After mastodons and mammoths, a transformed landscape

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Mastodons graze on black ash trees in a pleistocene swamp. A new study by researchers at the University of Wisconsin-Madison shows that the disappearance of North America's large herbivores not long after the retreat of the ice sheets that covered much of the continent triggered a dramatic reshaping of the landscape. Illustration: Barry Roal Carlsen

(PhysOrg.com) -- Roughly 15,000 years ago, at the end of the last ice age, North America's vast assemblage of large animals -- including such iconic creatures as mammoths, mastodons, camels, horses, ground sloths and giant beavers -- began their precipitous slide to extinction.

And when their populations crashed, emptying a land whose diversity of large animals equaled or surpassed Africa's wildlife-rich Serengeti plains then or now, an entirely novel ecosystem emerged as broadleaved trees once kept in check by huge numbers of big herbivores claimed the landscape. Soon after, the accumulation of woody debris sparked a dramatic increase in the prevalence of wildfire, another key shaper of

landscapes.

This new picture of the ecological upheaval of the North American landscape just after the retreat of the ice sheets is detailed in a study published today (Nov. 19) in the journal *Science*. The study, led by researchers from the University of Wisconsin-Madison, uses fossil pollen, charcoal and dung fungus spores to paint a picture of a post-ice age terrain different from anything in the world today.

The work is important because it is "the clearest evidence to date that the extinction of a broad guild of animals had effects on other parts of these ancient ecosystems," says John W. Williams, a UW-Madison professor of geography and an expert on ancient climates and ecosystems who is the study's senior author. What's more, he says, the detailing of changes on the ice age landscape following the crash of keystone animal populations can provide critical insight into the broader effects of animals disappearing from modern landscapes.

The study was led by Jacquelyn Gill, a graduate student in Williams' lab. Other co-authors are Stephen T. Jackson of the University of Wyoming, Katherine B. Lininger of UW-Madison and Guy S. Robinson of Fordham University.

The new work, says Gill, informs but does not resolve the debate over what caused the extinction of 34 genera or groups of large animals, including icons of the ice age such as elephant like mastodons and ground sloths the size of sport utility vehicles. "Our data are not consistent with a rapid, 'blitzkrieg' overkill of large animals by humans," notes Gill, nor was their decline due to a loss of habitat.

However, the work does seem to rule out a recent hypothesis that a meteor or comet impact some 12.9 thousand years ago was responsible for the extinction of ice age North America's signature large animals.

The study was conducted using lake sediment cores obtained from Appleman Lake in Indiana, as well as data obtained previously by Robinson from sites in New York. Gill, Williams and their colleagues used pollen, charcoal and the spores of a dung fungus that requires passage through a mammalian intestinal tract to complete its life cycle to reconstruct a picture of sweeping change to the ice age environment. The decline of North America's signature ice age mammals was a gradual process, the Wisconsin researchers explain, taking about 1,000 years. The decline in the huge numbers of ice age animals is preserved in the fossil record when the fungal spores disappear from the record altogether: "About 13.8 thousand years ago, the number of spores drops dramatically. They're barely in the record anymore," Gill explains.

Like detectives reconstructing a crime scene, the group's use of dung fungus spores helps establish a precise sequence of events, showing that the crash of ice age megafauna began before plant communities started to change and before fires appeared widely on the landscape.

"The data suggest that the megafaunal decline and extinction began at the Appleman Lake site sometime between 14.8 thousand and 13.7 thousand years ago and preceded major shifts in plant community composition and the frequency of fire," notes Williams.

Absent the large herbivores that kept them in check, such tree species as black ash, elm and ironwood began to colonize a landscape dominated by coniferous trees such as spruce and larch. The resulting mix of boreal and temperate trees formed a plant community unlike any observed today.

"As soon as herbivores drop off the landscape, we see different plant communities," Gill explains, noting that mastodon herds and other large animals occupied a parkland like landscape, typified by large open spaces and patches of forest and swamp. "Our data suggest that these

trees would have been abundant sooner if the herbivores hadn't been there to eat them."

While both the extinction of North America's ice age megafauna and the sweeping change to the landscape are well-documented phenomena, there was, until now, no detailed chronology of the events that remade the continent's biological communities beginning about 14.8 thousand years ago. Establishing that the disappearance of mammoths, giant beavers, ground sloths and other large animals preceded the massive change in plant communities, promises scientists critical new insight into the dynamics of extinction and its pervasive influence on a given landscape.

Source: University of Wisconsin-Madison (news : web)

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