

Will the iconic saguaro cactus start to disappear from parts of the Southwest?



Saguaros at Boyce Thompson Arboretum

Saguaro cacti grow on a north-facing slope at Boyce Thompson Arboretum on April 23, 2020. As the climate in the Sonoran desert has warmed, Saguaro cacti, which typically grow on south or east-facing slopes, has been found increasingly recruiting on north-facing slopes.

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The saguaro cactus, an iconic symbol of the Southwest and a key cultural touchpoint to desert tribal peoples such as the Tohono O'odham, may one day begin to fade from some parts of the Sonoran Desert as natural and human-caused factors reshape the landscape.

Already scientists are seeing changes in the way saguaros grow in their native habitat. Cactuses are reproducing in smaller numbers, struggling to survive in urban areas and have begun to "migrate" in some places as temperatures rise.

A 2018 report by the [National Park Service](#) found that climate change, drought, invasive plants like buffelgrass and stinknet, and activities such as woodcutting and cattle grazing have left fewer saguaro seedlings to replace aging and dying specimens.

A team of more than 475 citizen scientists collected data in long-term study areas at Saguaro National Park that contain about 10,000 saguaros. The researchers counted just 70 that were less than 1 foot in height, which equates to less than 15 years old.

Don Swann, a biologist at the park and co-author of the 2018 study, said seedlings and juvenile cactuses have been on the decline since the 1990s.

"We don't get a crop of saguaros every year under any conditions," said Swann. "A lot of saguaros come into the population when we get just the right precipitation and temperature."

That level of rapid reproduction can occur anywhere from 5 to 20 years apart. "But we've been in a long drought and we've had very few saguaros coming into the population," he said. "It's definitely something to keep an eye on."

The giant cactuses have a relatively small area where they can survive. Although a few saguaros grow on the west side of the Colorado River, Swann said, "they're pretty much confined just to the Sonoran Desert areas in Sonora, Mexico, and southern Arizona." They need just the right conditions of heat versus cold and summer moisture to survive.

One of the critical limiting factors is that they are not freeze tolerant, he said. "They can handle frost. But if you have a night that's below freezing, followed by a day that does not get above freezing, followed by another night below freezing, then you'll start to get mortality in saguaros."

Giant plants have sensitive growth factors

The giant cactuses, some of which can live for up to 200 years, grow to maturity at an equally long pace. That slow growth can be disrupted by many factors.

"When they're little, they can't store much water, they're very vulnerable," said Swann. "For the first few years, they have to have beneficial climate conditions so they can reach the point where they can store some water against the droughts."

Adult saguaros are more resilient, Swann said, but the seedlings are at the mercy of the weather.

Invasive grasses and other plants also take a toll on baby saguaros. "Buffelgrass is a really significant problem," he said. It directly competes with saguaros and other native plants for water. "It's so aggressive that it takes up water after rain before other plants can."

Invasive grasses create another hazard to both baby and adult saguaros (*Carnegiea gigantea*): wildfire. Fires are particularly hazardous to the giant cactuses, which can't withstand flickering flames and heat that can reach 900 degrees.

"Saguaros are just columns of water," said Swann. "When it heats up it'll kill the plant." Wildfires have killed large numbers of saguaros.

Park staff and volunteers have been working to reduce exotic plant species, Swann said. Efforts to eradicate them have been successful in some areas, but the problem is widespread.

Then there's the problem of nurse plants, or rather the lack of nurse plants.

Kevin Hultine, plant physiologist at the Desert Botanical Garden, said saguaro seedlings require species such as mesquite, palo verde and ironwood trees to make it through those first critical decades.

"They create a microenvironment that is more conducive for the seedlings to survive," said Hultine. "But through a combination of climate change and land use, there may be fewer and fewer of these woody plants on the landscape for them to grow under."

The National Park Service study attributed woodcutting and cattle ranching as factors that contributed to reduced numbers of these key species.



Your admission fee to Saguaro National Park is valid for seven days and provides entry to the east and west sections of the park. (Photo: Roger Naylor/Special for the Republic)

Effects of urban heat island, elevation

The urban heat island in the Phoenix metro area also affects the saguaro's metabolism, Hultine said.

"All the concrete on the landscape absorbs heat and hangs onto it," he said. "And so the temperatures at night are much higher than you would see in the open desert."

Virtually all cactuses use a method known as CAM, or [Crassulacean acid metabolism](#), to minimize water loss during photosynthesis, he said. Instead of taking in carbon during the day, saguaros open tiny stomata, or pores, on their skin at night when temperatures are cooler.

"But when you have very warm evenings in the middle of the summer, nights can still be in the 80s," said Hultine. That's warmer than what the enzymes that power the giant saguaro's photosynthesis need to work most efficiently. The reduction in enzymatic action reduces carbon dioxide uptake, which is the food of the plant, he said.

Less food equals less energy to produce flowers for reproduction or to grow.

"This is a very tough environment for especially young plants," Hultine said, especially during droughts.

He said conditions for the giant cactuses are more amenable at higher elevations, such as Cave Creek. At 2,100 feet in elevation, "it's not nearly as hot in the nighttime as it is right here in the middle of Phoenix's urban footprint," Hultine said.

Swann said both elevation as well as water can play a role in saguaro health.

"The western part of the park, which is the west side of Tucson, is actually fairly low and warmer than the eastern part of the district," he said. "The district on the east side of Tucson is a sky island."



Desert Botanical Garden uses red paint to measure cactus growth. (Photo: Debra Krol/The Republic)

Cultural connections to the cactus

The saguaro, known as ha:sañ in the O'odham language, is a key species for Indigenous peoples. Lois Liston, a citizen of the Tohono O'odham Nation and a traditional singing and art teacher at [Ha:san Preparatory & Leadership School](#) in Tucson, is also a traditional saguaro fruit harvester. She related a story about how the saguaro came to be considered a person to the Tohono O'odham, or Desert People.

"A young child was left alone with some provisions by its mother who went off to play toka (a traditional O'odham game)," said Liston, who added that the story varies depending on which O'odham community tells the tale.

The child meets up with four animals who help find the mother. But the mother told the child to wait because she was so involved in the game. The youth was so sad that he started sinking into the ground. Later, the mother came back to see a cactus growing where her child was. The cactus gave people fruit, which Liston said was a good outcome to a sad tale.

O'odham have made use of the saguaro for food, building materials and to pass culture down through the generations ever since.

"We base our new year when the fruit is ready to be gathered," said Liston. After animals and birds have eaten their share, people gather the fruit, using tools fashioned from saguaro ribs. Families share stories, songs and histories while gathering the fruits. "It's part of our life," said Liston.

Although the saguaros are still thriving in the higher parts of the Tohono O'odham lands, Liston said the increasingly hot summers take their toll on gatherers.

"We used to go out for three, four days at a time," she said. "But now it's just for two days, and we can only go out in the early morning instead of mornings and afternoons because it's so hot."



A saguaro at Desert Botanical Garden in Phoenix. (Photo: Courtesy of Martha Reith)

The future of the giant cactus

As the climate changes, saguaros are starting to adapt, said Lynne Nemeth, executive director of Boyce Thompson Arboretum in Superior.

“For the first time we’re seeing saguaro cactus actually growing in northern facing slopes as a way of avoiding the heat and sun,” she said. “So they are changing their habits, which is interesting.”

Nemeth said the arboretum isn’t the only location where saguaro adaptation has been observed. A [study conducted](#) by a University of Arizona researcher and the U.S. Geological Survey at the Desert Laboratory on Tumamoc Hill, a nature preserve in Tucson, found that many young saguaros there were also growing on the north-facing slope of the hill.

The citizen scientists who volunteered thousands of hours in the studies as well as home gardeners can play a key role in preserving these giant cactuses.

“There’s a lot of recognition that citizen science is really critical for our understanding of how the earth is changing,” said Hultine. “People who have saguaros in their

neighborhoods or in their own yards should take notes when they're flowering and how many flowers that they produce."

Hultine said home gardeners and citizen scientists can send their data to the [National Phenology Network](#), a nonprofit organization that monitors the effects of climate change on plants and animals in the U.S. (Find it at [usanpn.org](#))

"The more information out there, the more we will collectively be able to understand how climate change is impacting the world in which we're living," Hultine said.

Swann also praised the work of volunteers. "One of the things that we do at the park that I'm really proud of is we have citizen science events," he said. "We can bring people out to the park and train them to help us collect data on saguaros."

Also, he said, "If we could get everybody out there, you know, pulling buffelgrass and eradicating stinknet and dealing with these issues, it just really helps nature be more resilient to the changes that are occurring."

Swann also encouraged residents to learn more about the desert where they live. "Anything you can do, like plant native plants and encourage native animals, plants and pollinators, are beneficial to the Sonoran Desert ecosystem."

"I'm confident the saguaros are going to be here for a long time," said Hultine. "It's possible that some of the locations that we see it today may not be able to persist in the future. But for the most part, I think they'll be around, and that's something I think we can feel good about."

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