

Woolly mammoth diet mystery solved by DNA analysis

Nutritious veggies, not just grass, covered ice age Arctic, study finds

By Emily Chung, [CBC News](#) Posted: Feb 05, 2014 1:00 PM ET Last Updated: Feb 05, 2014 2:37 PM ET



Huge mammals including mammoth, horse, reindeer, bison and musk ox roamed the Arctic during the Ice Age. (Mauricio Anton)

What did giant mammals like woolly mammoths eat when they roamed the Arctic during the last ice age? A DNA analysis has solved that mystery and helps explain the rise and fall of giant mammals.

Up until now, the diet of mammoths and other large herbivores that grazed in the Arctic 15,000 to 50,000 years ago has been a bit of a puzzle, according to Grant Zazula, a paleontologist with the Yukon government who co-authored the study published Wednesday online in the journal *Nature*.

That's because scientists had previously analyzed ancient pollen and concluded that there wasn't much vegetation in the Arctic during the ice age, just a small amount of grass.

Meanwhile, paleontologists were uncovering the bones of ice age woolly rhinos, horses, and bison that would have needed generous amounts of food to keep their massive bodies fuelled up.

"The paleontologists at the time asked, 'well, if we have all these animals around, what are they eating?'" Zazula recalled.

Previously, evidence from fossil pollen suggested there was grass and not much else for big mammals like woolly mammoths to eat. Scientists were puzzled about how such massive animals survived. (Flying Puffin/Wikimedia Commons)

"And the fossil pollen researchers were saying, 'Well, there's really very little for them to eat.'"

Now, an international team led by Eske Willerslev, director of the Centre for Geogenetics at the Natural History Museum of Denmark, has come up with a vastly different picture of what the ice age Arctic looked like – and what kind of food was available.

By analyzing the DNA of plants preserved in the permafrost during the ice age, the team concluded that the Arctic landscape was not a bleak, grassy prairie at all, but had a lush cover of small, nutritious plants called forbs – "things like poppies and buttercups and anemones, little flowering plants," said Zazula.

"And those might have been more high in proteins and other nutrients that were very important to sustaining the populations of large mammals."

Forbs include many plants that humans eat, including dandelion, sunflower, alfalfa, watercress, parsley and carrot.

This mammoth tusk was extracted from ice deposits along the Logata River in Russia. DNA analysis was performed on the stomach contents of some well-preserved remains of Ice Age mammoths, woolly rhinos and horses. (Per Moller/Johanna Anjar)

The ice age Arctic was very cold and dry and probably dusty – extremely different from

today's swampy tundra, Zazula said. It was far more like mountaintop environments where small flowering plants thrive today.

Zazula and Duane Froese at the University of Alberta helped drill permafrost samples in the Yukon and Alaska, while other scientists collected samples in other parts of the Arctic – over 200 in all.

Radiocarbon dating was used to determine how old different parts of the samples were. The DNA found inside was then compared to the DNA of known plants.

"Even if there are plants that aren't around today, there's close enough living relatives that you can figure out what family it's from," Zazula said.

Ancient stomach contents analyzed

The researchers also analyzed the stomach contents of well preserved carcasses of mammoths, woolly rhinos and ancient horses, as well as preserved feces. Those contained a similar variety of plants to the ones in the permafrost – mostly forbs.

is one of more than 200 permafrost cores containing DNA from Ice Age plants that was analyzed in the study. Cores from Alaska and Yukon were collected by Canadian scientists Grant Zazula and Duane Froese. (Ross MacPhee)

Froese said those had been barely detected before because those plants don't produce much pollen.

The DNA analysis also showed that the vegetation changed dramatically around 10,000 years ago, when the Arctic grew warmer and wetter, giving rise to the tundra

we know today, dominated by grasses and woody plants.

"Most of the evidence we've been able to see is these large mammals disappear almost at the same time these vegetation changes were taking place," Froese said.

Meanwhile, there was a population explosion of animals that adapted to eating woody plants, such as moose, elk and caribou. Froese thinks they likely out-competed mammoths, rhinos and horses.

He added that the dramatic changes in climate, vegetation and the dominant large mammals in the Arctic at that time only took a few hundred years.

Dramatic changes in the climate of the Arctic are also happening today, and the findings of the new research may foreshadow changes that today's climate change could bring about, Froese suggests.

"It's just more evidence for just how sensitive environment is and how quickly these changes can happen."