



Species no longer act as a single ecosystem; experts cite warming

Our enduring desert may be coming apart at the seams

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The Sonoran Desert is fracturing, with species increasingly doing their own thing rather than growing together as a single ecosystem, researchers say.

If the trend toward hotter, drier weather continues, eventually the desert we know will look different, a new study finds.

Today, when we see palo verde, ironwood, saguaros and organ pipe cacti growing together, that tells us we're in the Sonoran Desert, said Sue Rutman, an Organ Pipe plant ecologist who participated in this study by the United States Geological Survey and in a similar one of just one desert plant species in 2002.

But, she said, "in the future those species may not be able to live together anymore."

"Some people are under the impression that the Sonoran Desert with climate change is going to move northward or eastward or westward, but we'll still have a desert," Rutman said. "But that's not what's really predicted. What's predicted is that each of these species will go in its own way and the system will be unzipped."

The study found that in certain kinds of plant habitats in four prime Southern Arizona desert settings, some signature plant species are on the rise while others are in decline due to our hotter, drier climates of recent decades.

In the future, climate change is likely to have major but inconsistent effects on desert plants, with drought-tolerant cacti faring better than thirsty trees and grasses, researchers said in a peer-reviewed study published in the Global Change Biology Journal.

The study analyzed plant population trends in four of the planet's longest-running vegetation monitoring sites: Saguaro National Park, the Santa Rita Experimental Range, the Desert Research Laboratory on Tumamoc Hill and Organ Pipe National Monument. The plots at Tumamoc and Santa Rita date back more than a century.

Here's what researchers found:

- Prickly pear and cholla cacti, long known for being hardy in dry weather, have risen in recent decades. It happened most consistently in Sonoran Desert grassland regions such as at mid-level elevations in Saguaro National Park East. The number of cacti at the park rose by 10 times from 1965 to 2005, said United States Geological Survey researcher Seth Munson, the study's lead researcher.
- Mesquite trees, grass cover and forbs, broad-leafed herbs, such as desert marigold and poppies, have declined since the 1990s at Saguaro National Park and the experimental range. At the experimental range, which has monitored plant populations since 1902, the percentage of grass cover has dropped from close to 5 percent in the 1980s to 2 to 3 percent today, said Mitchel McClaran, the range's research director.
- In lower-elevation, desert scrub settings, the kind many people associate with the Sonoran Desert, creosote bush, ocotillo and foothill palo verde trees declined under certain conditions in hotter, drier weather. Creosote, for instance, declined in areas of older soils, where rock-hard caliche layers can form and limit the roots' access to nourishing soil and water. Palo verde have declined over the past two decades, with mainly older trees dying off faster than they used to.
- Saguaro cacti are generally doing better today than a few decades ago, but it's too early to say if this desert icon is unequivocally on the rise. In recent years the number of young and/or baby saguaros has declined in some places after increases in earlier years and decades. At Tumamoc Hill, saguaro populations are clearly rising, but more analysis of the Desert Lab's data is needed to determine if that represents a genuine, long-term population gain.
- At Organ Pipe National Monument, some researchers found a separate study that indicated a major increase in a vine cactus, very rare in the United States, between 1944 and 2002. The Sonoran Queen of the Night cactus, whose scientific name is *Penicocereus striatus*, is a slender-stemmed variety that grows more than 6 feet tall in some places and lives only in frost-free Sonoran Desert settings.
- Also at Organ Pipe, scientists have documented a major decline in the small Acuña cactus since the 1990s, although they're not sure if it's due to climate change.

Response to climate change

Whether plants have an individual or shared response to climate change is an active area of research and debate going back to at least the 1920s, said Munson, the study's lead researcher.

Cacti, for instance, can be expected to increase in high temperatures because this region gets fewer days with freezing temperatures today than it did 50 years ago, he said. Succulent plants such as cacti store water in their tissues, making them vulnerable to frost, so less frost means less risk of tissue damage and mortality.

In mesquite savanna communities of grass and woody vegetation, the largest increase has been in prickly pear cacti. At the desert lab, Munson said, staghorn cholla appears to be on the rise.

In Arizona's upland communities, ocotillo, a semi-succulent shrub, decreased on south and west-facing slopes with higher temperatures. Roots can be susceptible to direct heat damage and low water availability at high temperatures, the study found.

Change is ongoing

This phenomenon isn't unique to today or to the Sonoran Desert.

Other research has shown that plant communities of thousands of years ago changed along with the climate, Munson said. "We don't have a plant community today that looks like it did thousands of years ago," he said.

In 2007, researchers in the Ecological Society of America's journal noted this ancient trend and warned that continued greenhouse gas emissions would eventually lead to "novel communities and other ecological surprises" worldwide.

Last year, University of Vermont researchers published findings that on a mountain in that state, various plants behaved differently from one another at some elevations but not others as temperatures gradually rose between 1964 and 2006.

The latest, USGS study is the first one to examine these seemingly conflicting effects in detail across the Sonoran Desert. What's missing, Munson said, is how the various plant species interact, how quickly plants can spread and their ability to reproduce in changing climates.

Still, one of the study's take-away messages should be that **long-term monitoring can help determine causes of the changes and predict future changes**, he said.

"The desert is a very complex place. We barely understand it," said Robert Webb, a USGS hydrologist. "Compared to the conditions in the '80s and '90s, we'll be seeing some die-offs. It's going to look bad.

"But does that mean the desert is going away and going to turn into a dust bowl? No."

"The desert is a very complex place. We barely understand it."

Robert Webb, USGS hydrologist

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