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Ice Age Bison Decline Not Due to Hunting, Study Says

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for National Geographic News

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Climate and environmental change, not human hunters, forced the extinction of mammoths, saber-toothed cats, and many other large creatures that once roamed Siberia, Alaska, and Canada, a new study suggests.

Scientists say the changes also spurred the near obliteration of massive herds of bison that once thundered through the region of Beringia about 37,000 years ago. A land bridge formed during the last ice age, Beringia joined Asia to Alaska and northwestern Canada.

"This research shows it wasn't humans that instigated the loss of diversity," said Beth Shapiro, an evolutionary biologist at England's Oxford University. Shapiro led the study, which appeared last week in the journal *Science*.

Previous studies have suggested that early humans hunted mammoths, saber-toothed cats, and other large mammals to extinction and triggered the decline of bison herds. A basis of the theory is the belief that the ancient animal die-offs coincided with the migration of the first large human populations into North America.

Since the fossils of many of these animals are scarce, Shapiro and her team are attempting to infer the larger story of these animals from ancient bison fossils.

By analyzing the DNA from 442 bison fossils found in North America, Siberia, and China and preserved in museums around the world, Shapiro and her colleagues created a picture of how bison populations have changed over time.

According to the researchers' DNA analysis, bison populations surged and then inexplicably began to crash about 37,000 years ago.

The researchers say that whatever drove changes in bison populations also likely drove changes in the populations of other large mammals such as mammoths, short-faced bears, and saber-toothed cats.

Humans began their massive migration across the Beringia land bridge about 12,500 years ago, according to one theory (see related article)—well after the bison decline and large mammal extinctions began.

Shapiro said the DNA analysis shows that the arrival of large human populations in North America was not the factor that initiated the animals' extinction.

"It could be that humans turned up just at the wrong time," Shapiro said. "The big mammals were so stressed from ecological changes that the influence of humans may have been what actually pushed them over the edge."

David Meltzer, an archaeologist at Southern Methodist University in Dallas, Texas, said the study is fascinating because it provides a first look at the history of ancient bison populations.

"If we have evidence bison populations were going through bottlenecks, there isn't any reason mastodons, camels, horses, and all the other critters weren't also experiencing similar [disturbances] in their populations," he said.

DNA Analysis

Shapiro, the study author, said that relying on the mere abundance of fossils to estimate ancient animal populations is inaccurate, because bones are better preserved under certain environmental conditions than others.

A lack of fossils could mean a population was extinct or rare, she said. Or it could mean that geological conditions were not good for preserving bones.

Comparing bison genes from ancient herds throughout Beringia enabled Shapiro and her colleagues to draw a diagram, or tree, of how the populations were related. A statistical model, based on what are known as coalescence events, allowed the researchers to make inferences about population size.

A coalescence event is an instance when two genetic lineages, or branches, come together and share a common ancestor, Shapiro said. These are more likely to occur when populations are small. The frequency of coalescence events determines the shape of the tree.

"One way to think about it is to imagine sampling two people from a small village and two people from a large city like London," Shapiro said, noting that a diagram relating the pairs will likely show that the two village residents share a common ancestor more recently than the two Londoners.

In the case of the ancient bison, the researchers divided the animal's tree up into periods of time. They then estimated the shape of the tree in each time period and used the tree shape to estimate what the bison population looked like over time.

"We repeated this process for 27,000 of the trees that best describe the relationships among bison and came up with a picture that the population was increasing to a point and then begins to crash," Shapiro said.

Population Crash

Shapiro and her colleagues are unclear why the bison populations suddenly plummeted. But they believe the decline coincides with a time of environmental and climate change that immediately preceded the last North American ice age.

At the time some areas of vast grasslands converted to forests, which were more difficult for bison to move through and forage in. Further analysis of the climate and environmental record may reveal the forces that ultimately drove the mammals' decline, Shapiro said.

What is clear, according to Shapiro, is that the decline began long before the arrival of large human populations. "We are not arguing that humans had no effect. We are arguing that humans didn't start it," she said.

Migration Patterns

In addition to extinction insights, the bison DNA analysis also allowed Shapiro and her colleagues to reconstruct how herds from Siberia, Alaska, Canada, and the lower U.S. moved around and interacted through time.

Previous research indicates that the first bison came from Asia, moved into North America, and diversified. The new DNA analysis adds to that picture, suggesting that these North American bison later dispersed back to Siberia and replaced the bison that were there about 140,000 years ago.

Until the peak of the last ice age about 22,000 years ago, bison roamed freely across Siberia, much of North America, and south to Mexico. Then the climate began to cool. Ice sheets moved across North America. By 22,000 years ago the ice formed a geographic barrier that prevented bison herds of Beringia and central North American from mixing.

After the glaciers receded, creating what is known as the ice-free corridor, humans may have moved through the corridor toward central North America. Previously, researchers believed the bison living in North America today descended from herds that moved south through the ice-free corridor at the same time early humans migrated.

Shapiro and her colleagues found, however, that forest cover and peat swamps prevented the Beringian bison from moving south. "The modern bison, both the wood and plains bison, are descended from the maternal lineage of bison that were already present south of the ice sheets when the glaciers formed," Shapiro said.

Today the wood and plains bison in North America are the only surviving populations. Over the last 8,000 years bison stampeded across the plains of the North American West and their numbers swelled into the hundreds of thousands. But in the late 1800s the animals were hunted to the brink of extinction. Today only a few herds remain.

Meltzer, the Southern Methodist University archaeologist, said: "I'm not at all surprised that the record shows the population did have boom and bust periods and did have bottlenecks through which they passed. It happens to all other critters, and there's no reason to think bison were any different."

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DNA Evidence Weighs In on Ice Age Extinction Debate

By Sarah Graham | Monday, November 29, 2004

The end of the Pleistocene epoch brought with it widespread extinctions of large mammals, such as saber-toothed cats and mammoths. Ancient bison, too, were threatened with elimination, but they managed to survive. The two leading theories of what caused the precipitous population drop focus on environmental shifts and pressure from human hunters. A genetic analysis published in the current issue of the journal *Science* lends support to the hypothesis that climate change was the culprit.

Image: COURTESY OF HENRY WELCOME ANCIENT BIOMOLECULES CENTER/OXFORD UNIVERSITY

Beth Shapiro of Oxford University and her colleagues analyzed mitochondrial DNA from 352 bison fossils recovered from eastern and western Beringia (the landmass that includes Alaska, Canada and Siberia), North America, China and Russia. In addition, the scientists performed radiocarbon dating on 220 of the samples. They determined that the genetic diversity of the bison population dropped off drastically around 37,000 years ago. ¿The timing of this decline correlates with environmental changes associated with the onset of the last glacial cycle,¿ the team reports, ¿whereas archaeological evidence does not support the presence of large populations of humans in eastern Beringia until more than 15,000 years later.¿

The authors suggest that their findings will help inform the debate about end-Pleistocene megafauna extinctions because ¿they offer the first evidence of the initial decline of a population, rather than simply the resulting extinction event.¿ The researchers do not rule out human intervention entirely, however, because some disputed archaeological evidence suggests a low number of humans may have been present at the time. Future studies with more samples from around the time of the Last Glacial Maximum, they say, should help clarify the course of extinction events.