Study finds climate changes faster than species can adapt

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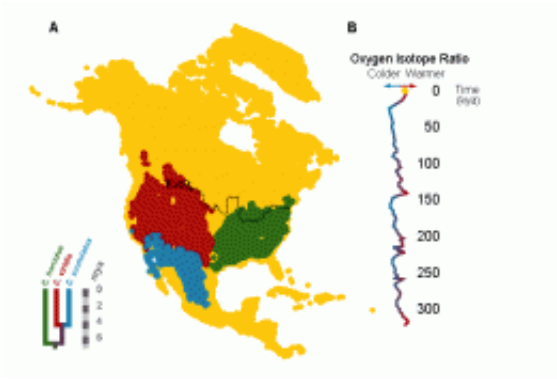


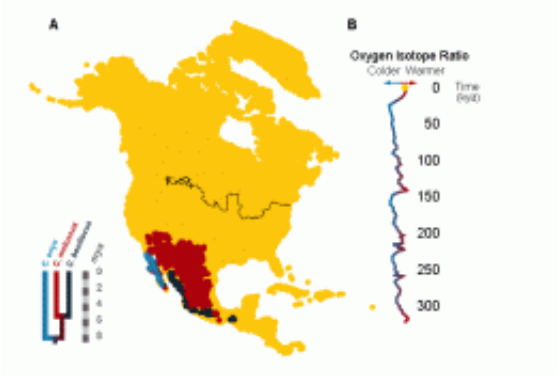
Time-lapse videos showing the change in the range of Crotalus species at 4,000-year intervals over the past 320,000 years

The ranges of species will have to change dramatically as a result of climate change between now and 2100 because the climate will change more than 100 times faster than the rate at which species can adapt, according to a newly published study by Indiana University researchers.

The study, which focuses on North American rattlesnakes, finds that the rate of future change in suitable habitat will be two to three orders of magnitude greater than the average change over the past 300 millennia, a time that included three major glacial cycles and significant variation in climate and temperature.

"We find that, over the next 90 years, at best these species' ranges will

change more than 100 times faster than they have during the past 320,000 years," said Michelle Lawing, lead author of the paper and a doctoral candidate in geological sciences and biology at IU Bloomington. "This rate of change is unlike anything these species have experienced, probably since their formation."



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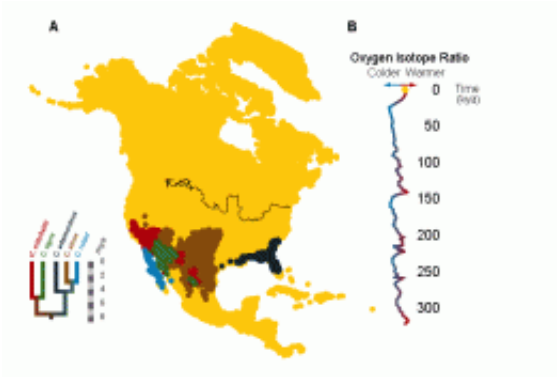
The study, "Pleistocene Climate, Phylogeny, and Climate Envelope Models: An Integrative Approach to Better Understand Species' Response to Climate Change," was published by the online science journal PLoS One. Co-author is P. David Polly, associate professor in the Department of Geological Sciences in the IU Bloomington College of Arts and Sciences.

The researchers make use of the fact that species have been responding to climate change throughout their history and their past responses can inform what to expect in the future. They synthesize information from climate cycle models, indicators of climate from the geological record, evolution of rattlesnake species and other data to develop what they call "paleophylogeographic models" for rattlesnake ranges. This enables

them to map the expansion and contraction at 4,000-year intervals of the ranges of 11 North American species of the rattlesnake genus Crotalus.



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Projecting the models into the future, the researchers calculate the expected changes in range at the lower and upper extremes of warming predicted by the Intergovernmental Panel on Climate Change — between 1.1 degree and 6.4 degrees Celsius. They calculate that rattlesnake ranges have moved an average of only 2.3 meters a year over the past 320,000 years and that their tolerances to climate have evolved about 100 to 1,000 times slower, indicating that range shifts are the only way that rattlesnakes have coped with climate change in the recent past. With projected climate change in the next 90 years, the ranges would be displaced by a remarkable 430 meters to 2,400 meters a year.

Increasing temperature does not necessarily mean expanded suitable habitats for rattlesnakes. The timber rattlesnake, for example, is now found throughout the Eastern United States. The study finds that, with a temperature increase of 1.1 degree Celsius over the next 90 years, its range would expand slightly into New York, New England and Texas.

But with an increase of 6.4 degrees, its range would shrink to a small area on the Tennessee-North Carolina border. The giant Eastern diamondback rattlesnake would be displaced entirely from its current range in the Southeastern U.S. with a temperature increase of 6.4 degrees.

The findings suggest snakes wouldn't be able to move fast enough to keep up with the change in suitable habitat. The authors suggest the creation of habitat corridors and managed relocation may be needed to preserve some species.

Rattlesnakes are good indicators of climate change because they are ectotherms, which depend on the environment to regulate their body temperatures. But Lawing and Polly note that many organisms will be affected by climate change, and their study provides a model for examining what may happen with other species. Their future research could address the past and future effects of climate change on other types of snakes and on the biological communities of snakes.

More information: The article is available online at www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0028554

Provided by Indiana University