

Amazon landscape change study highlights ecological harms and opportunities for action

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Large-scale agriculture in the Brazilian Amazon. Credit: Erika Berenguer

A major study into landscape changes in the Brazilian Amazon sheds new light on the many environmental threats the biome faces—but also offers encouraging opportunities for ecological sustainability in the

world's most biodiverse tropical forest.

The study's findings are critical because as the Amazon moves closer towards a 'tipping point', they provide a robust evidence base to inform urgently needed conservation and regeneration priorities in the forest. They show that gains can be achieved through a range of actions—including, but not limited to, halting deforestation.

The research, which is published today in the scientific journal *Proceedings of the National Academy of Sciences*, was conducted by an international team of scientists from Brazil and the UK. They examined the ecological impacts caused by changes people are making to forest landscapes in two regions of the Brazilian State of Pará—Santarém and Paragominas.

"While the focus to date has been on deforestation, we know tropical forests landscapes are being altered by a much broader range of human activities," said lead researcher Dr. Cássio Alencar Nunes from Universidade Federal de Lavras in Brazil and Lancaster University in the United Kingdom. "These modifications include deforestation and degradation of primary forest, for example through selective logging and fires, but even deforested landscapes are changing as agricultural abandonment leads to secondary forest regrowth. As a result, many tropical landscapes are now a mosaic of non-forest land uses, regenerating secondary forests, and degraded primary forests."

By investigating the rate of transformation between different land-uses and their impacts on the ecological condition, the researchers identified the transitions that are common and have high ecological impacts, as well as those that have large impacts but occur less frequently.

"Our results have revealed a richer understanding of how people are affecting the Amazon and its ecosystem," said Dr. Alencar Nunes.



Mosaic of forests, pastures, and agriculture in the Brazilian Amazon. Credit: Marizilda Cruppe / Rede Amazônia Sustentável

Collecting data from 310 plots, the researchers looked how changes affect biodiversity, examining more than 2,000 species of trees, lianas, birds and insects. They also looked at carbon and soil properties.

The researchers also used published data from 2006-2019 about how quickly the landscape has changed over the past decade.

Their results show that transitions from primary and secondary forests to pasture through deforestation amounted to 24,000 km² a year. They found that species richness of almost all biodiversity groups declined by between 18 and 100 percent across plots where primary or secondary forest had been converted to pasture or mechanized agriculture.

Transitions from [forest](#) to mechanized agriculture had the most ecological impact but occurred less frequently than conversion of forests to pasture.

"Deforestation of primary forests to create pasture is the most damaging land-use change in the Brazilian Amazon," said Dr. Alencar Nunes. "Our results show that transitions from [primary forests](#) to pasture were always classed as 'high impact, high rate' for biodiversity, carbon storage and soil properties. This underlines the critical and urgent importance of combating deforestation, which has been increasing in the past few years."

However, the study also revealed opportunities for positive action, for example highlighting the importance of protecting secondary forests and allowing them to mature. They found that the diversity of large trees doubled and small tree diversity increased by 55 percent when young secondary forests became older than 20 years—bringing biodiversity and carbon storage gains.

Other results revealed less obvious forms of degradation that are affecting the Amazon's ecology. They found that changing between types of farming, from cattle pasture to more intensive mechanized agriculture, also diminishes biodiversity, with the diversity of ants and birds decreasing by 30 percent and 59 percent respectively.



Dusky-capped Woodcreeper (*Lepidocolaptes fuscicapillus layardi*) is a bird that is sensitive to forest degradation. Credit: Alexander Lees

Dr. Alencar Nunes said: "These are important findings as they show that there are a multitude of actions that can be taken to protect and improve the ecology of the Amazon. When farmers switch land from pasture to growing crops using mechanized agricultural methods, that is also impacting on biodiversity, but it is a process that is largely hidden when compared to deforestation.

"By reducing the amount of land that is converted to mechanical farming, and by allowing secondary forests to regrow, we can deliver significant ecological restoration gains in the Amazon.

"Our analysis helps to define and prioritize the local and regional actions required to stimulate a better Amazonia."

Co-author Jos Barlow, Professor of Conservation Science at the Lancaster Environment Center of the Lancaster University, highlighted that the study has further implications for conservation and policy.

He said: "Our results emphasize yet again the importance of tackling deforestation, as well as the additional benefits of avoiding degradation and enhancing the permanence of [secondary forests](#). However, achieving this will require transforming the way the Amazon is currently being managed, including a much better integration of science, policy and local practices.

"We also highlight the need to focus on biodiversity as well as carbon in tropical forests—of the three ecosystem components that we analyzed, biodiversity was the most affected by all the land-use changes. We hope that [biodiversity](#) can be included in climate change mitigation actions, and that this will be emphasized in the upcoming COP15 on Biodiversity.

More information: Linking land-use and land-cover transitions to their ecological impact in the Amazon, *Proceedings of the National Academy of Sciences* (2022). [DOI: 10.1073/pnas.2202310119](https://doi.org/10.1073/pnas.2202310119)

Provided by Lancaster University

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