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Guinea pigs beat climate change by tweaking their own DNA

Hot stuff. For the first time, wild mammals have been seen responding to higher temperatures by altering chemical structures on their DNA. These epigenetic changes may adjust the activity of specific genes, and some are passed on to offspring.

“Global temperatures are rising. It is crucial to understand how wild species are able to cope,” says Alexandra Weyrich of the Leibniz Institute for Zoo and Wildlife Research in Berlin, Germany.

Evolution by genetic mutation and natural selection can be slow. But epigenetic changes that affect how genes are expressed, such as attaching methyl molecules onto DNA, are much faster and more flexible. Experiments in a type of brine shrimp and the plant *Arabidopsis thaliana* have shown that such heat-induced epigenetic responses can even be inherited by the next generation.

Getting steamy

more genetically diverse animals, Weyrich's team studied guinea pigs sourced from South America. They allowed five males to mate with females in an enclosure at a normal ambient temperature of below 5 °C, and then again with other females after spending two months at 30 °C.

This is a higher temperature difference than they might experience with more gradual climate change, but after two months at this higher temperature, Weyrich's team found signs of significantly altered methylation in at least 10 genes that seem to be linked to regulating body temperature. "That these genes were differentially methylated before and after heat is stunning," says Weyrich.

"This suggests global changes in the environment like climate change will affect all species through environmental epigenetics," says Michael Skinner at Washington State University in Pullman.

Temporary solution

Weyrich says there is evidence of epigenetic heat responses in corals, fruit flies, chickens and fish, but this is the first time it's been seen in mammals.

These epigenetic responses may help organisms cope, but they won't make them adapt more quickly, says team member Jörns Fickel, because they don't affect the DNA sequence. Instead, they might buy a species time to evolve permanent adaptations to a warmer climate.

However, it is not known if every animal can respond in this way. Some organisms may not have an epigenetic heat response to fall back on when temperatures rise.

The team also identified differences in the methylation patterns of the offspring conceived before and after heat treatment, suggesting that temperature can affect the next generation.

But intriguingly, the changes found in the later batch of pups were not very similar to the changes seen in their fathers. Weyrich's team believe this may be because the fathers underwent their own set of immediate epigenetic responses to temperature, and then passed on a different set of "preparedness" changes to their offspring via the sperm they developed during the hot two months.

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