

Greatest warming is in the north, but biggest impact on life is in the tropics

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In recent decades documented biological changes in the far Northern Hemisphere have been attributed to global warming, changes from species extinctions to shifting geographic ranges. Such changes were expected because warming has been fastest in the northern temperate zone and the Arctic.

But new research published in the Oct. 7 edition of *Nature* adds to growing evidence that, even though the temperature increase has been smaller in the tropics, the impact of warming on life could be much greater there than in colder climates.

The study focused on ectothermic, or cold-blooded, organisms (those whose body temperature approximates the temperature of their surroundings). Researchers used nearly 500 million temperature readings from more than 3,000 stations around the world to chart temperature increases from 1961 through 2009, then examined the effect of those increases on metabolism.

"The expectation was that physiological changes would also be greatest in the north temperate-Arctic region, but when we ran the numbers that expectation was flipped on its head," said lead author Michael Dillon, an assistant professor of zoology and physiology at the University of Wyoming.

[Metabolic changes](#) are key to understanding some major impacts of [climate warming](#) because a higher [metabolic rate](#) requires more food and

more oxygen, said co-author Raymond Huey, a University of Washington biology professor. If, for example, an organism has to spend more time eating or conserving energy, it might have less time and energy for reproduction.

"Metabolic rate tells you how fast the animal is living and thus its intensity of life," Huey said.

Using a well-documented, century-old understanding that metabolic rates for cold-blooded animals increase faster the warmer the temperature, the researchers determined that the effects on metabolism will be greatest in the tropics, even though that region has the smallest actual warming. Metabolic impacts will be less in the Arctic, even though it has shown the most warming. In essence, organisms in the tropics show greater effects because they start at much higher temperatures than animals in the Arctic.

Dillon and co-author George Wang of the Max Planck Institute for Developmental Biology in Tübingen, Germany, sifted through temperature data maintained by the National Oceanic and Atmospheric Administration's National Climatic Data Center. They came up with readings from 3,186 stations that met their criteria of recording temperature at least every six hours during every season from 1961 through 2009. The stations, though not evenly spaced, represented every region of the globe except Antarctica.

The data, the scientists said, reflect temperature changes since 1980 that are consistent with other recent findings that show the Earth is getting warmer. Temperatures rose fastest in the Arctic, not quite as fast in the northern temperate zone and even more slowly in the tropics.

"Just because the temperature change in the tropics is small doesn't mean the biological impacts will be small," Huey said. "All of the studies we're

doing suggest the opposite is true."

In fact, previous research from the University of Washington has indicated that small temperature changes can push [tropical](#) organisms beyond their optimal [body temperatures](#) and cause substantial stress, while organisms in temperate and polar regions can tolerate much larger increases because they already are used to large seasonal temperature swings.

The scientists say the effects of warming temperatures in the tropics have largely been ignored because temperature increases have been much greater farther north and because so few researchers work in the tropics.

"I think this argues strongly that we need more studies of the impacts of warming on organisms in the tropics," Dillon said.

Provided by University of Washington

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