Research Suggests Large Mammals Influenced Global Climate

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Mammoth exhibit at a museum. The rapid decline of mammoths and other megafauna after humans spread across the New World may explain a bone-chilling plunge in global temperatures some 12,800 years ago, researchers reported Sunday.

(PhysOrg.com) -- More than 13,000 years ago, millions of large mammals such as mammoths, mastodon, shrub-ox, bison, ground sloths and camels roamed the Americas and may have had profound influences on the environment according to research in a paper titled, “Methane Emissions from Extinct Megafauna” released in the publication *Nature Geosciences* Sunday.

The extinction of these large herbivores, which also include horses, llamas and stag moose in addition to the giant wooly mammoth, probably led to an abrupt decrease in methane emissions and atmospheric concentrations of the gas with potential implications for climate change says Dr. Felisa Smith, Associate Professor of Biology at the University of New Mexico.

The research also involved Dr. Scott Elliott from the Climate, Ocean, Sea Ice Modeling Team at the Los Alamos National Laboratory and Dr. Kathleen Lyons in the Department of Paleobiology at the National Museum of Natural History at the Smithsonian Institution.

Approximately 13,400 years ago, the Americas supported a mammal fauna that was richer than that of Africa today explained Smith. “Around 11,500 years ago and within 1,000 years of the arrival of humans in the New World, 80 percent of these large-bodied mammals were extinct,” said Smith in the paper.

“This is arguably the first detectable influence of humans on the environment going back 13,400 years to when humans first got to the continent,” said Smith. “I think that it’s intriguing because there are a lot of ramifications. Potentially, if the decrease in methane, which is synchronous with this ice spell, was actually the cause, then humans contributed to the Younger Dryas cold episode.”

Herbivores produce methane as a by-product of cellulolytic-microbial fermentation during the digestive process. Enteric emission occurs when methane (CH4) is produced in the rumen as microbial fermentation takes place; most of this is released as burps. Past studies have shown that domestic livestock are an important contributor to greenhouse gas concentrations and can represent ~20 percent of annual emissions. The study says that this influence may have been greater in the Pleistocene epoch when methane concentrations were considerably lower.

The researchers looked at 114 different herbivorous species that were extirpated from the Americas at the end of the Pleistocene epoch. Using ice cores to determine the amount of methane during the onset of the Younger Dryas cooling period, they found the extinction of megafauna closely coincides with an abrupt drop in atmospheric methane concentration.

“If you look at the ice cores, which record things like methane, you see this huge drop in methane that perfectly coincides with when humans arrived on the continent,” said Smith. “We looked at all the other drops in methane over the last million years and this one is quite different. It happens about 2-40 times more rapidly than the others.”

Armed with that information, the researchers then decided to try and determine how much methane was produced by these species. They came up with an estimate of the number of animals and then an estimate of how much methane those animals actually produced. Other animals such as elephant, giraffes and hippos have been studied by putting a gas mask type of apparatus on them to determine how much methane they produce in a day.

“We were able to come up with an estimate, which turns out to be about 10 teragrams. This is really pretty enormous,” said Smith. “When you bracket it, at the very minimum, the demise of all these animals explains 12 percent of the decrease in methane seen at this time. At the maximum, it explains the entire decrease. This suggests that the extinction of megafauna by humans caused a detectable impact on the environment long before the development of agriculture and the industrial age.”

Ice core records from Greenland suggest the methane concentration change associated with a 1 degree Celsius temperature shift ranges from 10 to 30 parts per billion by volume with a long term mean of about 20

ppbv. A drop of 185 to 245 ppbv methane drop observed at the Younger Dryas stadial is associated with a temperature shift of 9 to 12 degrees Celsius. The calculations suggest that decreased methane emissions caused by the extinction of New World megafauna could have played a role in the Younger Dryas cooling event.

Provided by University of New Mexico