

Deforestation is stressing mammals out

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A mouse opossum (*Gracilinanus agilis*) from a deforested area of the Atlantic Forest, eastern Paraguay. Credit: © Noé U. de la Sancha, Field Museum

Lots of us are feeling pretty anxious about the destruction of the natural world. It turns out, humans aren't the only ones stressing out—by analyzing hormones that accumulate in fur, researchers found that rodents and marsupials living in smaller patches of South America's

Atlantic Forest are under more stress than ones living in more intact forests.

"We suspected that organisms in deforested areas would show higher levels of stress than animals in more pristine forests, and we found evidence that that's true," says Noé de la Sancha, a research associate at the Field Museum in Chicago, Associate Professor of Biology at Chicago State University, and co-author of a new paper in *Scientific Reports* detailing the discovery. "Small mammals, primarily rodents and little marsupials, tend to be more stressed out, or show more evidence that they have higher levels of stress hormones, in smaller forest patches than in larger forest patches."

"A lot of species, all over the world, but especially in the tropics, are understudied," says Sarah Boyle, an Associate Professor of Biology and Chair of the Environmental Studies and Sciences Program at Rhodes College and the study's lead author. "There is not a lot known about many of these animals in terms of even their baseline hormone levels."

The Atlantic Forest is often overshadowed by its neighbor the Amazon, but it's South America's second-largest forest, extending from northeastern Brazil down south along the Brazilian coastline, into northwestern Argentina to eastern Paraguay. It once covered about 463,000 square miles, an area bigger than California, Oregon, Washington, and Nevada put together. Since the arrival of Portuguese colonists 500 years ago, parts of the forest have been destroyed to make way for farmland and urban areas; today, less than one-third of the original forest remains.

The destruction of an animal's habitat can drastically change its life. There's less food and territory to go around, and the animal might find itself in more frequent contact with predators or in increased competition with other animals for resources. These circumstances can

add up to long-term stress.

Stress isn't a bad thing in and of itself—in small doses, stress can be life-saving. "A stress response is normally trying to bring your body back into balance," says David Kabelik, an Associate Professor of Biology and Chair of the Neuroscience Program at Rhodes College and one of the paper's authors. "If something perturbs you and it can cause you to be injured or die, the stress response mobilizes energy to deal with that situation and bring things back into a normal state. It allows you to survive." For instance, if an animal encounters a predator, a flood of stress hormones can give them the energy they need to run away, and then those hormone levels go back down to normal. "But then these animals are placed into these small fragments of habitat where they're experiencing elevated stress over prolonged periods, and that can lead to disease and dysregulation of various physiological mechanisms in the body."

For this study, the researchers focused on patches of forest in eastern Paraguay, which has been particularly hard hit in the last century as the region was clear-cut for firewood, cattle farming, and soy. To study the effects of this deforestation, the researchers trapped 106 mammals from areas ranging from 2 to 1,200 hectares—the size of a city block to 4.63 square miles. The critters they analyzed included five species of rodents and two species of marsupials.

The researchers took samples of the animals' fur, since hormones accumulate in hair over periods of many days or weeks, and could present a clearer picture of the animals' typical stress levels than the hormones present in a blood sample. "Hormones change in the blood minute by minute, so that's not really an accurate reflection of whether these animals are under [long-term stress](#) or whether they just happened to run away from a predator a minute ago," says Kabelik, "and we were trying to get at something that's more of an indicator of longer term

stress. Since glucocorticoid stress hormones get deposited into the fur over time, if you analyze these samples you can look at a longer term measure of their stress."

Back in the lab, the researchers ground the fur into a fine powder and extracted the hormones. They analyzed hormone levels using enzyme immunoassay: "You use antibodies that bind these hormones to figure out how many are there," says Kabelik. "Then you divide that by the amount of fur that was in the sample, and it tells you the amount of hormones present per milligram."

The team found that the animals from smaller patches of forest had higher levels of glucocorticoid stress hormones than animals from larger patches of forest. "Our findings that animals in the small forest patches had higher glucocorticoid levels was not surprising, given the extent to which some of these forested areas have been heavily impacted by forest loss and fragmentation," says Boyle.

"In particular, these findings are highly relevant for countries like Paraguay that currently show an accelerated rate of change in natural landscapes. In Paraguay, we are just beginning to document how the diversity of species that are being lost is distributed," says Pastor Pérez, a biologist at Universidad Nacional de Asunción and another of the paper's authors. "However, this paper shows that we also have a lot to learn about how these species interact in these environments."

The scientists also found that the methods of trapping the animals contributed to the amount of stress hormones present. "It's an important consideration that people have to understand when they're doing these studies, that if they are live trapping the animals, that might be influencing the measured [hormone](#) levels," says Kabelik.

The study not only sheds light on how animals respond to deforestation,

but it could also lead to a better understanding of the circumstances in which animals can pass diseases to humans. "If you have lots of stressed out mammals, they can harbor viruses and other diseases, and there are more and more people living near these deforested patches that could potentially be in contact with these [animals](#)," says de la Sancha. "By destroying natural habitats, we're potentially creating hotspots for zoonotic disease outbreaks."

And, the researchers say, the results of this study go far beyond South America's Atlantic Forest.

"Big picture, this is really important because it could be applicable to [forest](#) remnants throughout the world," says de la Sancha. "The tropics hold the highest diversity of organisms on the planet. Therefore, this has potential to impact the largest variety of living organisms on the planet, as more and more deforestation is happening. We're gonna see individuals and populations that tend to show higher levels of [stress](#)."

Provided by Field Museum

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