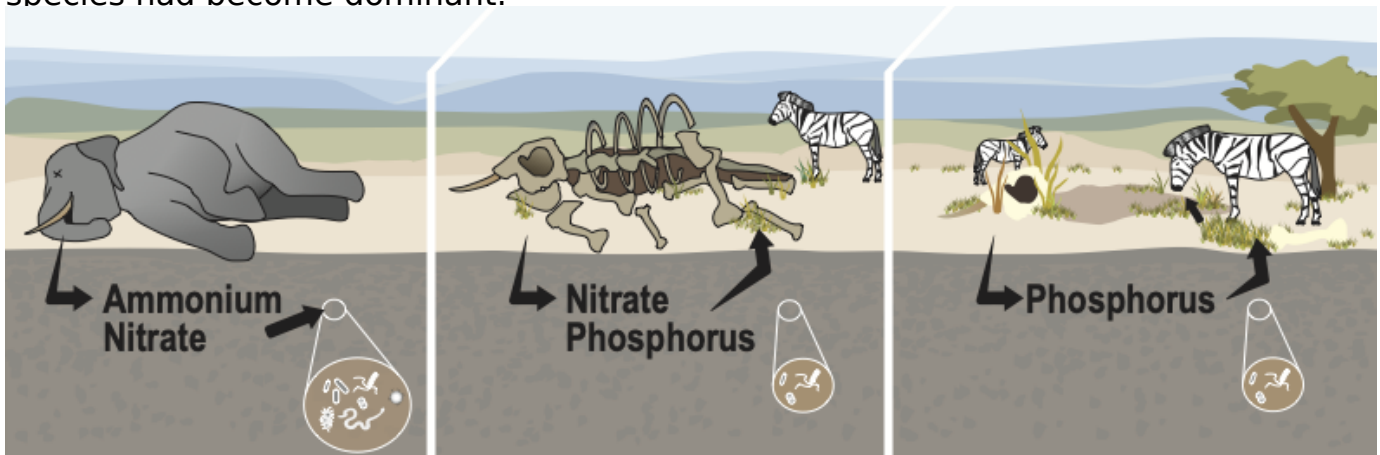


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Kirsten Boeh

The nutrient dump from a mega-carcass permeates the local ecosystem, affecting soil chemistry, microbial and plants communities, and animal behavior.

Once the soil chemistry mellowed a bit, the plant community followed a similar pattern. The team once again saw a biodiversity coldspot dominated by just a handful of fast-growing species, a trend that persisted for at least 8 years after an elephant’s death.

The plants that are able to colonize the site are especially nutritious, though, based on assays of grass leaves. “It turns these grasses from watery iceberg lettuce into a juicy romaine,” Burkepile said. “Those plants are probably growing faster, but the herbivores are just mowing them down because they want to get at that nutrient-rich forage.” Grazers continued to revisit carcass sites for years, and their manure further enriched these areas, keeping nutrient levels in the soil high.

The team put up fenced exclosures to keep herbivores at bay so they can investigate regrowth rates at carcass sites. They hope to publish the results from that experiment in the coming year.

New insights spark new questions

Burkepile believes that savannas may sit in a Goldilocks zone where these carcasses have a particularly strong impact. In more dynamic ecosystems, like forests or wetlands, the effect may be short-lived as nutrients are leached out of the topsoil and washed away by lots of rain. Meanwhile, deserts may be too water-limited to see the full effect because microbes and plants need moisture to take advantage of nutrients from the carcass. The team is seeking collaborators in areas of sub-Saharan Africa to test these hypotheses, and intends to continue surveying the sites in Kruger National Park to build up a time series of data for a longitudinal study.

The team also plans to look into the effect of extreme weather conditions on the processes that play out around mega-carcasses. Kruger experienced exceptionally high rainfall this past year, and the 2026–27 El Niño promises to dry the region considerably this coming year. Both floods and drought can affect where nutrients end up, allowing them to percolate into the ground, washing them away, or preventing anything from growing at all.

Hotbeds of ecological activity

Reed and Burkepile compare the elephant carcasses to whale falls: the remains of giant whales that sink to the seabed and trigger an explosion of activity and productivity. “Honestly, I was expecting it to operate really similarly to a whale fall,” Burkepile said. “You have this big pulse of nutrients that can create these unique islands of ecosystem processes and biodiversity.”

But the abyssal plane isn’t the African savanna. “The deep sea is essentially a food desert,” he said. “It’s so low in nutrients, so low in energy that those whale carcasses attract organisms from all over.” In contrast, Kruger National Park is reasonably fertile, so the nutrient dump from an elephant carcass creates a hotspot that is so intense that it actually suppresses microbial and plant diversity.

Processes also happen much faster under the African sun than in the icy ocean depths. While parts of a whale carcass can persist for decades, “even for a huge animal like an elephant, the meat and the bones can disappear within a couple of weeks,” Burkepile said.

Whale falls were first studied by scientists in the late 1970s, however research on terrestrial mega-carcasses is still relatively new. Most studies on the topic have come out within the past five years, the authors explained, and none have looked at



Photo Credit

NOAA

A Whale fall is a windfall for creatures in the deep sea, which is mostly a barren, featureless expanse. The remains of these ocean giants can support a thriving community for over a decade.

“When we got started, we didn’t know how the carcass of a 4-tonne elephant would impact its environment,” Thompson said. “Nothing of that magnitude had been studied in a terrestrial system.”

Over fifteen years, the project evolved from two curious scientists armed with clipboards to an interdisciplinary team funded by the National Science Foundation with expertise spanning many levels of ecological organization — from microbes and soils through plants, herbivores and predators to whole ecosystems — and

extending into social science, conservation management, communication and creative media.

The team has come to encompass students, young academics and seasoned professors. It even includes individuals from the creative arts who helped translate the research into engaging outputs, including a documentary, Midzi explained. “And the rangers have been instrumental, as they are the ones who keep records of elephant mortalities in the park and could direct us to carcasses of various ages,” she said.

An elephant’s long legacy

The team was surprised by just how enduring the impacts of an elephant carcass site were. “We found that even around eight years after an elephant had died, the ‘signal’ was still present in the soil and vegetation, and herbivores were still preferentially visiting those areas,” Smit said.

Grazing and nitrogen levels in grasses didn’t show any decline, even at the oldest sites the researchers visited — around eight years postmortem. Meanwhile, the lower microbial and plant diversity still hadn’t rebounded in that time.

“It was such a powerful reminder that what we see in nature is often shaped by legacies from the past,” Smit said, “even when the causes of those legacies have long since disappeared from view.”

Elephants and their kin were present over large landscapes across most of the continents until just a few short millennia ago. And these leviathans would’ve lived, and died, alongside other megafauna. This study reveals that it’s not merely the effect of these living animals that has been lost, but also their impacts after death.

“We can only speculate on what this may mean for ecosystems where these mega-herbivores are now missing,” Smit said, “but our Kruger mega-carcass study does make one ask and wonder about those questions more seriously.”

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