

Trouble in paradise: Warming a greater danger to tropical species

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This leaf beetle, which lives in the cloud forest on the east slope of the Andes Mountains in Ecuador, is from the family Chrysomelidae. Climate change could have a much bigger impact on such tropical species than scientists previously thought. Credit: Kimberly Sheldon, University of Washington

Polar bears fighting for survival in the face of a rapid decline of polar ice have made the Arctic a poster child for the negative effects of climate change. But new research shows that species living in the tropics likely face the greatest peril in a warmer world.

A team led by University of Washington scientists has found that while temperature changes will be much more extreme at high latitudes, tropical species have a far greater risk of extinction with warming of just a degree or two. That is because they are used to living within a much smaller temperature range to begin with, and once temperatures get beyond that range many species might not be able to cope.

"There's a strong relationship between your physiology and the climate you live in," said Joshua Tewksbury, a UW assistant professor of biology. "In the tropics many species appear to be living at or near their thermal optimum, a temperature that lets them thrive. But once temperature gets above the thermal optimum, fitness levels most likely decline quickly and there may not be much they can do about it."

Arctic species, by contrast, might experience temperatures ranging from subzero to a comparatively balmy 60 degrees Fahrenheit. They typically live at temperatures well below their thermal limit, and most will continue to do so even with climate change.

"Many tropical species can only tolerate a narrow range of temperatures because the climate they experience is pretty constant throughout the year," said Curtis Deutsch, an assistant professor of atmospheric and oceanic sciences at the University of California, Los Angeles. "Our calculations show that they will be harmed by rising temperatures more than would species in cold climates.

"Unfortunately, the tropics also hold the large majority of species on the planet," he said.

Tewksbury and Deutsch are lead authors of a paper detailing the research, published in the May 6 print edition of the *Proceedings of the National Academy of Sciences*. The work took place while Deutsch was a UW postdoctoral researcher in oceanography.

The scientists used daily and monthly global temperature records from 1950 through 2000, and added climate model projections from the Intergovernmental Panel on Climate Change for warming in the first years of the 21st century. They compared that information with data describing the relationship between temperatures and fitness for a variety of temperate and tropical insect species, as well as frogs, lizards and turtles. Fitness levels were measured by examining population growth rates in combination with physical performance.

"The direct effects of climate change on the organisms we studied appear to depend a lot more on the organisms' flexibility than on the amount of warming predicted for where they live," Tewksbury said. "The tropical species in our data were mostly thermal specialists, meaning that their current climate is nearly ideal and any temperature increases will spell trouble for them."

As temperatures fluctuate, organisms do what they can to adapt. Polar bears, for example, develop thick coats to protect them during harsh winters. Tropical species might protect themselves by staying out of direct sunlight in the heat of the day, or by burrowing into the soil.

However, since they already live so close to their critical high temperature, just a slight increase in air temperature can make staying out of the sun a futile exercise, and the warming might come too fast for creatures to adapt their physiologies to it, Tewksbury said.

Other authors of the paper are Raymond Huey, Kimberly Sheldon, David Haak and Paul Martin of the University of Washington and Cameron Ghalambor of Colorado State University. The research was funded in part by the National Science Foundation and the UW Program on Climate Change.

The work has indirect implications for agriculture in the tropics, where

the bulk of the world's human population lives. The scientists plan further research to examine the effects of climate change, particularly hotter temperatures, on tropical crops and the people who depend on them.

"Our research focused only on the impact of changes in temperature, but warming also will alter rainfall patterns," Deutsch said. "These effects could be more important for many tropical organisms, such as plants, but they are harder to predict because hydrological cycle changes are not as well understood."

Source: University of Washington

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