Widely used climate theory doesn't 'ring' true, according to new tree data

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A collage of photographs of the Colorado pine (Pinus edulis), also known as the pinyon pine, contributed to SEINet, an NSF-supported resource. New NSF-supported research using tree rings shows that in the case of these trees, climate envelope theory outlining how individuals within a species will respond to a changing climate might not be true. Instead of half the distribution benefiting from warming, all trees at all sampled locations suffer with warming. Without evolutionary change of individual-scale climate tolerances, common piñon faces a risk of extinction as the climate warms. Credit: Patrick Alexander and Mac Licher, via SEINet (CC-BY-SA)

New data on over 1,500 trees across nearly 1,000 sites shows that an existing theory of how individuals within a species will respond to a

changing climate might not be true.

The data, in the form of tree rings from an aridland pine, contradicts the assumptions underlying climate envelope forecasting, which uses the set of climate conditions or "envelope" under which a species can live to predict how it will respond to climate change.

When looking at temperature, individuals of a species in the coolest area—known as the "leading edge"—are forecasted to benefit from warming while those in the warmer area or "trailing edge" will suffer. If this is true, species' geographic distributions can track changing climate.

When examining the tree ring data, research—published *Proceedings of the National Academy of Sciences* and conducted by Margaret Evans and her team at the University of Arizona—found that the trailing edge encompasses the entire geographic distribution of common piñon, a tree endemic to the Colorado Plateau.

Instead of half the distribution benefiting from warming, all trees at all sampled locations suffer with warming. Without evolutionary change of individual-scale climate tolerances, common piñon faces a risk of extinction as the climate warms.

Evans shares co-first authorship on the paper with a former postdoctoral researcher in her lab, Kelly Heilman, and Sharmila Dey, who first came to the lab as a high school volunteer and is now an undergraduate at Harvard University.

More information: Margaret E. K. Evans et al, Tree rings reveal the transient risk of extinction hidden inside climate envelope forecasts, *Proceedings of the National Academy of Sciences* (2024). DOI:

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