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## Persistent hiker discovers plants blooming at higher elevations than ever before

By Tony Davis

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After scaling a Catalina Mountains hiking trail more than 1,000 times over 20 years, David Bertelsen has turned pleasure into hard science.

Bertelsen's observations of thousands of flowering plants on the Finger Rock Trail led researchers to conclude that dozens of varieties are blooming at higher elevations than used to occur.

This phenomenon, documented in staggering detail, was discovered by an unusual research method in the annals of science: a weekly 4,158-foot trek to a mountaintop. In this case, the peak is the 7,255-foot Mount Kimball, lurking just behind the Catalinas' front range.

Bertelsen's findings suggest that global warming is causing the plants' flowering range to move uphill, said one of two University of Arizona researchers who worked with Bertelsen on a study published last week in a scientific journal.

Bertelsen, a retired probation officer, is what many researchers call a citizen scientist. It's a term he dislikes but that's coming into vogue nationally, as universities and governments enlist average folk to help them track the effects of climate change on plant and animal life.

He started climbing the Kimball trail in 1981, and fell instantly in love with the area's steep, craggy, reddish cliffs. He was entranced by the dramatic changes he saw in animal and plant life as he moved uphill. In January 1984, after 30 hikes only increased his love for the trail, he started climbing it once a week.

Acting out of what he calls sheer curiosity, he also started recording every plant he saw on a 30-foot-wide swath on either side of the trail. Over the next 20 years, he marked on a checklist the identities of more than 111,000 individual plants and would paste or tape individual flowers and leaves into a loose-leaf notebook.

Over time, he came to feel that "I belong in this canyon, that I am truly a part of it. If I miss a week, I miss it. It's good old human curiosity. There's always something different. It's absolutely amazing."

Finger Rock is a steep, exhausting trail for the novice hiker. It rises 4,158 feet in five miles, from Sonoran Desert scrub to pine forest, offering sweeping views of the valley floor stretching north from the Tucson suburbs toward the community of Oracle.

On Bertelsen's treks, he has spotted a broad mix of desert specialties, led by but hardly limited to the saguaro, whose white blossoms have earned the honor of Arizona's state flower.

Of 363 flowering plant species Bertelsen documented in that period, 93 — about 26 percent — bloomed at higher elevations during the second half of that 20-year period than they did in the first half.

Some of those plants also stopped flowering at lower elevations. Others did both: flowered at higher elevations and stopped flowering at lower elevations.

Over the same period, average summer temperatures recorded at six weather stations in the vicinity of the trail rose about 1.8 degrees Fahrenheit.

The relationship between rising temperatures and rising floral blooms amounts to a strong correlation, although not clear-cut proof that warming was the cause, said Theresa Crimmins, a research specialist for UA's Arid Lands Information Center.

The reason a cause isn't proved is that the researchers didn't conduct a classic controlled experimental study, in which the bloom changes on Finger Rock Trail would be compared with what happened on a similar trail where temperatures didn't rise as fast.

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But these findings are right in line with at least 10 and up to 30 other studies documenting the effects of rising temperatures on plant activity, said Crimmins. She co-authored the study with Bertelsen and Michael Crimmins, her husband and a UA climatologist.

On the surface, the upward movement of floral blooming may seem innocuous. But because some plant varieties are moving uphill and others aren't, these changes can make space for invasive species to move in, and may even cause local extinctions by reducing the food sources of local insects and animals, Theresa Crimmins said.

Since the researchers found that every plant was moving individually rather than as part of a "nice, neat community" of plants, that opens the door for conditions to change a lot, she said.

One species that has apparently taken advantage of this new niche created by the plant movements is buffelgrass. It's a highly invasive grass that many scientists say threatens the Sonoran Desert's basic health — and that Bertelsen has indeed seen at higher elevations than he used to.

For his part, Bertelsen said he never thought about global warming as a cause of the floral bloom movements until he went to a meeting on another topic in 2005 and ran into Michael Crimmins.

But, he recalled, he had "kind of sensed all along" that the blooms were moving uphill, although not for as far a distance as they turned out to be moving.

He is one of many observers around the country who have found changes in plant life and sent their findings to universities and other research institutions.

His work is exactly what Theresa Crimmins hopes to get more of as she and others at the UA try to build a National Phenology Network. The network encourages plant-counting research from citizen scientists, in hopes of gleaning more indications of plant changes from warmer weather.

Bertelsen thinks "citizen scientist" is a dumb term.

"To me, 'amateur' is the right term. What's Theresa and Mike? Are they non-citizen scientists?" he said.

To be honest, he added, "I'm just glad that my work is useful to someone. I did it because it was interesting."

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