



Nicknamed petticoat palms because of the skirts of dead leaves that hang around their trunks, fan palms are the largest native palm trees of the continental United States.

David Muench

Reading the Fan Palms

We know where these trees grow, but we're not sure how they got there

by James W. Cornett

The Colorado Desert—which reaches from the edge of Arizona into southeastern California and down into Baja California—is an arid, low-lying region of shifting sand dunes and stony flats. In July the temperature often rises above 110 degrees Fahrenheit, and the average annual rainfall barely reaches three inches. It is one of the last places on the North American continent where one might expect to find verdant groves of palm trees, yet desert fan palms (*Washingtonia filifera*) do exist here. The trees thrive near the occasional stream, spring, or seep, sometimes growing to seventy-six feet in height and forty inches in width. Their stout trunks are typically shrouded by ground-length skirts of dead fronds, but sometimes those coverings have been burned away. This species is the only endemic palm in the western United States and the most massive in all of North America.

These palm oases—"tropical islands" tucked away in such remote places as Lost Palms Canyon, Hidden Spring, and Surprise Canyon—had piqued my curiosity for two decades. I wondered how the palms had become established in such out-of-the-way sites. Were the trees ancient residents or new arrivals? And what determined the size and vitality of the groves? How did they spread from one distant spring to another, if indeed they did? With the aid of a grant from the R.K. Mellon Foundation, my co-workers at the Palm Springs Desert Museum in California and I were able to embark on a three-year search for answers to these questions.

The desert can be a lonely place in which to conduct ecological studies, but to our delight, we were seldom alone in an oasis. These verdant outposts attract an abundance of birds, which come to feed, drink, and rest among the palms. More than eighty avian species use these "pit

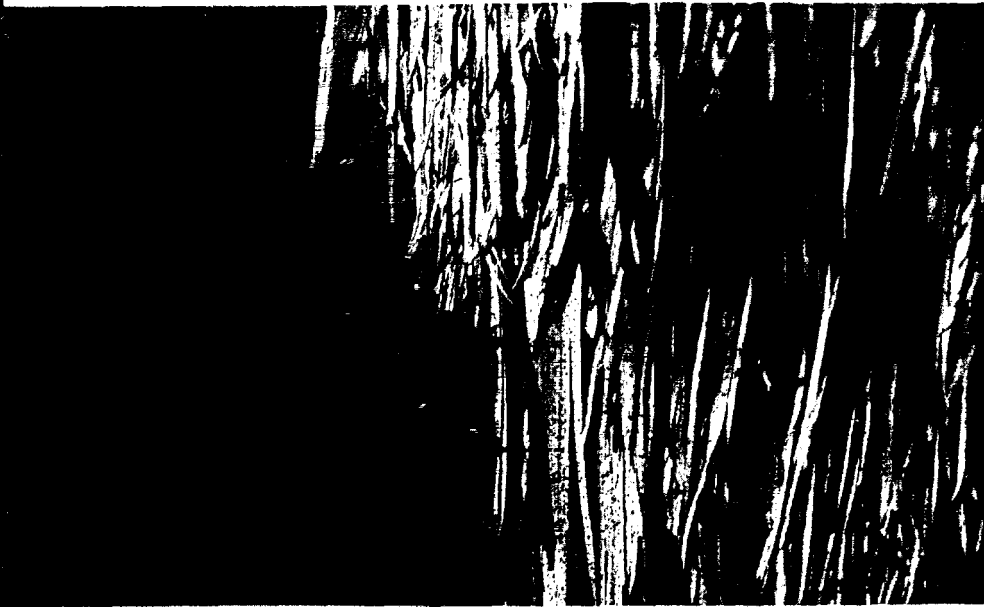
stops" on their migratory journeys. Some of our more startling sightings included snow geese coming down their flyway on the way from Canada to the Salton Sea, as well as American avocets and belted kingfishers. Nearly two dozen other bird species are known to nest in the oases, and for most of them there are no other satisfactory nesting sites for miles around. Mourning doves, owls, roadrunners, and house finches frequently rear their young in the thick skirts of the palm trees. Brightly colored hooded orioles use palm leaf fibers for their basketlike nests, which they attach to the underside of a palm leaf.

Oases also attract many kinds of mammals. Where there are palms, there is often drinking water nearby, and the trees' great height—the equivalent of a six- or seven-story building—can serve as a distant visual signal to birds, coyotes, and bighorn sheep. Rams and ewes are occasionally seen near the oases, and their droppings are regularly observed. The western yellow bat, as far as is known, is restricted to the vicinity of palm oases where it roosts under the trees' skirts during daylight hours. The ubiquitous raccoon, although not really a desert animal, has been able to disperse into the largest of these remote sites. In several cases the raccoons must have crossed miles of inhospitable desert and then become trapped in the islandlike environment of an oasis. Coyotes are the most conspicuous large mammals drawn to palm oases. Because they gorge themselves on the palm fruits, they visit every grove, even those where drinking water is not available.

Healthy, mature fan palms produce up to half a million fruits each fall. These pea-sized dates possess a sweet-tasting flesh, similar to that of commercially marketed dates. Unfortunately for humans, the seed occupies most of the fruit and is rock-hard.

The house finch is one of at least eighty bird species sighted in fan palm oases. It often nests and rears its offspring in the trees' leaf skirts.

Alan Morgan



That makes the fruit nearly impossible to eat. Two migratory species—western bluebirds and cedar waxwings—feed extensively on the rind but consistently discard the seeds. In the laboratory, cactus mice and antelope ground squirrels also eat the rind but only consume the seeds if the alternative is starvation. Only the spiny pocket mouse eats the entire fruit, yet even this species loses weight on a diet of nothing but palm fruits and would probably die without supplementary foods.

Coyotes digest only the flesh of the date and pass the intact seeds in their droppings. In the late fall and winter, when the palms are in fruit, coyote droppings may contain hundreds of palm seeds. We were surprised to learn that not only did these seeds germinate after their intestinal travels but they also did so in less time and with twice the success of unconsumed seeds. Coyotes are also known to travel up to thirty-six miles in three days, probably the maximum time that palm seeds can remain in the digestive tract of a healthy animal. Thus coyotes may be the most important dispersal agents of the palms' seeds and could have transported them to almost all of the known fan palm sites. The only three exceptions are a group of five trees at Mopah Spring in California's Turtle Mountains and oases in the Kofa

Mountains and at Castle Creek, both in the Sonoran Desert of Arizona. These three sites have had palms for as long as anybody can remember, and each is more than seventy miles from the next nearest palm oasis, too far for coyote dispersal. Since the seeds are too heavy to be transported by the wind, how did these isolated groves come into being?

One explanation for their existence is that they are relict populations, left over from a time when palms were more abundant and more widely distributed. Fifty million years ago, during the Tertiary period, the climate in western North America was warmer and more humid than it is now. Springs, streams, and lakes were relatively common and provided the large quantities of water required by palms. Palm fossils indicate that these conditions were widespread and existed as far north as Alaska. Much later, during the Pleistocene epoch, about two million years ago, increasing aridity and periods of cooler temperatures forced the palms, as well as many other types of subtropical vegetation, southward into what is now the Sonoran Desert. With the drying out of the Southwest since the Pleistocene, many, and ultimately most, of the springs and seeps disappeared. The result has been the restriction of palms to the few places





Cottonwoods have longer roots than fan palms and therefore have a competitive edge even where water collects, as in this region of Guadalupe Canyon in Baja California.

David Cavagnaro

where faults and fractures allow ground water to reach the surface and along streams that drain the mountain peaks forming the western edge of the Colorado Desert.

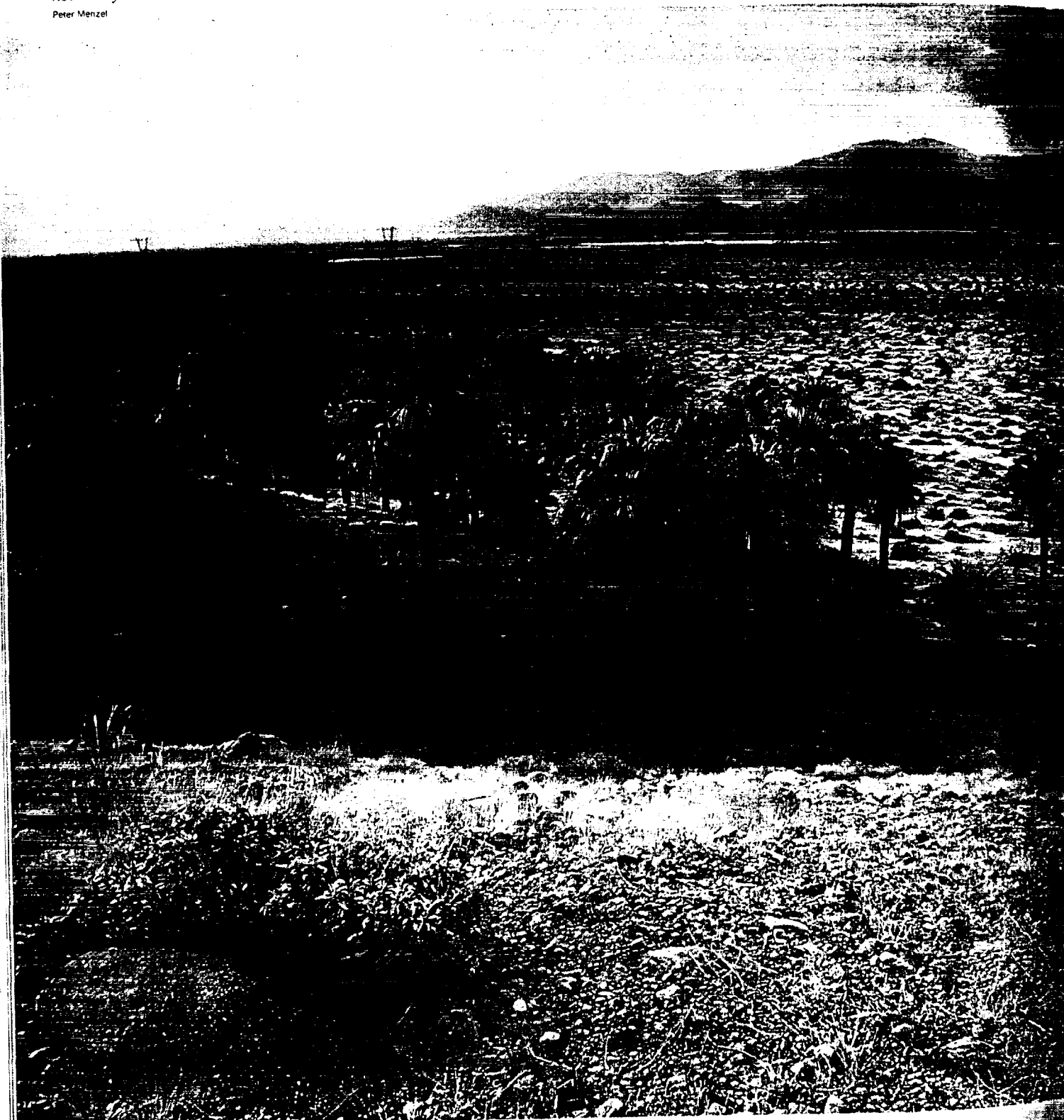
Are all palm oases, then, relict populations? In an attempt to answer this question, we searched for some clue that would help us determine whether a specific palm oasis was indeed a relict population or the result of a recent, possibly human introduction. Palms are almost impossible to date because they don't produce growth rings in their trunks. Even if we had encountered a very old tree, we could not have assigned an age to it that might have placed it at a spring prior to Indian occupation or at least the very recent arrival of white settlers. Nor could we find any fossils near the sites of present-day oases. We had nearly given up trying to determine the question of origin when Kenneth Cooper, a retired biology professor from the University of California, suggested that the answer might lie with the palm's only deadly parasite—the giant palm-boring beetle.

Almost without exception, mature fan palms possess one or more half-inch holes in their trunks. These are the exit burrows of the parasitic beetle known to entomologists as *Dinapate wrightii*. The larvae of these beetles spend up to six years feeding on the woody interior of a trunk (sometimes killing the tree) before pupating and chewing their way out. Upon emergence, males and females fly off to mate in the crown of a palm. We have found only three oases in which we saw no exit holes and where the palm borers did not exist. These were the three most isolated sites: Castle Creek, Kofa Palm Canyon, and Mopah Spring. If those groves had been around when palms had a continuous distribution, the beetles should have reached them. The absence of the beetles suggests these palm oases were not present during past geological epochs and therefore are not relict populations.

If their seeds were not dispersed by coyotes, how then did the palms reach these remote locations? The most likely explanation is that the seeds were purposefully brought in by humans. We know that

*A fan palm oasis thrives in a desert area.
Wherever palms grow, water, although
not always seen, cannot be far away.*

Peter Menzel



Undeterred by the spiky edges of a fan palm frond, a roadrunner eats a small lizard it has caught.

James W. Cornett



Native Americans often transported seeds from one place to another, as demonstrated by the spread of corn throughout the New World. The abundant potsherds, bedrock mortars, and rock carvings around palm oases indicate that in southern California, Indians did live in or near the oases, and other archeological and ethnographic evidence indicates that they ground the palm fruits into flour, made baskets from the palm leaf fibers, and covered their homes with palm fronds. It seems reasonable, therefore, to assume that the same Indians introduced the useful fan palm to new regions. Today's Cahuilla Indians, living in the Colorado Desert, have told us that their ancestors distributed fan palm seeds when they moved from one region to another.

Although the dispersal of seed is necessary for the spread of most plant species, Indians played an even more important role in palm oasis ecology. The Cahuilla of southern California regularly set fire to palm oases to clean debris from an oasis floor. (Most mature trees are rarely killed by fire since their vascular bundles are strewn throughout the trunk, but this is not true of conifers and such trees as oaks, which are prone to heat damage because they possess a vulnerable layer of cells, called a cambium, just beneath the bark.)

The Indians also knew that burning increased fruit production and killed the beetle larvae gnawing at the tree's interior. Setting fires, probably under carefully managed conditions, not only enhanced the harvest of palm fruit but also favored the survival of the palms by eliminating or reducing competitor tree species that are less tolerant of heat.

When my co-workers and I began our research on the ecology of desert fan palm oases in 1981, we knew that many oases had been named at the turn of the century for the number of palms they contained—for example, Una Palma, Dos Palmas, Five Palms, Twelve Apostles, Seventeen Palms, and Twenty-nine Palms. But when we visited those sites between 1981 and 1984, the names did not jibe with our counts. Una Palma had 3 trees, Dos Palmas had 308, the Twelve Apostles had vanished, and Seventeen Palms was more like the Twenty-nine Palms site, which had 36 trees. At first, we did not know how to interpret our count. Two earlier palm researchers had outlined a bleak picture, stating that palm oases were "being disturbed or destroyed by urban development and a reduction of natural water supplies." We also knew of destruction caused by countless fires set by vandals, by the introduction of the invasive tama-

Hooded orioles build their basketlike nests out of the fibers of fan palm leaves. They attach the nests to the undersides of leaves high above the ground, where the young are safe from predators.

James W. Cornett



risk shrub, which crowds out other plants, and by the incursion of hikers and campers into many oases each weekend. But our preliminary results suggested that palm populations might nevertheless be growing rather than shrinking.

During our studies, we visited most of the palm oases within the natural range of *Washingtonia filifera*. Fortunately, the late Randall Henderson, editor and publisher of *Desert* magazine, had visited those oases decades before and had painstakingly counted the palms in nearly every oasis in the Southwest, describing their condition, their associated vegetation, and the location and amount of water. His articles, which appeared over a 25-year period, were the basis for our comparisons.

We were surprised by what we found. Palm numbers were increasing at a dramatic rate. Sixty-five percent of the 110 palm oases that Henderson had investigated now had more adult trees. In some cases the increases were staggering. Willis Palms, which had 370 trees in 1964, had grown to 612 individuals by 1983. Andreas Canyon, near Palm Springs, California, grew from 322 palms in 1935 to 1,157 in 1984, an increase of 259 percent in forty-nine years. In several instances new groups of palms had sprung up where none existed before. There were at least

three new oases in the center of the Colorado Desert just east of the huge inland body of brackish water known as the Salton Sea, and we discovered two new oases in Anza-Borrego Desert State Park in the eastern half of San Diego County. Fan palms have spread into southern Nevada at Rogers and Moapa springs, now the most northerly sites of this species. Our estimates place the current population of wild fan palms at approximately 19,000 individuals, up 40 percent since 1945. What had been happening that could account for such an impressive increase in the numbers and distribution of this plant?

As already mentioned, we knew that Indians set fires to clean oases floors of debris and permit the harvesting of the palms' fruit. We learned that ten years after a fire, the fallen flower stalks, fronds, and trunks pile up again, making it difficult to walk through an oasis. Twenty years after a fire, the debris is so deep and unstable that walking through an oasis can actually be hazardous: one step on the end of an eight-foot flower stalk can result in a blow to the head that is akin to stepping on a hoe. (It took our team an embarrassing number of mishaps to learn this bit of palm lore.) In addition, rattlesnakes use the litter as shelter and we met up with these oasis inhabitants many times. It was



Despite the obvious aridity of this region of Anza-Borrego Desert State Park, a flourishing fan palm oasis has evolved in a shallow trough.

Willard Clay



Coyotes are among the large mammals attracted to fan palms. They feed on the trees' sweet, pea-sized fruit and pass the seeds in their feces. Because the seeds are still able to germinate, coyotes are deemed an important agent in the spread of palms to new oases.

John S. Flannery, Bruce Coleman, Inc.



easy for us to understand why Indians burned oases, perhaps every ten years, certainly every twenty. But with the permanent departure of Indians from the vicinity of palm oases in the late nineteenth century, the pattern of burning was altered, and for fifty years fire was all but absent in the palm oases.

Henderson's articles and photographs indicate that from 1890 until 1940 the size

of palm oases had either stabilized or decreased slightly. The absence of fire allowed the palm litter to accumulate to depths that inhibited the germination and growth of young palms. Photographs taken in the Colorado Desert by Stephen Willard, one of the West's first desert landscape photographers, in the 1930s show stands of adult trees with leaf skirts to the ground and few, if any, young

Fifty years ago there were 322 palms in Andreas Canyon, near Palm Springs. By 1984, the oasis had 1,157 palms. Periods of above-average rainfall are largely responsible for this impressive increase.

David Muench

palms. Cottonwoods and sycamores, common plant associates, appeared to be crowding out the palms. The former have longer, but less dense, root systems and probably had a competitive advantage over the palms throughout the long-term drought that lasted from the 1920s to 1939. Then, after World War II, palm oases suddenly began expanding.

Two things set the stage for that expansion. First, from 1939 through 1945, there was a twofold increase in precipitation in southeastern California. This change was accompanied and followed by an increase in the frequency of wildfires. (The increase resulted from the buildup and accumulation of vegetation, which acted as fuel, and the influx of settlers into the Southwest. Most palm oases fires are started by people.) The sudden loss of transpiring plants after a fire also resulted in an increase of water flow at the surface. Palm seeds sprout like weeds when scattered over moist, barren soil and, in general, those were the prevailing conditions in many oases in the 1940s. Although a thirty-year drought began in 1946, many young palms were already established by that time. Today, the postwar boom can be seen as a distinct generation of thirty-to forty-foot trees and accounts for the large increases observed in our study.

In 1976 the rains returned with a vengeance to the same Colorado Desert region, and greater-than-normal annual rainfall persisted through 1983. Now a new generation of young palms has emerged. A cyclic pattern of change in the size of a tree population is not unique to fan palms; it is a common form of survival of many organisms that live in regions with extremes of rainfall. In deserts, it is the scarcity of water, more than anything else, that limits the growth of populations and individuals. The success of most desert species depends on their ability to expand their populations rapidly during periods of above-average rainfall so that some individuals will be able to survive the inevitable drought ahead. In the case of the desert fan palm, both water and fire determine its success or failure in maintaining a foothold in the remote oases of the Colorado Desert. □

