Plants take a hike as temperatures rise

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Miniature woolly star, known to scientists as Eriastrum diffusum, is one of the plants that has been blooming at higher elevations in Arizona's Santa Catalina Mountains as the summer temperatures warm. Credit: C. David Bertelsen

Plants are flowering at higher elevations in Arizona's Santa Catalina Mountains as summer temperatures rise, according to new research from The University of Arizona in Tucson.

The flowering ranges of 93 plant species moved uphill during 1994 to 2003, compared to where the same species flowered the previous ten years. During the 20-year study period, summer temperatures in the region increased about 1.8 degree Fahrenheit (1 degree C.).

"For years, probably decades now, scientists have been trying to understand how species are going to respond to the anticipated global

changes and global warming," said Theresa Crimmins, research specialist for the UA's Arid Lands Information Center and the network liaison for the National Phenology Network.

To better understand how plants respond to climate change, Crimmins and her husband, UA climatologist Michael Crimmins, teamed up with naturalist Dave Bertelsen. He's been hiking the Finger Rock trail about one to two times a week since 1983 and recording what plants were in flower.

The 5-mile hike starts in desert scrub vegetation and climbs 4158 feet (1200 meters), ending in pine forest. Bertelsen has completed 1,206 round-trip hikes and recorded data along the trail for nearly 600 plant species, he said in an e-mail.

Lead author Theresa Crimmins said Bertelsen's data shows that some species flowered farther upslope than before, others stopped flowering at lower elevations, and some species did both.

Because some plant species are moving and others staying put, she said the changes may divide plant communities, increase the growth of invasive species and even cause local extinctions by affecting the food sources of local insects and animals.

"I think we can be confident that things are going to continue to change and we don't necessarily know the ripple effects of all these changes in flowering ranges," Crimmins said.

Theresa Crimmins, Michael Crimmins, assistant professor and climate science extension specialist for the UA's department of soil, water, and environmental science, and Bertelsen will publish their paper, "Flowering range changes across an elevation gradient in response to warming summer temperatures." The paper is published this week in the

online Early View of the journal *Global Change Biology*.

Many scientists have wanted to study the movement of flowering ranges, but lack the years of detailed data required for this research, Theresa Crimmins said.

At a meeting about monitoring plant species held by the U.S. Bureau of Land Management in 2005, Crimmins discussed his need for data to study the effect of climate change on ecosystems over time.

Bertelsen was at the meeting and told Crimmins about the extensive data he had collected during his many years hiking Finger Rock trail. Bertelsen had the sense some plants were flowering farther uphill and had observed many changes he attributed to drought.

Bertelsen had begun hiking the trail in 1981 and fell in love with the flora and fauna. He had just taken up macrophotography and took close-up pictures of all types of plants and animals while recording his observations in a journal.

"Somebody once said that I have this compulsion. I don't feel driven at all, it's drawn. If I miss a week, I miss it. I just feel that I'm really part of that canyon and it's a part of what I am. It's just good old human curiosity," Bertelsen said. "There's always something different. It's just absolutely amazing."

In 1983 he developed a checklist to document each species in bloom along each of five one-mile long trail segments. Thus, on a single day, if a particular plant was seen in bloom in three segments, there would be three different records. Bertelsen collected flowering data from 1984 to 2003.

To see whether the plants had shifted their flowering, the Crimminses

compared Bertelsen's location records from 1984 to 1993 for 363 plant species with his records from 1994 to 2003 for the same species.

The Crimminses used climate data from six National Weather Service Cooperative Observer Network stations surrounding the trail to see how the temperature varied during the 20-year study period.

The Crimminses' collaboration with Bertelsen is a great example of how scientists and amateur naturalists can work together, Theresa Crimmins said. As part of its mission, the National Phenology Network encourages such collaborations to document events in the life cycles of plants and other organisms.

Theresa and Michael Crimmins plan to do additional analyses of the data to determine whether climate change is also causing flowers to bloom earlier in the year.

"The changes are happening fast enough now that more eyes on the ground are going to be much more useful as the human species tries to understand how these other systems, that we rely upon so dearly, are going to change," Theresa Crimmins said.

"We can really start to think about what the true impacts of those changes are and how can we mitigate these impacts."

National Phenology Network: www.usanpn.org/

Source: University of Arizona