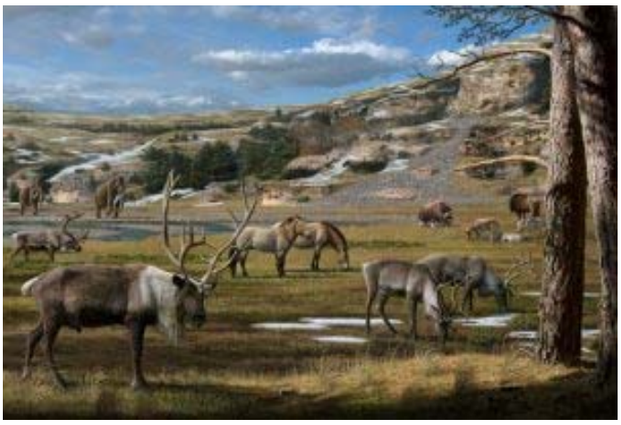
Ancient Arctic mystery solved: What did a woolly rhino do for food? New study has ‘profound’ answers

Forbs, flowering plants, were the food of choice for woolly mammoths, woolly rhinos, horses and bison until the last glacial maximum, new research shows



Artist's rendering of the Pleistocene Arctic landscape, including mammoth, horse, reindeer, bison and musk ox.

Until they went extinct approximately 10,000 years ago, woolly rhinos, woolly mammoths, horses, bison and even camels roamed the Arctic. That much is clear from the frozen and fossilized remains they left behind.

But what did all these ancient megafauna eat? Until now, scientists argued they subsisted primarily on grasses, rushes and other plants that left a whack of pollen in the geologic record.

New research published in this week’s issue of the journal Nature challenges that. By using groundbreaking genetic analysis to read DNA fragments in permafrost, and by supplementing that information with megafauna stomach contents and coprolites — fossilized poop — the research team concluded that from 50,000 to 10,000 years ago, Arctic vegetation was dominated by a type of flowering plant called forbs.

Modern forbs include daisies, poppies and dandelions.

“I sort of picture — what’s that movie with Julie Andrews? The Sound of Music? But just with mammoths,” said Duane Froese, an earth scientist at the University of Alberta who is a co-author on the Nature paper.

Froese is obviously kidding. But the research does recast the accepted picture of the ancient Arctic, suggesting it was a much richer, more biodiverse habitat than previously expected.

“You go up there today, and sure, you see poppies, you see Arctic willows and grasses and sedges and mosses and things. But the diversity is quite low, and so is the diversity of large mammals,” said David Greenwood, a paleobotanist at Brandon University who was not involved in the research.

“But of course back then, 50,000 years ago, you had woolly mammoth, woolly rhinos, camels, horses, bison. That was the problem. How did you support this diversity of large mammals? They’ve very neatly and I think elegantly given us some very profound answers.”

One limitation of previous research was that scientists had relied on preserved pollen. Pollen can be very useful, but it can also skew the results, says Eske Willerslev, lead author on the new study and director of the Centre for GeoGenetics at the University of Copenhagen.

Some plants “produce a lot of pollen, even though they might not be super abundant in the ecosystem. They’re kind of swamping everything else,” he said. Likewise, pollen can drift in from very far away, polluting the record. “For those reasons, there have been a lot of controversies surrounding the question of Arctic vegetation through time.”

Scientists have supplemented pollen analyses with plant fossils, but again, that skews the picture towards plants that are hardy and fossilize well and are readily identifiable by their stalks or flowers.

Instead, Willerslev and his team used a novel type of genetic analysis called DNA metabarcoding.

They drilled 242 permafrost samples from 21 Arctic sites, including several dozen collected by Froese’s team in the Yukon and Alaska, some from old Klondike mining cuts. Those samples were spiked with a special bacterial stain and carefully transported back to the laboratory, where they were analyzed for tiny DNA fragments.

DNA metabarcoding is unique in that it can analyze a huge range of genetic material, even if the DNA is heavily degraded. And unlike pollen analysis, it can identify different types of vegetation in the permafrost down to the species level.

Their analysis produced a totally different result than pollen studies, which had emphasized the role of graminoids — rushes, grasses and sedges. Graminoids are self-pollinating and produce a lot of pollen. Forbs, which are pollinated by insects and don’t need to produce as much pollen, hadn’t featured much.

Even Froese was surprised to see how often forbs turned up in this new analysis.

“It wasn’t just a few samples that were telling us that, it was again and again and again,” he says. The team also probed DNA fragments in the stomach contents and preserved poop, or coprolites, of eight ancient woolly mammoths, woolly rhinos, bison and horses. Again, the majority of those eight samples were dominated by forbs.

Forbs are much higher in protein and easier to digest than grasses. So their dominance could help explain how so many unique megafauna were sustained in the Arctic — and also perhaps why they died out. After about 10,000 years ago, the new study found, the type of vegetation in the Arctic shifted rapidly, and diversity fell to the levels seen today.

“This is a brilliant piece of detective work,” said Greg Henry, a professor of biogeography at the University of British Columbia who was not involved in the study.

“The authors have shown that these new tools can provide evidence at levels of detail we have not been able to achieve before. With further studies like this, we may well come closer to understanding why we don’t have mammoths, mastodons and rhinos in the Arctic today.”

By: Kate Allen Science and Technology reporter, Wed Feb 05 2014

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