# Even adaptable viruses have trouble surviving erratic temperatures

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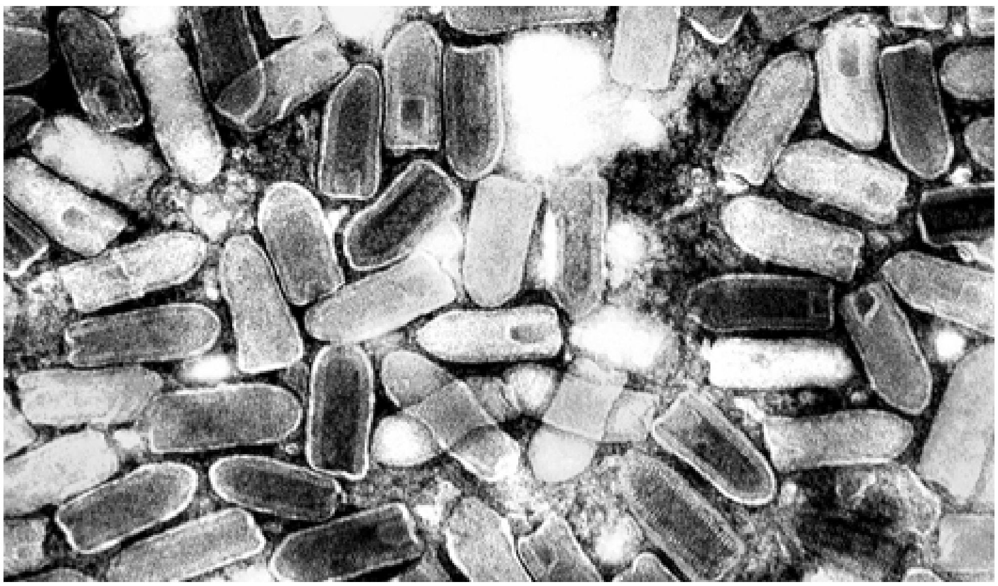

(Phys.org)—Aside from rising sea levels, many climate change models predict that in the future, the planet's temperature and weather will become increasingly erratic with wild, unpredictable storms and fluctuating conditions. A new study from researchers at the University of Florida and Yale University and published today by the journal *Evolution* investigated how an organism – in this case, a simple virus –adapts to temperature change when that change comes in different ways: constant, in a recognizable pattern or at random.

Their findings suggest that some organisms, especially those that are long-lived and have low genetic variation, such as manatees, polar bears or cheetahs, may be in for a rough time as they try to adapt to previously unseen conditions.

"We didn't specifically take the predictions of climate change and mimic that … that wasn't the point of the study," said UF's Barry Alto, an assistant professor of arborvirology. "Rather, we are fundamentally studying how an organism adapts to temperature change when that temperature change comes in different ways. Because we know that the pattern of change makes a difference."

The research team included Alto and his Yale University colleagues Paul Turner, professor and chair of ecology and evolutionary biology; and Brian Wasik and Nadya Morales, postdoctoral associates in Turner's lab. Alto is now based at the Florida Medical Entomology Lab in Vero Beach, part of UF's Institute of Food and Agricultural Sciences.

Alto began by cloning the RNA vesicular stomatitis virus, which typically affects livestock, and is often used in scientific studies as a model to study evolutionary processes. They use it because its genetic blueprint is simple, its populations multiply rapidly and one flask of host cells used to grow the virus can yield millions or even billions of viruses. Even better: the researchers can freeze the virus indefinitely, creating a near-permanent archive, comparable to a fossil record.

The same ancestor virus was then used to create 20 separate populations, and researchers divided the 20 populations into four test groups: One batch of the virus was kept at a consistent temperature of 84.2 degrees Fahrenheit, considered the 'low' temperature; the second was exposed to a 'high' temperature of 98.6 degrees Fahrenheit, the third group was exposed to the high and low temperatures in a predictable pattern of alternating days; and the fourth group was exposed to a random pattern of temperatures that ranged from 84.2 degrees to 98.6.

Afterward, the scientists tested the viruses' fitness against that of the ancestral clone.

They discovered that the viruses exposed to the predictable but alternating temperature pattern were the most fit; the viruses exposed to consistent high and low temperatures followed; and to the researchers' surprise, the viruses exposed to random temperatures were the least fit – meaning the population couldn't improve or adapt when faced with randomly changing temperatures.

"Our study shows, that in the time allowed, (the viruses) weren't able to cope," said Yale's Turner, whose lab housed the study. "They could not rely enough on the mutations that were being generated in that population for anything to emerge and dominate that could deal with this highly unpredictable environmental change."

Turner said the findings came as a surprise, because viruses are among the most adaptable organisms on the planet. For example, the influenza virus mutates from one season to the next, often a step ahead of the next vaccine. Also surprising, he said, was that they observed an inability to adapt despite temperature discrepancy being a mere 14 degrees.

Viruses aren't people or animals, but because they share the ability to mutate over time to adapt to changing conditions, he said it's reasonable to expect that if viruses have trouble with randomly changing temperatures, other organisms far less suited to change almost certainly will have trouble.

"That suggests that indeed we should be worried under certain climate models, that there's probably no way that certain long-lived, lower-mutation species would be able to cope with radical environmental change," Turner said. "It's kind of remarkable how handicapped they were from an adaptation standpoint."

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