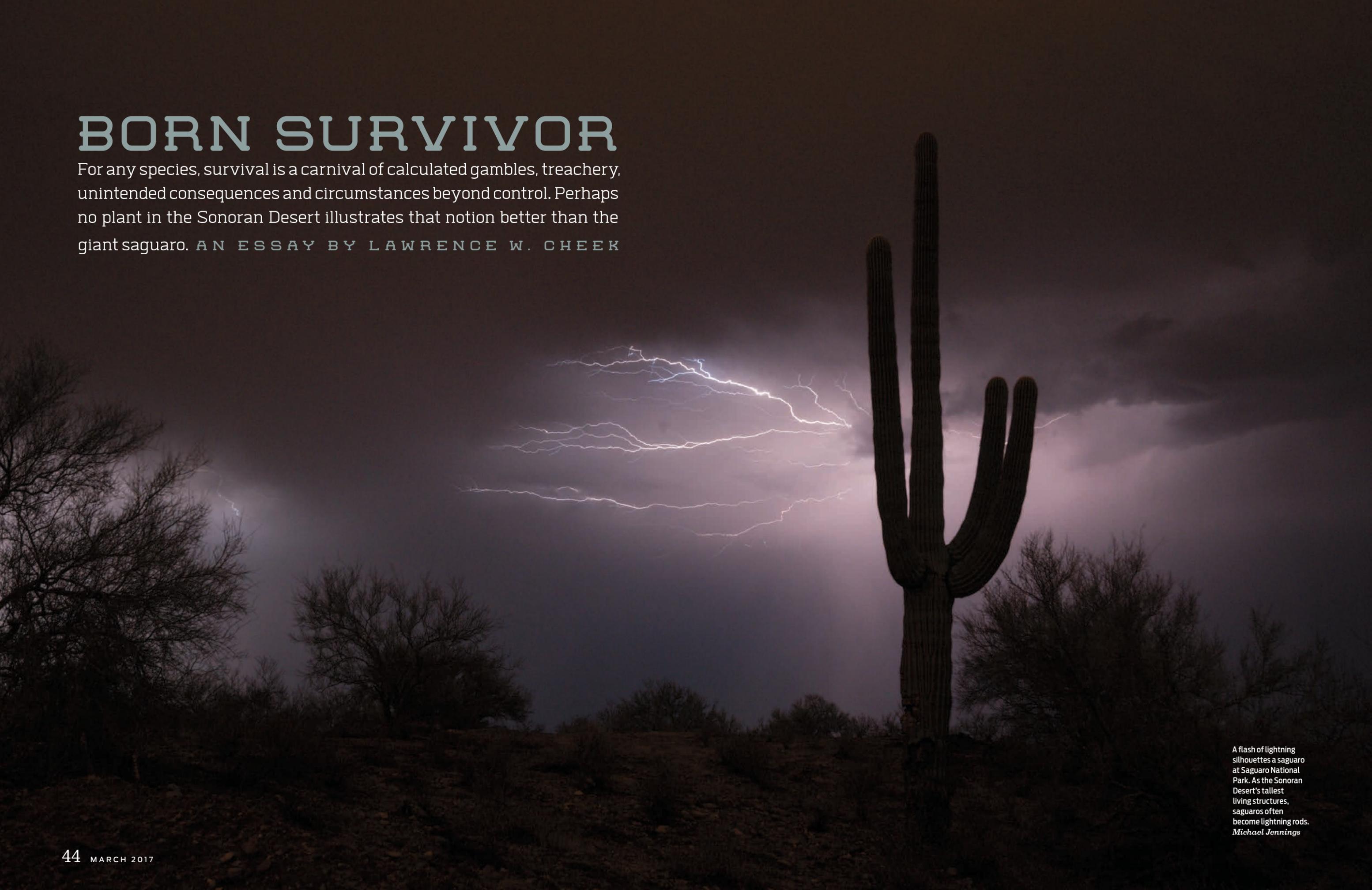


BORN SURVIVOR

For any species, survival is a carnival of calculated gambles, treachery, unintended consequences and circumstances beyond control. Perhaps no plant in the Sonoran Desert illustrates that notion better than the giant saguaro. AN ESSAY BY LAWRENCE W. CHEEK



A flash of lightning silhouettes a saguaro at Saguaro National Park. As the Sonoran Desert's tallest living structures, saguaros often become lightning rods.
Michael Jennings

TRANSCENDENCE, SOLACE, serenity, inner peace ... your first encounter with a saguaro forest, a fantasy landscape that seems as improbable as a lake on the moon, fills you with none of these sensations. Instead, it is disquieting, disorienting, its overpowering strangeness a signal that something here is not quite right — and that something might be your presence. Everything here has a defensive posture; everything feels quietly armed for a ferocious battle for survival. How can such a place feel welcoming?

I lived in the Sonoran Desert for a quarter-century, and this sensation never quite left me. But the strangeness itself became irresistible, and I returned to the desert forest countless times for hiking and contemplation. The saguaro became a central character in my understanding of how nature works, what ecology actually is. For any species, ours included, survival is a carnival of calculated gambles, treachery, unintended consequences and circumstances beyond control. Of everything that exists in this desert, *Carnegiea gigantea*, a candelabrum of improbabilities, best illustrates the web of relationships and environment among living things in the desert.

The life cycle of the species begins with an appropriately implausible event: A white flower pops out of an adult saguaro during the driest, bleakest slice of the year, mid-May to mid-June. To produce fruit, the next step in reproduction, the flowers have to be pollinated, and this job falls to a visiting medley of bats, birds and bees. The red fruits appear in June, when they're practically the only moist plant food available in the region — and with this, the saguaros' strategy becomes clear. Birds such as white-winged doves and Gila woodpeckers eat them, and rodents such as woodrats race for fallen leftovers. Each fruit contains as many as 2,000 seeds, which all of these animals will helpfully spread through their feces.

In the summer heat, these birds and rodents are ducking for cover in the filigreed shade of desert trees such as paloverde and mesquite. This appears to be an essential link in the saguaro survival strategy, because seedlings can only thrive in the shelter of these “nurse plants” — the sun will quickly scorch any with the bad luck to germinate in the open. But these plants are not symbiotic best buds. A saguaro that survives long enough will eventually reward its nurse by killing it, radiating shallow roots that intercept the sparse moisture available to the deeper tree roots. Nature, as Emerson observed, is no saint.

Despite the astronomical abundance of saguaro seeds, the odds of one sprouting and surviving to maturity are absurdly low. University of Arizona ecologist Charles Lowe estimated that a healthy saguaro produces some 40 million seeds in its century of fertility. But insects devour the seeds, assorted animals attack the seedlings in the first few weeks before they sprout their protective spines, and drought and freezing are eternal hazards. One estimate is that a single seed enjoys less than a one-in-1,000 chance of germinating. And then the seedlings demand a summer of at least average rain, a winter of

mild temperatures and several more decently rainy seasons — until, in the relatively wet Tucson region, they might reach the towering height of 2.5 inches by the time they're 10 years old.

It first occurs to a saguaro to pop out an arm or two at about the age that a human signs up for Medicare. The number and reach of arms appears to correlate with rainfall and soil that's conducive to retaining water. But a prolific saguaro is playing the odds, dangerously. The more limbs it extends, the more reproductive success it may have, because blossoms and fruits mostly appear at the stem and arm tips. Promiscuity is a risky strategy, as it is for certain other species, because the heavy arms make it more vulnerable to a blow-down in high winds. As an adaptive strategy to the skinflint rainfall, the saguaro root system is extremely shallow — a taproot 2 or 3 feet deep, and then a system of feeding roots that radiate about as far out as the plant is tall, but only some 4 inches deep. It's a delicate foundation for a mature plant that can weigh as much as 6 tons.

A further unhappy irony: The more successful a saguaro becomes, the more likely it is to literally become a lightning



LEFT: A Gila woodpecker perches on a cluster of saguaro blossoms. The flowers typically open from mid-May to mid-June. *Bruce D. Taubert*
ABOVE: A dusting of snow covers saguaros and other vegetation on a hillside at the park. Abnormally cold freezes in the 1930s killed many of the park's saguaros. *Michael Jennings*

rod. It's the tallest living structure in the desert, and at the peak of the summer monsoon, it's likely to be more than 90 percent water — an ideal conductor to ground. The monsoon is the prime lightning season.

Everything that lives in a desert devises a strategy for capturing and conserving water, and the saguaro is no exception. Drought isn't among a mature saguaro's worries. The skin's pleats are designed to expand to accommodate water storage during rainy seasons and then fold in as the storage is used up. The plant is naturally thrifty. Arizona naturalist Gary Paul Nabhan estimated that a 75-year-old saguaro uses about 250 gallons of water per year. This averages to a little less than 3 quarts per day. The average Tucson human, taking into account all of the city's golf courses and other necessities of civilization, requires 360 quarts per day.

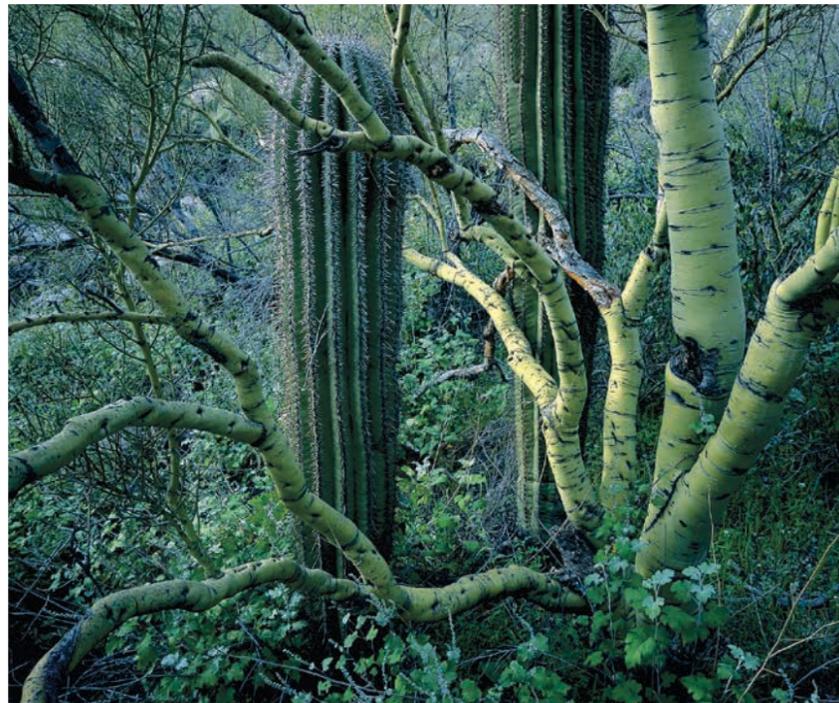
Just as a long spell of dry weather can discourage a whole generation of seedlings from surviving, an unusual wet spell can do the opposite. An event far away from the Sonoran Des-

ert in the 19th century illustrates the global interconnections of life and environment, and how a catastrophe for one species may raise the fortunes of another.

On August 27, 1883, the Indonesian volcano Krakatoa exploded, triggering tsunamis an estimated 130 feet high and heaving unimaginable amounts of dust and sulfur dioxide into the atmosphere, and, in the neighboring islands, killing more than 36,000 people. The dust veil cooled the entire world's climate by as much as 2 degrees for several years, and on the other side of the world, the North American deserts enjoyed two or three years of extravagant rainfall. In 2016, a Canadian biogeographer published a study showing that an unusually large cohort of saguaros sprouted in Arizona in those years. Many are still living, enhancing the lives of the 21st century people who see them and the woodpeckers and owls that depend on them. In the meta scheme of nature, how do we know which bears higher value? We are not objective observers; we'd best recuse ourselves.

Bad events also befall the saguaro, and some have seemed serious enough to trigger widespread worries about the demise of the entire species.

As early as the 1930s, observers were beginning to notice that large numbers of saguaros within Saguaro National Monument were dying of a blackening necrosis that gradually became fatal rot. [See related story, page 50.] Theories floated — airborne bacteria, air pollution, increasing ultraviolet radiation



LEFT: A saguaro skeleton stands along one of several hiking trails in the park's Rincon Mountain District. *Randy Prentice*
ABOVE: Young saguaros grow beneath a paloverde serving as a "nurse plant." As the saguaros mature, they may eventually kill the paloverde by depriving it of moisture. *Randy Prentice*

— until eventually, decades later, scientists figured out the real cause. And it was not unnatural.

Every decade or two, a fierce winter storm will heave a vast mass of frigid arctic air into the Sonoran Desert, and if it persists long enough, the cold will overwhelm the heat-retaining thermal mass of even a large saguaro and kill some of its tissue. One of the worst freezes in Tucson's recorded history struck in January 1937, when the temperature plunged to 15 degrees and lingered below freezing for 19 hours. (The average January low is 42 degrees.) Deep freezing can kill even healthy, mature saguaros. They have relatively little green skin area to devote to photosynthesis — in contrast with the lavish leaves of a maple tree — and when frost damages a significant fraction of this tissue, the plant will slowly starve, though it may take a decade or more to die. What the alarmed observers were seeing was the periodically normal result of an attack of abnormal weather.

Later in the 20th century, the saguaro population still appeared to be inexplicably declining. Photos taken at the monument in 1935 and 1965 showed that the cactus forest had thinned to something like half of its earlier abundance. As some saguaros completed their natural life cycles, there weren't enough maturing adults coming along to replace them.

A saguaro born in 1900 might have been only 12 feet tall by 1960. But here's what was happening: Late in the 19th century, Southeastern Arizona was a quilt of ranchlands. The high-desert grasslands south and southeast of Tucson provided fruitful grazing for cattle, and the federal government routinely leased grazing rights to its land — including what became Saguaro National Monument. A large fraction of monument land continued to be legally grazed until 1978. The cattle, it turned out, were the culprits: They had erased a lot of the natural grasses that helped shelter saguaro seedlings, and probably had crushed countless other seedlings as they tried to shade themselves under mesquite or paloverde trees. The mesquite bosques were also decimated by early settlers needing to heat their homes; the dense and heavy wood yields excellent heat.

And now, in this century, yet another hazard is confronting the saguaro. While a warming climate may reduce the frequency of freeze, a threat has emerged in the form of fire. As improbable as it sounds, desert wildfires are becoming increasingly common, thanks in large part to the prolific spread of invasive African buffelgrass. A study of one

high-desert burn area northeast of Phoenix found 19 percent of its saguaros dead, compared with 2 percent in an adjacent unburned area. Again, we can blame cows — or, more accurately, their human managers. Buffelgrass was first introduced to Arizona in 1938 as livestock forage.

The saguaro cactus is the Sonoran Desert's singular icon, the largest native living thing that exists here, and it appears to be a stunningly robust presence in a harsh land. A 40-foot saguaro strikes an invincible pose: bristling with defenses, assertively towering over every other living thing in the landscape, seemingly confident in its life span of 200 years or longer. A forest of saguaros seems as formidable as a battalion of NFL linebackers massed on a hillside, and far stranger. But the tough stance is misleading. The saguaro is always in danger.

Biologists tell us that in a harsh, marginal environment, a species' survival is dependent as much on its relationships with neighbors as it is on the vagaries of climate and accident. And here's the encouraging thing: The most imaginatively threatening of the saguaros' neighbor species — we *Homo sapiens* — has spent the last 80-some years studying the saguaro and its ecology, creating sanctuaries for it, passing legislation to protect it and understanding our potential impacts on it. Belatedly, we seem to be doing our best. And anyway, in the long run, the saguaro is better adapted to the desert than we are and will outlast our tenure here. I believe the long run in nature is all that really matters, and in this, finally, is transcendence and inner peace. [AH](#)

For more information on saguaros, pick up a copy of our book *All About Saguaros*. To order online, visit www.shoparizonahighways.com/books.