

Climate change could become the main driver of biodiversity decline by mid-century, analysis suggests

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Climate change could become the main driver of biodiversity decline by mid-century, according to a new study published in *Science*. Credit: Oliver Thier

Global biodiversity has declined between 2% and 11% during the 20th century due to land-use change alone, according to a large multi-model study [published](#) in *Science*. Projections show climate change could become the main driver of biodiversity decline by the mid-21st century.

The analysis was led by the German Center for Integrative Biodiversity Research (iDiv) and the Martin Luther University Halle-Wittenberg (MLU) and is the largest modeling study of its kind to date. The researchers compared thirteen models for assessing the impact of land-use change and [climate change](#) on four distinct biodiversity metrics, as well as on nine [ecosystem services](#).

Global biodiversity may have declined by 2% to 11% due to land-use change alone

Land-use change is considered the largest driver of biodiversity change, according to the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES). However, scientists are divided over how much biodiversity has changed in past decades.

To better answer this question, the researchers modeled the impacts of land-use change on biodiversity over the 20th century. They found [global biodiversity](#) may have declined by 2% to 11% due to land-use change alone. This span covers a range of four biodiversity metrics calculated by seven different models.

"By including all world regions in our model, we were able to fill many blind spots and address criticism of other approaches working with fragmented and potentially biased data," says first author Prof Henrique Pereira, research group head at iDiv and MLU. "Every approach has its

ups and downsides. We believe our modeling approach provides the most comprehensive estimate of biodiversity trends worldwide."

Using another set of five models, the researchers also calculated the simultaneous impact of land-use change on so-called ecosystem services, i.e., the benefits nature provides to humans. In the past century, they found a massive increase in provisioning ecosystem services, like food and timber production. By contrast, regulating ecosystem services, like pollination, nitrogen retention, or carbon sequestration, moderately declined.



Land-use change has been considered the largest driver of biodiversity decline in the 20th century. The photo shows an intensively managed grain field in Germany. Credit: Guy Pe'er

Climate and land-use change combined might lead to biodiversity loss in all world regions

The researchers also examined how biodiversity and ecosystem services might evolve in the future. For these projections, they added climate change as a growing driver of biodiversity change to their calculations.

Climate change stands to put additional strain on biodiversity and ecosystem services, according to the findings. While land-use change remains relevant, climate change could become the most important driver of biodiversity loss by mid-century.

The researchers assessed three widely-used scenarios—from a [sustainable development](#) to a high emissions scenario. For all scenarios, the impacts of [land-use change](#) and climate change combined result in biodiversity loss in all world regions.

While the overall downward trend is consistent, there are considerable variations across world regions, models, and scenarios.

Projections are not predictions

"The purpose of long-term scenarios is not to predict what will happen," says co-author Dr. Inês Martins from the University of York. "Rather, it is to understand alternatives, and therefore avoid these trajectories, which might be least desirable, and select those that have positive outcomes. Trajectories depend on the policies we choose, and these decisions are made day by day." Martins co-led the model analyses and is an alumna of iDiv and MLU.

The authors also note that even the most sustainable scenario assessed does not deploy all the policies that could be put in place to protect biodiversity in the coming decades. For instance, bioenergy deployment,

one key component of the sustainability scenario, can contribute to mitigating climate change, but can simultaneously reduce species habitats.

In contrast, measures to increase the effectiveness and coverage of protected areas or large-scale rewilding were not explored in any of the scenarios

Models help identify effective policies

Assessing the impacts of concrete policies on biodiversity helps identify those policies most effective for safeguarding and promoting biodiversity and ecosystem services, according to the researchers. "There are modeling uncertainties, for sure," Pereira adds.

"Still, our findings clearly show that current policies are insufficient to meet international biodiversity goals. We need renewed efforts to make progress against one of the world's largest problems, which is human-caused biodiversity change."

More information: Henrique M. Pereira et al, Global trends and scenarios for terrestrial biodiversity and ecosystem services from 1900 to 2050, *Science* (2024). [DOI: 10.1126/science.adn3441](https://doi.org/10.1126/science.adn3441).
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