

'Demographic compensation' may not save plants facing changing climate

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The scarlet monkeyflower's wide geographic range across the western US makes it a model system to learn more about climate change responses in plants. Credit: Seema Sheth

An in-depth look at how plants respond to climate change shows mixed results for the phenomenon of "demographic compensation" as a way for plants to avoid severe population declines.

Demographic compensation has served as a possible explanation for the survival of plants that haven't shifted geographic ranges in tandem with changes in climate. It hypothesizes that decreases in some plant characteristics, like survival or growth, may be offset by increases in other plant characteristics, like flowering.

To test the demographic compensation theory, researchers at North Carolina State University and the University of British Columbia surveyed 11,000 plants comprising 32 populations of scarlet monkeyflower, a perennial herb that grows throughout different climate zones in central Oregon, across California and into North Baja California in Mexico, to see how characteristics like survival, growth and flowering differed in plants at more northern and southern latitudes.

Seema Sheth, an assistant professor in the Department of Plant and Microbial Biology at NC State and lead author of a paper on the research, said the results were a mixed bag.

"We found strong evidence for demographic compensation across the scarlet monkeyflower's geographic range," Sheth said.

In the five-year study period, plant survival and growth rates were low in the southern edges of the plant's geographic range - in California near the Mexican border - but flowering rates were high. In the northern edges of the plant's geographic range - central Oregon - survival and growth rates from one year to the next were higher than in the south, but plants didn't flower every year.

Sheth added that even though flowering rates were high in the south, many of these plants flowered once and then died. "Overall, the study suggests that all southern populations declined, so demographic compensation alone may not save these populations from extinction.

"But it's not all doom and gloom," she said. "Demographic [compensation](#) may buy these endangered populations some precious time for climatic conditions to improve or to allow evolutionary processes to help the plant adapt to unfavorable conditions."

Sheth said that the 2010-2014 study, which began while she and Angert were at Colorado State University, occurred during record hot and dry years in California. Rather than skewing the study, she said that the conditions faced by plants during the study period are expected to become more common due to climate change.

Sheth plans to follow up with a study that will take a "resurrection approach." She will "resurrect" plants from seeds collected across the scarlet monkeyflower's geographic range before and after the 2010-2014 study to learn about the impact of strong climatic events on the genetic variation of important traits. If southern plants needed to flower early in order to survive, for example, Sheth may be able to see noticeable selection of genes involved in early flowering, thereby limiting the genetic variability of this important trait in those southern [plants](#).

"This approach allows us to resurrect pre-drought ancestors from stored seeds and compare them to post-drought descendants in the same environment, essentially allowing us to travel in time," Sheth said.

The study appears in *Proceedings of the National Academy of Sciences*.

More information: Seema Nayan Sheth et al, Demographic compensation does not rescue populations at a trailing range edge, *Proceedings of the National Academy of Sciences* (2018). [DOI: 10.1073/pnas.1715899115](https://doi.org/10.1073/pnas.1715899115)

Provided by North Carolina State University

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