Higher plant species richness may not be enough to protect ecosystems from the worst impacts of climate extremes

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Higher diversity generally leads to more stable ecosystems, but climate extremes complicate this relationship Credit: Dr Hans De Boeck, University of Antwerp

Studies on mild fluctuations in weather have provided support for the

idea that higher biodiversity results in more stable functioning of ecosystems, but critical appraisal of the evidence from extreme event studies is lacking.

Higher plant species richness is not always sufficient to reduce ecosystem vulnerability to climate extremes, as shown in a comprehensive literature analysis published today in the *Journal of Ecology*.

While biodiversity is under threat around the globe, the number of extreme weather events is on the rise as a direct consequence of climate change. Researchers from several institutes around Europe have now looked into the scientific literature that addresses these global changes to examine the interactions between biodiversity and extreme weather events.

They sought to find out whether and how increased biodiversity may help to uphold the functioning of ecosystems in the face of climate extremes. In other words, can biodiversity help to avert the worst effects of droughts, heat waves and extremely wet weather? The answer, it turns out, is not cut-and-dried. Available evidence from herbaceous systems indicates mixed effects of species richness on biomass stability to extremely wet and dry events.

Why doesn't plant species richness play a consistently beneficial role in ensuring that the functioning of ecosystems is better maintained under climate extremes? The authors provide several explanations for this unexpected finding. First of all, it seems that biodiversity may not offer as much protection if the event in question is very extreme: buffering mechanisms which drive ecosystem resistance, such as compensation by better-adapted species or species taking over the functional role of others (functional redundancy), may simply be overwhelmed in such cases.

However, as lead author Hans De Boeck from the University of Antwerp points out: "Biodiversity may still be important, as it has been shown to speed up recovery of plant productivity after an extreme event."

Secondly, the cause of biodiversity decline may confound biodiversity-stability effects. Unlike in artificially-assembled, experimental systems, widely-observed eutrophication (nutrient enrichment) caused by intensive agriculture, traffic and industry often leads to impoverished ecosystems with few but fast-growing species that are less able to cope with adverse climatic conditions such as drought. Reducing eutrophication and/or maintaining a greater diversity of species with different growth rates within ecosystems could lead to more stable systems that are better able to face extremes.

Finally, species richness may not be the most relevant indicator of 'biodiversity' when studying biodiversity-stability relationships. General patterns of biodiversity effects may be more apparent if scientists consider the diversity in plant traits rather than simply species numbers. "Diversity metrics can include a variety of properties of trait distributions, but studies have only just scratched the surface on the value of these different metrics for extreme event science", says De Boeck.

In order to better harness the benefits of biodiversity for sustained ecosystem function, the authors suggest that future research should focus on understanding the underlying mechanisms of diversity-stability relationships in the face of extreme events. The study presented here highlights current knowledge gaps and provides research recommendations so that ecologists can gain a deeper understanding of the linkages between biodiversity and ecosystem stability in a changing world.

More information: Patterns and drivers of biodiversity-stability

relationships under climate extremes. *J Ecol* onlinelibrary.wiley.com/doi/10 … 1365-2745.12897/full

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