

A Collapse of the Amazon Could Be Coming 'Faster Than We Thought'

A new study weighed a range of threats and variables in an effort to map out where the rainforest is most vulnerable.



By Manuela Andreoni

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Up to half of the Amazon rainforest could transform into grasslands or weakened ecosystems in the coming decades, a new study found, as climate change, deforestation and severe droughts like the one the region is currently experiencing damage huge areas beyond their ability to recover.

Those stresses in the most vulnerable parts of the rainforest could eventually drive the entire forest ecosystem, home to a tenth of the planet's land species, into acute water stress and past a tipping point that would trigger a forest-wide collapse, researchers said.

While earlier studies have assessed the individual effects of climate change and deforestation on the rainforest, this peer-reviewed study, published on Wednesday in the journal *Nature*, is the first major research to focus on the cumulative effects of a range of threats.

“This study adds it all up to show how this tipping point is closer than other studies estimated,” said Carlos Nobre, an author of the study. Dr. Nobre is a Brazilian Earth systems scientist who studies how deforestation and climate change might permanently change the forest.

The study overlapped data on forest cover, temperature and rainfall patterns, and then factored in other variables that might make various sections of the forest more or less fragile, like the presence of roads or legal protections, to map out where the rainforest is most likely to transform.

The regional profiles that emerged showed that a tenth of the Amazon was highly vulnerable to transforming into grasslands or degraded ecosystems with lower tree cover. Another 47 percent of the forest has moderate potential to transform, they found, including mostly untouched areas that are more vulnerable to extreme droughts like the current one.

These changes could push the forest to a tipping point that would lead to the collapse of the whole forest ecosystem.

“We don’t really know when we are going to reach it,” said Bernardo Flores, a postdoctoral researcher at the Federal University of Santa Catarina and the lead author of the study. But, he added, as the drought that set in last year shows, “we are approaching it faster than we thought.”



The new study found that a tenth of the Amazon was susceptible to becoming grassland or some other form of degraded ecosystem. Michael Dantas/Agence France-Presse, via Getty Images

Lincoln Muniz Alves, a climatologist at the National Institute for Space Research in Brazil who wasn't involved in the study, said the study added to a growing body of knowledge about the forest's resilience to the variety of challenges it faces. "The study makes progress in the understanding of the tipping point," he said. "In general, previous scientific papers have mostly explored the impact of deforestation."

Recent research has shown that parts of the forest in the southeast of the Amazon that have experienced large-scale deforestation and fires have already started emitting more carbon dioxide than they absorb because the rainforest there has been damaged past the point of recovery.

The collapse of part or all of the Amazon rainforest would release the equivalent of several years' worth of global emissions, possibly as much as 20 years' worth, into the atmosphere as its trees, which store vast amounts of carbon, are replaced by degraded ecosystems. And, because those same trees pump huge amounts of water into the atmosphere, their loss could also disturb global rainfall patterns and temperatures in ways that aren't well understood.

The researchers also estimated the limits of what the forest could withstand in terms of various threats. Global warming should not exceed 1.5 degrees Celsius, deforestation should be kept below 10 percent of the original tree cover and the annual dry season cannot exceed five months for the forest to remain intact, the study found.

To that end, governments need to not only halt carbon emissions and deforestation, but also restore at least 5 percent of the rainforest, the study said.

“If you pass those thresholds, then the forest could, in principle, collapse or transition into different ecosystems,” Dr. Flores said. “There is probably one tipping point of the system that is shaped by the interaction of these different stressors.”

There are, however, still unknowns. Researchers don't fully understand why some trees die after a drought while others don't; different biodiversity profiles across regions make general conclusions tricky; and, crucially, scientists still don't fully understand the complex interactions of factors like drought, deforestation and other threats.

Still, said Marina Hirota, a professor at the Federal University of Santa Catarina and another author of the paper, governments shouldn't wait for more clarity to act. “Sometimes science takes a little bit longer to really inform what we need,” Dr. Hirota said. “Are we going to wait and see, and blame uncertainty for not doing anything?”

Raymond Zhong contributed reporting.

Manuela Andreoni is a Times climate and environmental reporter and a writer for the Climate Forward newsletter. More about Manuela Andreoni

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