

What cold lizards in Miami can tell us about climate change resilience

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Central American brown basilisks (*Basiliscus vittatus*) are among the members of a lizard community that converged on a lower temperature tolerance after a cold snap in Miami. Credit: Day's Edge Productions

It was raining iguanas on a sunny morning.

Biologist James Stroud's phone started buzzing early on Jan. 22. A friend who was bicycling to work past the white sands and palm tree edges of Key Biscayne, an island town south of Miami, sent Stroud a picture of a 2-foot long lizard splayed out on its back. With its feet in the air, the iguana took up most of the sidewalk.

The previous night was south Florida's coldest in 10 years, at just under 40 degrees Fahrenheit. While most people reached for an extra blanket or a pair of socks, Stroud—a postdoctoral research associate in Arts & Sciences at Washington University in St. Louis—frantically texted a collaborator:

"Today's the day to drop everything, go catch some lizards."

When temperatures go below a critical limit, sleeping lizards lose their grip and fall out of trees. From previous research, Stroud and his colleagues had learned that different types of lizards in Miami can tolerate different low temperatures, ranging from about 46 to 52 degrees Fahrenheit, before they are stunned by cold. This [cold snap](#) provided a unique opportunity to understand how they are affected by [extreme climate events](#).

But when the researchers collected the scaled survivors of that coldest night, they discovered that the lizard community responded in an unexpected way: all of them could tolerate [cold temperatures](#) down to about 42 degrees Fahrenheit, regardless of their [species'](#) previous ability to withstand cold. The findings are reported Oct. 21 in the journal *Biology Letters*.

"Prior to this, and for a different study, we had measured the lowest temperatures that six lizard species in south Florida could tolerate," Stroud said. "We realized after the 2020 cold event that these data were now extremely valuable—we had the opportunity to re-measure the same

lizard populations to observe if their physiological limits had changed; in other words, could these species now tolerate lower temperatures?"

In the days that followed the January cold snap, researchers collected representatives of as many different kinds of lizards as they could find in the local area, rounding up small and large lizards and those that are active during the day and at night. Then the researchers tested their response to cold.

"A major unexpected result of this study was that all species converged on the same new, lower level of thermal tolerance," Stroud said. "While there was great variation in temperature tolerance before the cold event—some, like the large-bodied brown basilisk, were very intolerant of low temperatures, while others like the Puerto Rican crested anole were more robust—we observed that all species could now tolerate, on average, the same lowest temperature.

"Given great variation in body size, ecology and physiology, this was unexpected," he said.



On January 21, 2020, the National Weather Service in Miami tweeted: "Falling Iguanas Possible Tonight" Credit: National Weather Service / Miami

Only one of the species in the study is native to the area; the rest have been introduced to Florida over the past century, researchers noted.

The results provide evidence that tropical, cold-blooded creatures—often characterized as unable to withstand rapid changes in climatic conditions—can sometimes endure conditions that exceed their established physiological limits.

"The shifts to tolerate significantly lower temperatures that we observed

were so large that we found it unclear whether natural selection was responsible," Stroud said. "And so in our paper we discuss other alternative processes which may also have led to this pattern."

"The results of this study are surprising and unexpected. Who would have thought that tropical lizards from places like Puerto Rico and Central America could withstand temperatures near freezing?" said Jonathan Losos, the William H. Danforth Distinguished University Professor and professor of biology in Arts & Sciences and director of the Living Earth Collaborative at Washington University.

"What we now need to find out is how this was accomplished. Is this evidence of natural selection, with those [lizards](#) that just happened to have a lower cold tolerance surviving and others freezing to death, or was it an example of physiological adjustment—termed 'acclimation'—in which exposure to lower temperatures changes a lizard's physiology so that it is capable of withstanding [lower temperatures](#)?"

Regardless of the underlying mechanism, the new study provides a critically important piece of information for understanding the impacts of climate change.

Scientists expect that air temperatures will gradually become warmer under climate change, but also that temperatures will become more chaotic.

Events that spike temperature to extremes—both exceptionally hot and exceptionally cold episodes—will increase in frequency and magnitude. As such, it is important to understand both the effects of gradual, long-term increases in air temperatures as well as the consequences of abrupt, short-term extreme events.

"It is widely thought that tropical and subtropical species are going to be

especially vulnerable to changes in [temperature](#)—particularly extreme spikes of heat or cold—as tropical areas do not typically have strong seasons," Stroud said. "Unlike temperate species, which are adapted to summer highs and winter lows, tropical species have typically evolved in very thermally stable environments.

"While there is no doubt that climate change represents a major threat to species and ecosystems around the world, and deserves as much research attention as possible, this study provides fascinating insight and a glimpse of hope," he said. "Perhaps tropical and subtropical species can withstand more extreme climatic conditions."

More information: An extreme cold event leads to community-wide convergence in lower temperature tolerance in a lizard community, *Biology Letters* (2020). [royalsocietypublishing.org/doi1098/rsbl.2020.0625](https://royalsocietypublishing.org/doi/10.1098/rsbl.2020.0625)

Provided by Washington University in St. Louis

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