AMERICAN MUSEUM of NATURAL HISTORY

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ICE AGE VERTEBRATES HAD MIXED RESPONSES TO CLIMATE CHANGE

NEW STUDY CONTRADICTS IDEA OF UNIFORM POPULATION CHANGE, HAS SIGNIFICANCE FOR UNDERSTANDING GLOBAL WARMING IMPACT

New research examines how vertebrate species in the eastern United States ranging from snakes to mammals to birds responded to climate change over the last 500,000 years. The study, recently published in the journal *Ecology Letters*, reveals that contrary to expectation, the massive glaciers that expanded and contracted across the region affected animal populations in different ways at different times. The analysis provides a window into how animals might react to any kind of climate change, whether glacial cycles or global warming.

"A big glacier should have affected everybody. It doesn't matter if you're a snake or a bird, it probably makes it hard to live there," said Frank Burbrink, an associate curator in the American Museum of Natural History's Department of Herpetology and lead author of the study. "So did these communities all change together as if they were one unit? There's never been a study that has comprehensively analyzed whether vertebrate communities responded to the glacial cycles in a uniform way."

The most recent, rapid, and significant effect of global climate change occurred about 2.5 million years ago in the Quaternary period, when ice sheets expanded and contracted, altering both the environment and available land. In the area known as the Eastern Nearctic—defined as the forested and coastal regions of the eastern United States—glaciers extended as far south in the east to New York City and in the Midwest to south central Illinois. Temperature changed rapidly, in some cases at the rate of 5 to 10 degrees Celsius (about 40 to 50 degrees Fahrenheit) within several decades.

To analyze the impact of this climate change, multidisciplinary researchers from the

Museum, the ʻIolani School in Honolulu, the City University of New York's College of Staten Island, and Louisiana State University focused on the historical population sizes of tetrapods—snakes, lizards, mammals, birds, turtles, salamanders, and frogs—in the Eastern Nearctic over the last 500,000 years. They did this by looking at the animals' genomes and modeling the likelihood of their populations growing or shrinking.

"When a glacier retreats, all of the organisms that were pushed south move back into that space and the signal of those changing populations gets imprinted in the genome," Burbrink said. "If you look at any individual species, you can see what its population has been doing over time based on how many changes they have in their genome. When populations expand, they have more genetic differences. And when populations are small, they have fewer."

The longstanding scientific thought is that as a glacier recedes, local populations will expand "synchronously," or all at the same time. But the researchers did not find a uniform response to climate change within the tetrapod community. About 75 percent of the animals went through a population expansion, with only about 50 percent of those lineages expanding together. And 25 percent of the populations contracted. The results imply that there are additional layers of complexity involved in this problem.

"In some ways, the old idea that the glacier receding would have a single effect on everything in the community is naïve," Burbrink said.

And what do the results mean for the global warming the Earth is currently facing?

"We need to move beyond viewing communities as single units," said co-author Brian T. Smith, an assistant curator in the Museum's Department of Ornithology. "Some species will respond in one way and others will respond in other ways. And there are many external historical, biological, and stochastic factors that will influence how populations respond to global warming."

Other authors on this study include Yvonne Chan from the ʻIolani School, Edward Myers and Michael Hickerson from the City University of New York, and Sara Ruane from Louisiana State University.

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***Ecology Letters* paper**: http://onlinelibrary.wiley.com/doi/10.1111/ele.12695/abstract

AMERICAN MUSEUM OF NATURAL HISTORY (AMNH.ORG)

The American Museum of Natural History, founded in 1869, is one of the world's preeminent scientific, educational, and cultural institutions. The Museum encompasses 45 permanent exhibition halls, including the Rose Center for Earth and Space and the Hayden Planetarium, as well as galleries for temporary exhibitions. It is home to the Theodore Roosevelt Memorial, New York State's official memorial to its 33rd governor and the nation's 26th president, and a tribute to Roosevelt's enduring legacy of conservation. The Museum's five active research divisions and three cross-disciplinary centers support approximately 200 scientists, whose work draws on a world-class permanent collection of more than 33 million specimens and artifacts, as well as specialized collections for frozen tissue and genomic and astrophysical data, and one of the largest natural history libraries in the world. Through its Richard Gilder Graduate School, it is the only American museum authorized to grant the Ph.D. degree and the Master of Arts in Teaching degree. Annual attendance has grown to approximately 5 million, and the Museum's exhibitions and Space Shows can be seen in venues on five continents. The Museum's website and collection of apps for mobile devices extend its collections, exhibitions, and educational programs to millions more beyond its walls. Visit amnh.org for more information.

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