

Ecosystems study finds the higher the environmental stress, the lower the resistance to global change

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Open forest in New South Wales, Australia. Photograph by Manuel Delgado Baquerizo. Credit: Manuel Delgado Baquerizo

An international study led by the Institute of Natural Resources and

Agrobiology of Seville (IRNAS-CSIC), of the Spanish National Research Council (CSIC), has shown that as the number of global change factors increases, terrestrial ecosystems become more sensitive to the impacts of global change.

The results, [published](#) in the journal *Nature Geoscience*, show that the resistance of our ecosystems to global change decreases significantly as the number of environmental stressors increases, especially when this stress is sustained over time.

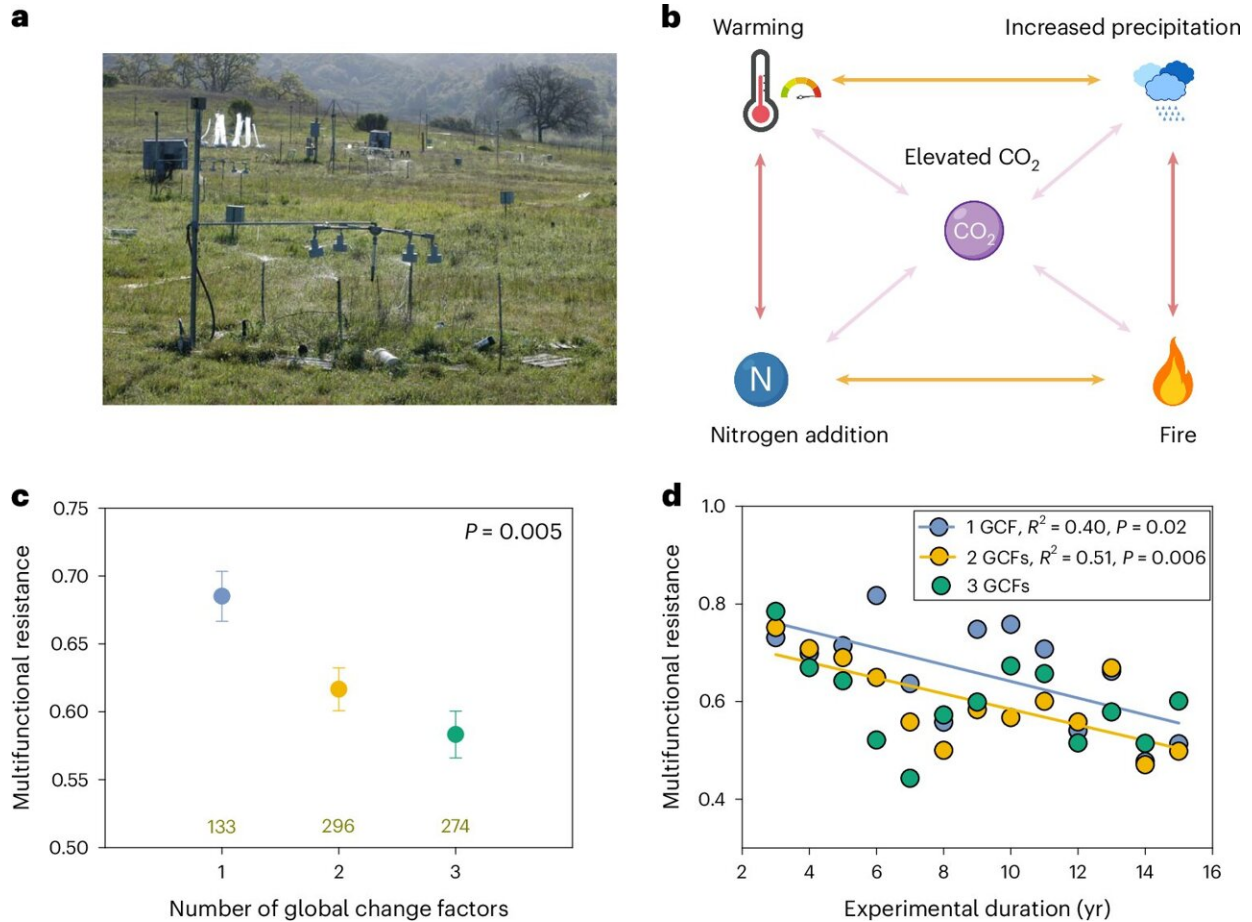
This is the conclusion reached by the Biodiversity and Ecosystem Functioning Laboratory (BioFunLab) at IRNAS-CSIC after analyzing 1,023 global change experiments worldwide in collaboration with 10 international institutions, including the German Center for Integrative Biodiversity Research (iDiv) Halle-Jena-Leipzig, the University of Alicante, the Northeast China Forestry University, the Massachusetts Institute of Technology (MIT) in the U.S., and the University of New South Wales in Australia.

"Terrestrial ecosystems are subject to a myriad of climate change and environmental degradation factors, including [global warming](#), drought processes, atmospheric pollution, fires or overgrazing among many others. We know that these global change factors impact the ability of our ecosystems to provide services such as [carbon sequestration](#) or [soil fertility](#) that are key in the fight against climate change and in food production.

"What we didn't know is how an increase in the number of global change factors affects the ability of ecosystems to resist this global change," explains Manuel Delgado Baquerizo, BioFunLab leader and senior author of the paper.

"Our research shows that as the number of global change factors to

which we subject our ecosystems increases, these ecosystems become more and more sensitive and reduce their natural capacity to resist the impacts of environmental perturbations."



The Jasper Ridge Global Change Experiment conducted over 15 years shows that increasing the number of global change factors erodes the resistance of key ecosystem service (that is, plant production) over time. Credit: *Nature Geoscience* (2024). DOI: 10.1038/s41561-024-01518-x

The study also demonstrates that the continued effects of global change on [terrestrial ecosystems](#) contribute to reducing the natural capacity of

ecosystems to withstand an increase in the number of global drivers of change. This conclusion was reached by analyzing 15 years of data from a U.S.-based experiment involving impacts of multiple global change factors on [ecosystem services](#) as important as primary production.

"Our results show that prolonged exposure to multiple drivers of global change, such as increased CO₂ and warming, gradually decreases the capacity of ecosystems to maintain essential services such as primary productivity. This is crucial to understand the limitations we will face in vital resources such as water and nitrogen," explains Emilio Guirado, co-author of the paper from the University of Alicante.

"Our study shows that increasing global drivers of change will significantly reduce the resilience of ecosystems to global change. However, this effect is much more pronounced on the ability of ecosystems to provide us with ecosystem services than on the biodiversity of our ecosystems," explains Guiyao Zhou, lead author of the paper and member of the BioFunLab.

"These findings show that the sustainability of our ecosystems depends on reducing the number of global drivers of change associated with human activity," concludes Zhou.

More information: Guiyao Zhou et al, Resistance of ecosystem services to global change weakened by increasing number of environmental stressors, *Nature Geoscience* (2024). [DOI: 10.1038/s41561-024-01518-x](#).
www.nature.com/articles/s41561-024-01518-x

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