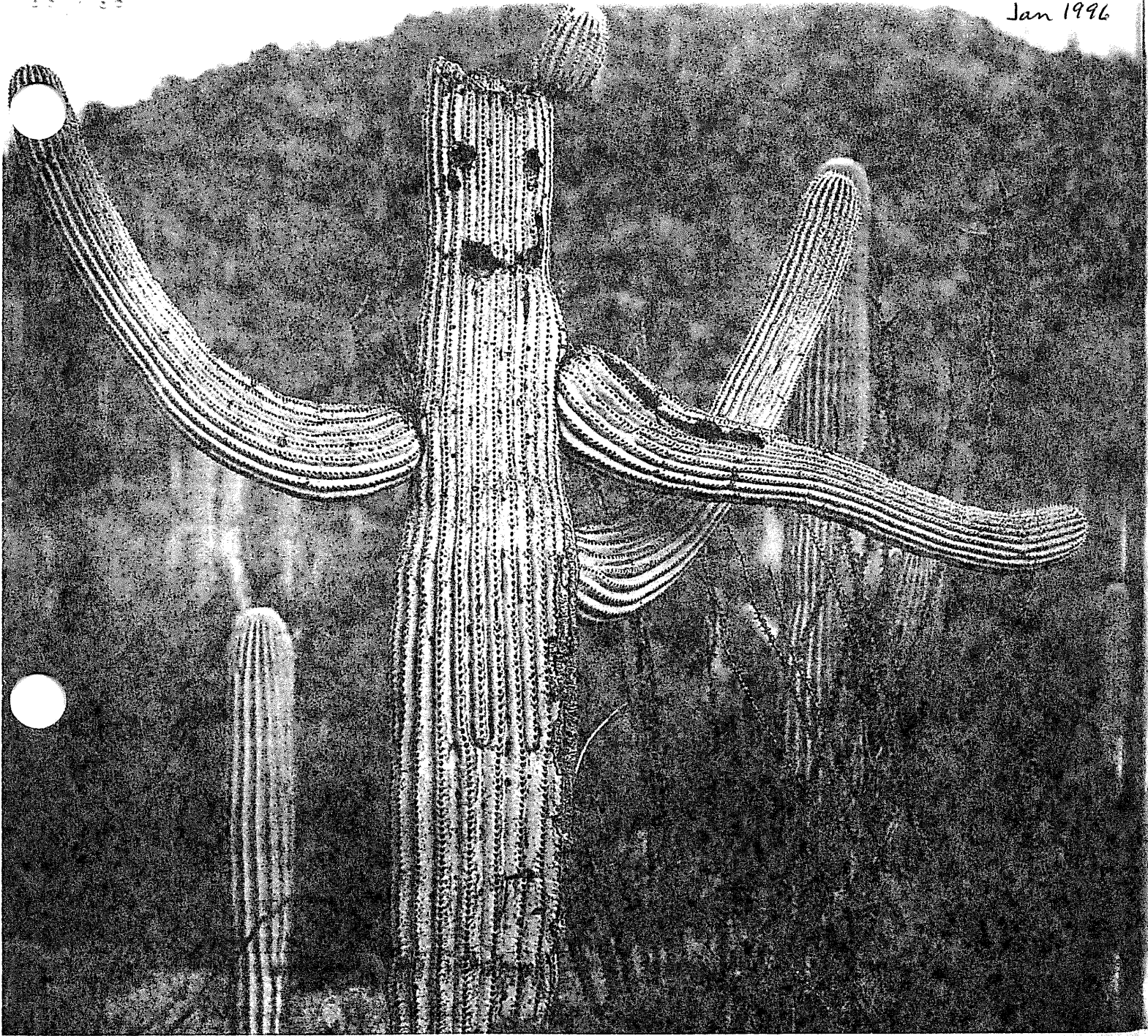
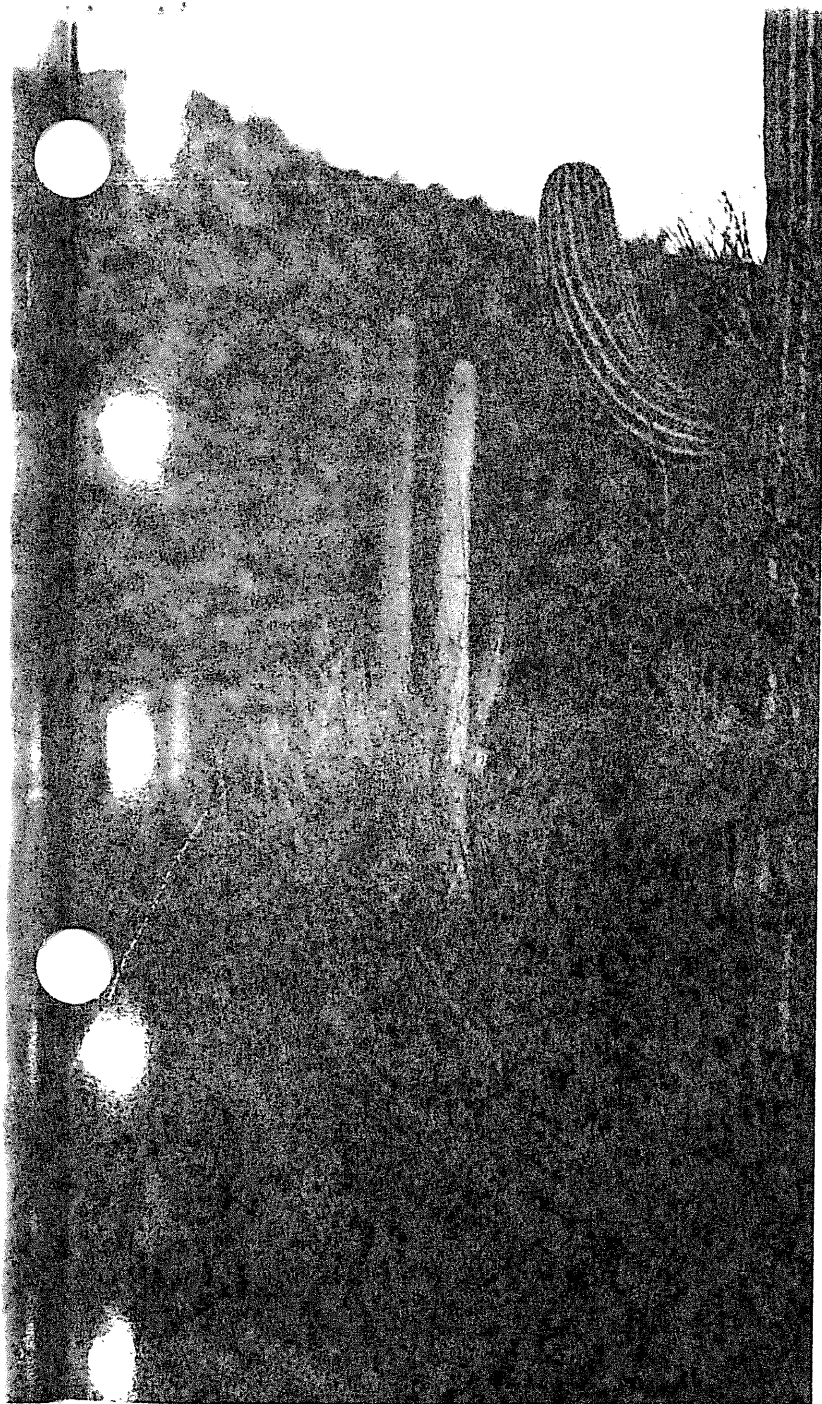




By Susan Hazen-Hammond

A giant shrugs off vandalism, poaching, tales of its demise

The Sonoran Desert's mighty saguaro cactus is the living embodiment of the Southwest, a 'charismatic megaplant' that people care about



Damage and decay have left this ten-foot specimen looking eerily like Gumby, the cartoon character.

One sunny February day several years ago, David Grundman, 24, a maintenance worker in Phoenix, Arizona, pulled on his Levis and boots and set out into the desert with a 16-gauge shotgun. That day, he saw all sizes and shapes of saguaro, the largest species of cactus in the United States. Some had so many bird cavities, rodent tunnels and bullet holes in them that their trunks and arms seemed made of spiny, green Swiss cheese. A few oozed a black bile that smelled like vinegar.

Grundman picked up his gun. We will never know what he was thinking. He shot a small saguaro in the trunk so many times that it thudded to the ground. "The first one was easy!" he called, according to a witness. Then he aimed the shotgun at a saguaro four times taller than he and fired. Before the ringing in his ears had stopped, a four-foot spiny arm, severed by the blast, fell on Grundman, crushing him.

Grundman's death by flying cactus quickly became the lead story in the unwritten book of saguaro lore. Years later, as I crisscrossed the Sonoran Desert—the only place on Earth where saguaros grow—scholars, desert rats and urbanites were still talking about the "saguaro that fought back."

Even without a macabre twist, the death of a giant saguaro makes the news. In January 1994 the *Arizona Republic* devoted nearly half a page to the demise of "Old Granddaddy," a 44-foot-tall, 50-arm saguaro estimated to be 300 years old.

"People identify with the saguaro. It's a symbol," says Raymond Turner, a retired biologist. Around the world the celebrity cactus has become a symbol not just of the Sonoran Desert but of the West and the entire United States. And although thousands of other plants, including more than a hundred Sonoran Desert species, are at greater risk for extinction, no other cactus and few other plants have produced greater or longer-lasting concerns about their survival.

All this for a plant with such a small range that it grows only in certain parts of the Sonoran Desert: in highly specialized microclimates in Arizona, in the Mexican state of Sonora and on the fringes of southeastern California. In the United States, the saguaro typically likes rocky soils with good runoff, on south-facing slopes. Again and again throughout the Sonoran Desert, stands of the stately cactus thin and stop, then reappear many miles away.

Saguaros are thought to have established themselves in their current range about 11,000 years ago. One of the legends of the Tohono O'odham peoples says the first one was created when a girl sank into the earth and rose back out as a giant cactus. Ever since, saguaros have been an essential part of desert dwellers' lives.

The cactus flesh, heated over coals, soothed rheumatism's pains. The flowers produced a sealant. The juice, turned to vinegar, allowed artisans to etch seashells. When a northern flicker or Gila woodpecker pokes through the waxy epidermis to make a nest, the cactus forms a callus. For centuries humans have harvested these callus-covered hollows, called boots, from dead saguaros and used them as containers. They have used the woody ribs to make shelters, tools, furniture, toys, splints and ceremonial objects.

Perhaps the greatest gift of the saguaro, however, has been its fruit. One evening late in June, when the sun

was about to set and the temperature had drifted down to 105 degrees F, I rendezvoused with Stella Tucker, a Tohono O'odham woman who lives in Tucson but moves into the desert each June during the harvest. We met at her ramada, an open-air shelter at a harvesting camp that she took over from her great-aunt, whom she calls her grandmother, according to O'odham custom.

The fruits keep her busy. Evenings and early mornings she harvests. For five hours during the hottest part of the day, she simmers saguaro juice over a mesquite fire until it turns into a thick, reddish-brown syrup that tastes like molasses. She spreads fresh pulp out to dry; before she can make jam from the dried pulp, she has to pull the seeds loose. Although the fruit is only a couple of inches long, the seeds are so tiny that one fruit contains two thousand of them. "My grandma used to make porridge out of the seeds," Tucker said. Sometimes Tucker still makes porridge or candy. Sometimes she uses the seeds for chicken feed.

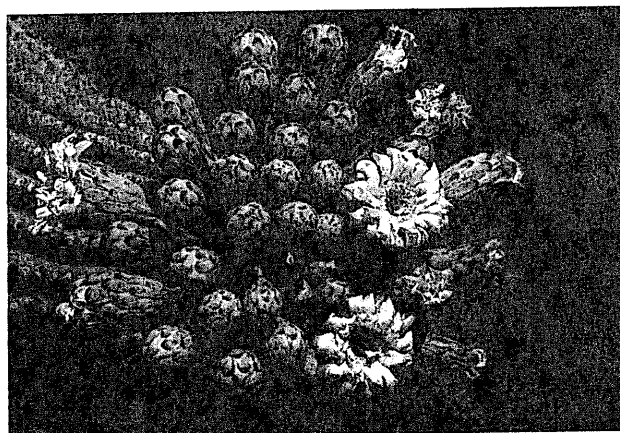
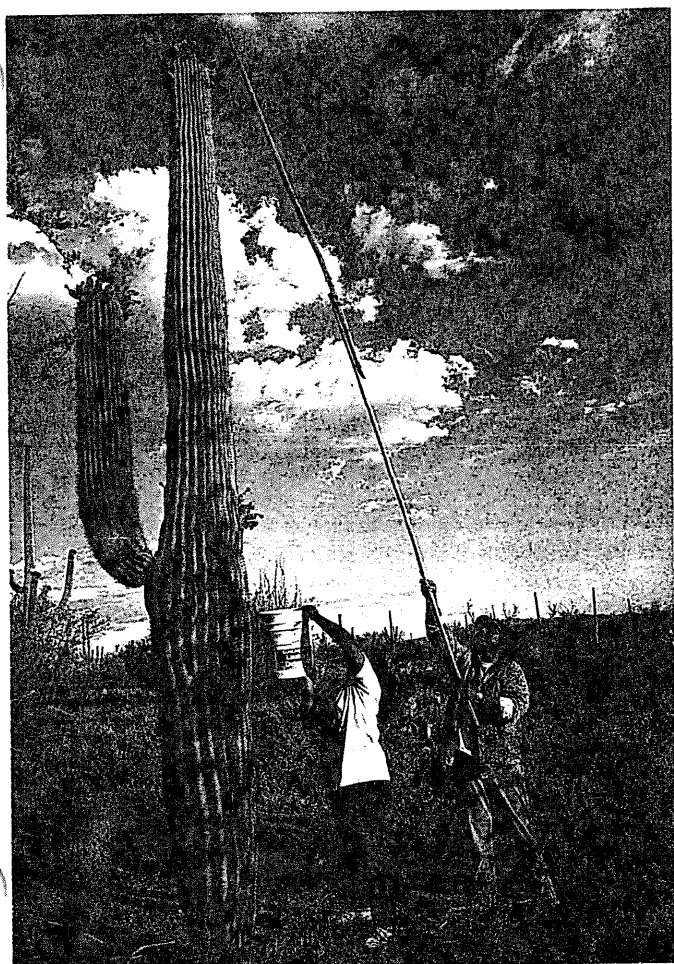
That evening, Tucker hefted a 16-foot-long harvesting tool onto her shoulder. It consisted of two overlapping

ten-foot saguaro ribs lashed together, with a crosspiece of wood at one end. Saguaro juice had stained the crosspiece a deep red.

Tucker and I and two young visiting relatives set out through a grove of prickly pear, jumping cholla and saguaros. In the soil a foot beneath us, each saguaro spread its roots in a circle wider than the cactus' height, waiting like a concealed net to harvest the summer rains. A young saguaro can lose 80 percent of its body fluids and survive. These had lost less, but after months of not having replenished the water stored in their pleated trunks, the pleats had pulled together like closed accordions.

The saguaro begins blooming in late April, in the desert's driest season, attracting birds and other pollinators, including bees and bats. The trumpet-shaped white flowers open at sunset and wither by the following afternoon. Pollinated flowers metamorphose into fleshy fruits about three inches long, which slowly redden as they ripen.

On this June evening, a crown of 20 or so fruits and a



The blossoming of a saguaro (at top) is followed by the development of fruits (above), which Stella Tucker and her niece (left) harvest with a cactus-rib pole.

few late-blooming buds decorated the end of each arm and the tops of the central trunks of many of the cacti. We stopped at one that rose ten feet above us. It lacked arms, but its trunk wore a wreath of fruits. Most saguaros flower for the first time by age 50 but wait another 25 years or more to grow arms. This one was probably younger than 75, not yet halfway through the usual life span of 150 to 200 years.

While one of the girls held a bucket high, Tucker positioned the harvesting pole and tugged. Fruits came flying down, one and two at a time. Those that missed the bucket splatted on our shoulders, heads and arms. "It's raining," Tucker laughed. "That's what my grandma used to say."

Using her thumbnail, she slit a fruit open and handed me some pulp. "In the old days people used the fruit to help quench thirst," she said. Juicy and sweet, it tasted like a cross between a watermelon and a fig.

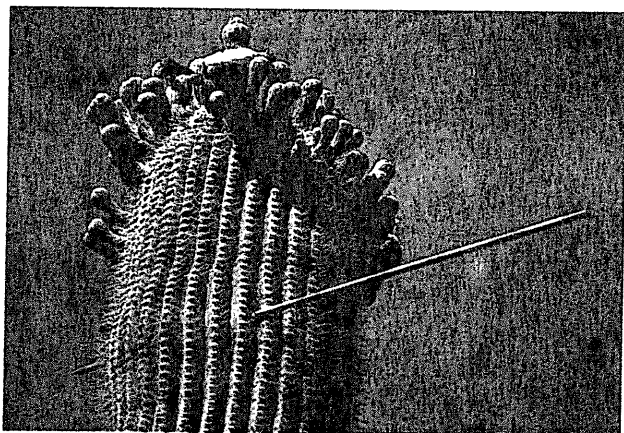
We moved from plant to plant until the bucket grew heavy, although less than half full. As we walked back toward the camp in the twilight, Tucker said, "We O'od-

ham people treat our saguaros as people. We consider them as people. We consider them with respect."

Like human beings, the saguaro (*Carnegiea gigantea*) is the only living species in its genus. And like us, it is subject to endless stresses. Its vulnerability begins with its reproductive patterns. In a century of blooming, an individual saguaro may produce 40 million seeds. But often only one will develop into a mature plant that outlives its parent.

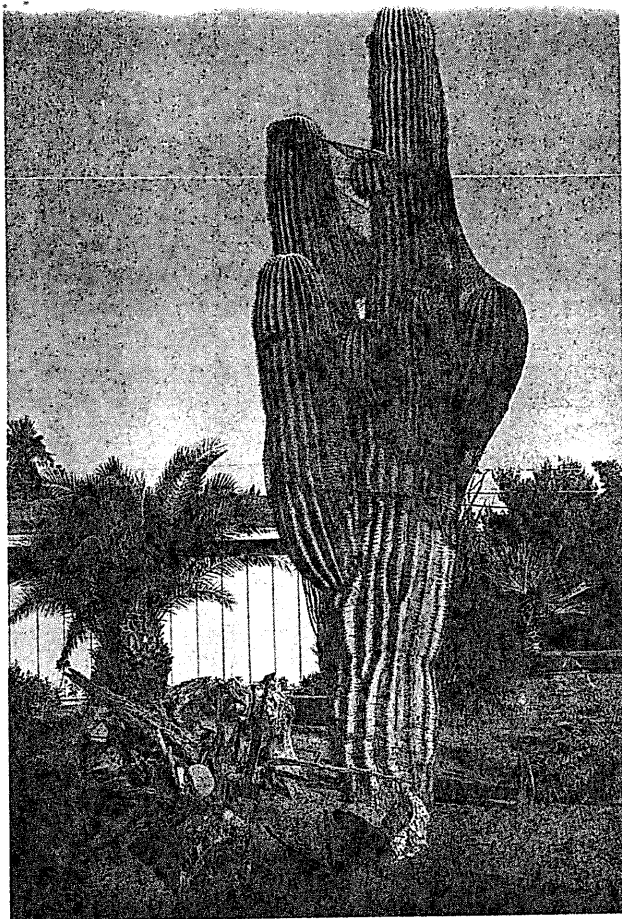
It takes two heavy summer rains within five days of each other to germinate a seed, and the desert environment is so austere that frequently 99 percent of the seedlings die within one year. Most young plants need two or three consecutive years of good summer rains followed by mild winters to become established. At three years, the cactus is still less than half an inch high.

Saguaros that survive usually do so because chance has sown them beneath a nurse plant, typically a palo-verde, mesquite or ironwood tree, which shades them from the summer sun and creates a canopy of warmer air in winter. Earlier in this century, when woodcutters

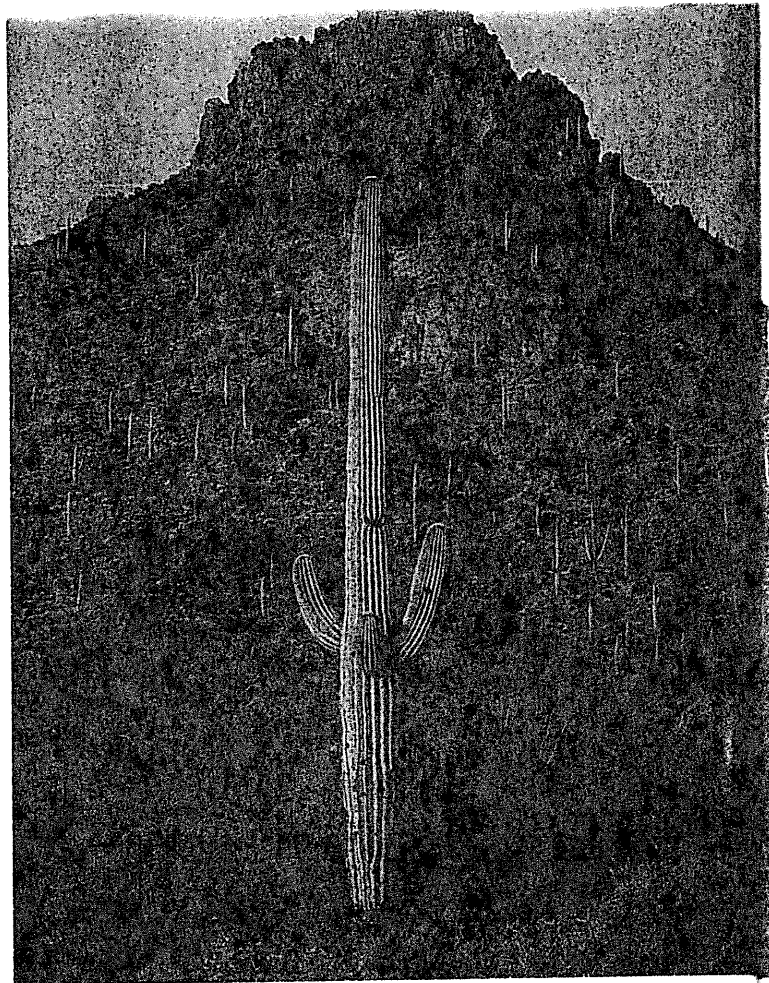


Damage is inflicted by humans (top) and animals: an elf owl (above) avails itself of a woodpecker cavity. Death follows black ooze of bacterial decay (right).





Plump with water, a 20-footer in a Scottsdale garden is protected from hole-drilling birds by netting.



chopped down thousands of desert trees, they interrupted the saguaro's life cycle. So did grazing cattle. In some areas, including what is now the east unit of Saguaro National Park, virtually no saguaros survived infancy for more than half a century.

Woodrats, burrowing insects, jackrabbits, flickers and other animals cause damage in their search for food, shelter and water. The nest of the northern flicker increases the cactus' vulnerability to frost damage in winter by creating an interior pocket of icy air.

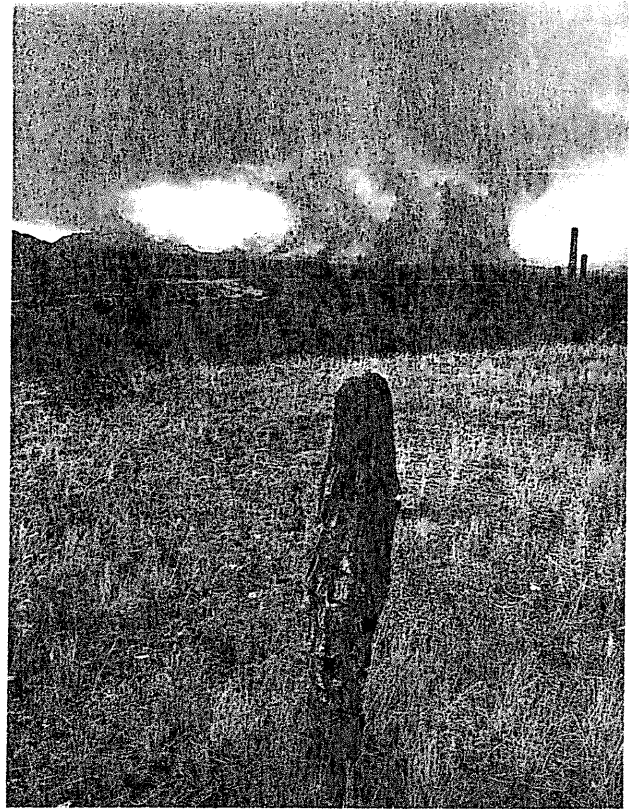
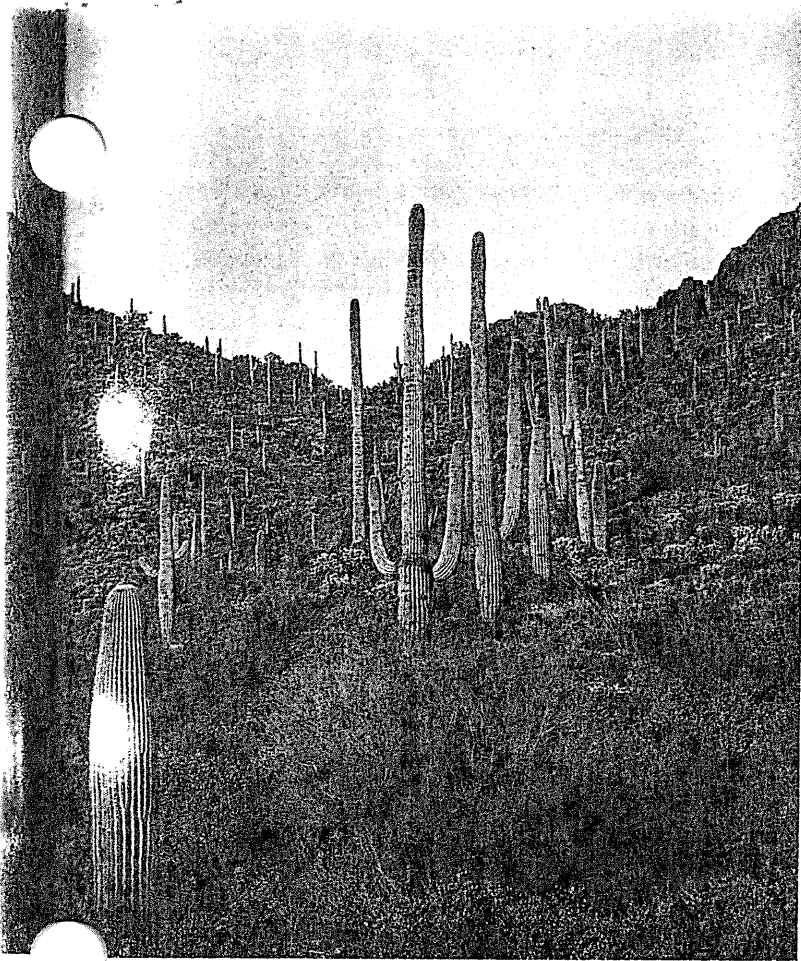
Lightning strikes saguaros directly, and it also starts fires which, fueled by non-native grasses that have invaded the desert, roast thousands of the cacti at a time. High winds topple the top-heavy plants. Housing developments eat their habitat.

In the northern part of the saguaro's range, including the areas near Tucson and Phoenix, the biggest killer, along with fire, is cold weather. The youngest and oldest plants are the most vulnerable. If there is an overnight freeze and temperatures stay below 32 F the next day and following night, many of them will die, often not right away but in years to come. But no single fact about the saguaro has attracted more attention or caused more concern than bacterial necrosis, a condition said to have killed Old Granddaddy and many thousands of others.

One blistering afternoon, Ranger Stanley Lawhead, manager of the visitors' center at the west unit of Saguaro National Park, took me on a tour. With elevations from about 2,200 to 4,700 feet, the west unit runs from the midpoint to the top of the cactus' natural range. In all directions, thousands of them climbed slopes or stood next to dry arroyos. No two looked exactly alike. Only one resembled the clichéd two-arm photograph. A few old-timers rose armless, like telephone poles, as saguaros often do in the drier, western edge of their range in northwestern Sonora and near the Arizona-California border. A few others had nearly two dozen arms, which is more common in the cooler, wetter parts of the range in eastern Arizona. One had spread at its top into a fan shape called cristate, a form so rare it reportedly occurs in only one of 200,000 specimens. The arms of many of the cacti had twisted and sagged following winter freezes.

We arrived at one that was clearly in trouble. The old ironwood tree that had nurtured the cactus in infancy was still growing six inches behind it but couldn't pro-

The author wrote on horny toads in the December 1994 issue. Her fifth book, Timelines of Native American History, will be published by Berkley early next year.



Behind the charred victim of an earlier blaze, fire marches across the desert on the outskirts of Phoenix.

Young and middle-aged (with arms) plants climb the steep terrain of Arizona's Saguaro National Park.

tect it now. Flesh had fallen away in places, and the cactus' bare ribs showed through. Several arms had broken off; those that remained had produced no flowers.

"The question is, why is this particular one dying?" Lawhead asked. "It's like people. Why does one have cancer and another not? Sometimes there's no way to know."

A thick black liquid oozed, one drop at a time, from a gash in the trunk and formed a broad tarry streak that ran down its length. The air smelled like vinegar: the stench of bacterial necrosis.

When Saguaro National Monument was established in 1933 at what is now the east unit of Saguaro National Park, it was with the goal of preserving dense stands of towering, richly armed saguaros. Yet by the early '40s, those very same plants dripped the black liquid of bacterial necrosis and fell, limb by limb, to the ground.

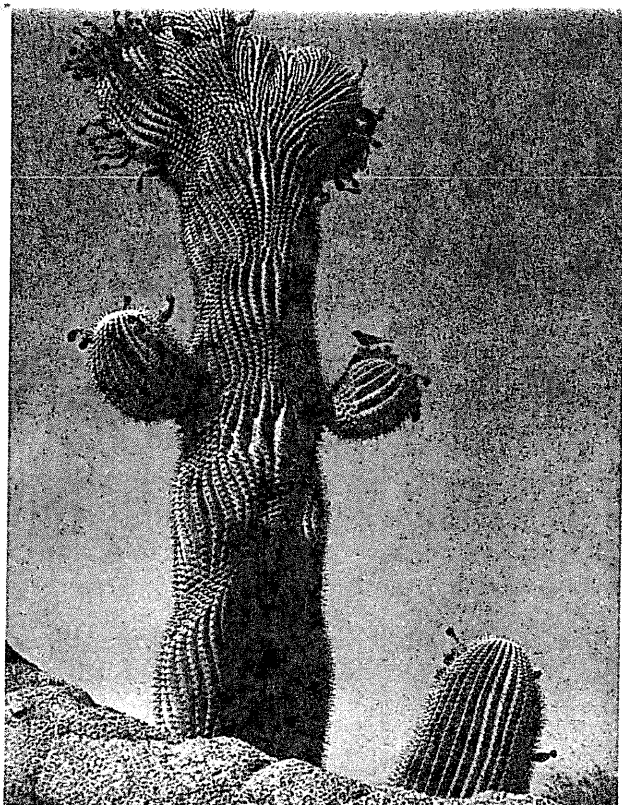
Newspapers nationwide announced the coming extinction of the saguaro. Scientists tried to combat what appeared to be a fatal disease. Field biologists surveyed a swath of the Sonoran Desert that ran 200 miles north to south and 250 miles east to west, and they found bacterial necrosis throughout, sometimes in as much as 20 percent of the tall cacti. They reviewed the scientific literature and found accounts of the condition from as early as 1889.

In 1941 and '42 researchers cut down all affected saguaros in a test plot and disinfected and buried them. But others in the test plot continued to develop bacterial necrosis as often as those in untreated areas. In following years, researchers considered eliminating with pesticides the vector moth they identified as the cause. They injected antibiotics into the cactus, but nothing worked. Some scientists predicted the obliteration of vast stands by the year 2000.

Then, in the 1970s, two University of Arizona researchers, Warren Steenbergh and Charles Lowe, observed that bacterial necrosis occurred mainly in those saguaros that had experienced prolonged freezes and those that had been otherwise damaged. The fallen cacti in the east unit of the monument had been old, and because they were situated near the upper end of the species' elevation range, they had been hit especially hard by freezes.

Bacterial necrosis is not a disease, the researchers concluded. It is simply the natural decay of tissues that are already dying or dead. As Joseph R. McAuliffe, director of research at the Desert Botanical Garden in Phoenix, told me, "Bacterial necrosis is the consequence of death due to another cause."

Still, the myth of the vanishing saguaro persists, and



Cristates, saguaros with gnarled, fan-shaped tops, are said to occur only once in every 200,000 plants.

McAuliffe and other researchers continue to receive calls from journalists and worried citizens. Said McAuliffe, "Ninety percent of the country still seems to believe that the saguaro is disappearing from the Earth. It's not." He understands the concern, though: "People get excited about charismatic megaplants, especially about saguaros, because they have arms, just like people."

Betsy Pierson, a U.S. Geological Survey botanist at the Desert Laboratory on Tumamoc Hill in Tucson, has reached the point where she refuses to talk to reporters if they insist on writing stories that proclaim the species' demise. And like most other researchers, she has little patience with those who worry that epidermal browning, a condition in which the skin of the saguaro turns brown, will wipe them out if bacterial necrosis doesn't.

"Far from being some ominous result of ozone depletion, air pollution or ultraviolet rays, epidermal browning appears to be a normal effect of aging, exposure to high heat and periods of drought," she says.

The real issue, Pierson believes, is this: "Are sufficient new saguaros becoming established?" Today saguaro "recruitment," as it's called, is down in some places, up in others.

In the east unit of the national park, where practically no seedlings survived for more than 50 years, cattle no longer graze, woodcutters no longer chop. Nurse plants have reestablished themselves, and hundreds of young saguaros rise like columns on the hills. Barring killer

freezes or other disasters, park visitors a hundred years from now will see fine, multi-armed saguaros much like the ones that stood in 1933.

One afternoon on Tumamoc Hill, as Pierson and I looked out over the 4,700 saguaros in her test plot, she said, "Nobody can say for sure at what point a saguaro is truly dead. Was it able to take up rains in the summer or not? And if it didn't take up water, is it still alive? Sometimes even saguaros that have blown down or fallen over will continue to flower."

No one has tried to census all the saguaros in the Sonoran Desert, and none of the specialists I spoke with wanted to be quoted regarding population estimates. Off the record, some said there are several hundred million. One suggested a billion.

Just because they are numerous doesn't mean they are safe, however. Vandals like David Grundman shoot them. Out near Saguaro Lake, east of Phoenix, I've counted more than 50 bullet holes in a single saguaro. Miscreants cut off the cactus' arms with chain saws, axes or machetes. In eastern Arizona, I saw one that had been pierced by an arrow. And many homeowners in Arizona and beyond, who wouldn't dream of shooting or mutilating one, want the stately cactus in their front yard.

In Arizona it's illegal to damage saguaros or to remove them from the desert, living or dead, without a permit. To reduce the century-old problem of cactus poachers, who steal saguaros from the desert and sell them for landscaping, permits are also required at nurseries, where saguaros with arms sell for more than \$1,000 apiece.

All a poacher needs is 15 minutes

Investigators for the Arizona Department of Agriculture, sometimes called Cactus Cops, patrol the desert. One ferociously hot July day I rode with investigator Tom Rogers. A slight man with wavy hair and a graying mustache, he has driven nearly 50,000 miles on patrol in the past two years. "We don't know how many saguaros are stolen off public lands every year, but it's a significant number," he told me. "Part of my job is just to let people know the area is being watched."

On a dirt track in Pinal County, Rogers stopped the pickup, and we walked out to check a cristate saguaro he's been keeping his eye on. It stood untouched, but nearby there was a shallow depression that spread three feet across the desert floor. "Here's where someone dug one up illegally, months ago," he said. "What they do, they go down this deep—less than a foot—and cut through the roots and dig it up. It only takes about 15 minutes to get it on the truck."

Rogers pointed to the cristate. "I'm so glad they didn't get that fellow. Probably they knew it would get

them stopped going down the road. Or maybe they knew no nursery would touch it."

No matter how hot it gets, Rogers cruises all day with the window rolled down and the air conditioner off so that he can listen to sounds from the desert. That day we encountered no cactus pirates, but for mile after mile we passed saguaros that had been shot up, some so badly they had fallen.

One morning I went back to see the saguaro where Stanley Lawhead had showed me the black ooze of bacterial necrosis. The air still stank of vinegar. Dark liquid dripped like black blood from the cactus' side. Several more limbs had fallen. The wind blew through the needles of the remaining arm with a whispering sound. A few months more and all that would remain would be a

skeleton of woody ribs standing like a ghost in the desert.

All around rose the next generation. Several were about 18 inches high, more than 20 years old. A few others, about four feet high, were older than 30.

At the edge of a runnel, beneath a creosote bush, I parted the brush, and there sat the smallest saguaro I'd seen in the wild. At six inches high, it was at least 12 years old. All the favorable factors were there—water, nurse plant, rocky soil, and good separation from both the dying parent and the animals that gather around mature cacti.

Betsy Pierson likes to say, "Young saguaros are only a promise. They're not a guarantee." But with luck, half a century from now this tiny saguaro will be a young adult, taller than you or I, sprouting white flowers.

Flexible ribs of long-dead saguaro form an austere arrangement that may stand for decades. Behind them,

however, healthy individuals bode well for the future. Speculation on the icon's imminent demise is baseless.

