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Why the West Is Burning

By J. Madeleine Nash/Sage

In California the wildfire season generally ramps up slowly, and the largest fires usually don't arrive until fall. But this year is different, says Riverside County fire captain Rick Vogt, surveying the aftermath of a blaze that swept through the rural community of Sage, 80 miles from Sa Diego, with unseasonal intensity late last month, blackening more than 3,500 acres. Fire fighters this time were able to contain the flames, bu next time they may not be so lucky. A five-year drought has left this always arid region even dryer than usual, and when the hot Santa Ana winds start to blow off the desert in September, it could take only a spark to set off fires that will be much more difficult to control.

Already the fire season in Southern California is breaking records. Last year was bad enough; this year is outpacing it in both the number of fires started (2,749 vs. 2,453) and the amount of acreage consumed (69,167 vs. 38,523). And Southern California is not alone. A fast-moving wildfire exploded in a canyon on the outskirts of Las Vegas two weeks ago, forcing the evacuation of 75 Girl Scouts from a campground in the Spring Mountains--this on top of a fire that threatened the capital of Nevada and another that nearly destroyed a $200 million astronomical observatory in Arizona. Just a few more big ones could easily turn 2004 into one of the West's worst fire years on record.

And no one knows when the drought will end. Scientists believe this dry spell, which has plagued a broad swath of the West since 1999, is mo typical of the region than its 60 million inhabitants would care to admit. As Charles Ester, chief hydrologist for Arizona's Salt River Project, a major provider of water and electricity, puts it, "What we took as a period of normal rainfall in the past century was actually a period of abundance."

Consider, for example, the 1922 compact that determines the allocation of water from the Colorado River. Scientists have shown, by studying tree rings and other historical evidence, that the allocation was based on water flows that were the highest they had been for more than 475 years. By contrast, the flows since 1999 rank among the lowest. As a result, Lake Powell, the giant reservoir created on the Colorado by the Glen Canyon Dam, stands some 60% below capacity and seems destined to fall even lower. No wonder that states like Colorado--whose rights to that water are trumped by the rights of California, Nevada and Arizona--are anxiously bracing for a crisis.

At risk are not only natural ecosystems and agricultural enterprises but also the multiple amenities that people living in the West have for so long taken for granted: ski resorts and golf courses, green lawns and lush gardens, swimming pools and hot tubs, not to mention such moderı necessities as dishwashers and flush toilets and the hydropower that keeps refrigerators and home computers humming. Caught off guard, political leaders and water-resource managers have been turning to scientists for help. What do researchers know about patterns of drought i North America? What do they think occurred in the mid-1990s when a big chunk of the West abruptly veered from wet to dry? And do they believe that the current shortfall of precipitation is just a temporary dry spell or an ominous realignment of the earth's climate system?

SECRETS OF TREE RINGS

That the West is a semiarid region subject to episodic droughts has been understood for some time. What's new is the detailed picture of those droughts that is emerging from a vastly improved network of North American tree-ring records that extend back more than 1,000 years. Those records--some 835 in all--are based on the growth rings laid down by multiple species of long-lived trees, including blue oaks, giant sequoia and bristlecone and ponderosa pines. Interpreting the rings takes skill, but the basics are simple. The rings are wide when moisture is sufficient, narrow when it is not.

Dendrochronologists, as scientists who study tree rings are called, are using these records to probe the patterns of drought over space and time. Droughts like the 1930s Dust Bowl, which was focused in the northern Rockies and Great Plains, appear to be quite rare, with only two somewhat close analogues over the past 500 years. But 1950s-style droughts, centered on the Southwest, are more common, recurring, on average, twice each century. An event that scientists have dubbed the 16th century megadrought resembled a combination of the droughts of the 1930s and 1950s.

And even the 16th century megadrought pales in comparison to earlier dry spells that California State University geographer Scott Stine has documented in the Sierra Nevada. Between A.D. 900 and 1350, he has established, trees and shrubs grew in lake basins and riverbeds that are now filled with water. By dating the wood from their stumps, Stine has identified two droughts that were separated by an extremely wet period. One of these droughts lasted 140 years, the other more than two centuries.

A prolonged dearth of precipitation during this time affected other areas as well. Across Mexico, Guatemala and the Four Corners region of the Southwest, unreliable rains threw the ancient Maya and Anasazi civilizations into crisis. In the Great Plains, peat marshes dried up and sand dunes resumed their wind-driven march. In Nevada's Great Basin, hardy bristlecone pines throttled back their growth, waiting for a wetter clime. "If the future resembles the past," says Stine, "then we're in for a lot of trouble."

What causes drought?

What could trigger droughts that persist for decades and even centuries? Topping the list of suspects are swings in sea surface temperatures like those associated with El Nino and La Nina. Every three to seven years, a distinctive warming of the eastern basin of the tropical Pacific (El Nino) influences North American weather patterns, often in ways that send winter storms farther south than usual. As a result, California and the Southwest tend to get quite wet. By contrast, the cooling of the sea's surface (known as La Nina) tilts the odds toward drought in this same region. And there is evidence that the swings between El Nino and La Nina are mirrored by longer-term changes in the tropical Pacific that are less extreme but much more persistent.

Some of this evidence comes from corals that grow in the tropical Pacific. Just like trees, observes Georgia Tech paleoclimatologist Kim Cobb, coral polyps lay down growth rings that encode information about temperature and precipitation. About a year ago, Cobb and her colleagues spliced together a 1,000-year-long climate record from corals collected on Palmyra Atoll, 1,000 miles south of Hawaii. The record reveals a sequence of long-term shifts in sea surface temperatures and precipitation that seem reminiscent of El Nino and La Nina. Cobb speculates that extreme La Nina--like conditions recorded by a 10th century coral might have been connected to the drought that occurred in the Sierra Nevada at that time.

Scientists are still trying to ferret out the physical mechanisms capable of causing long-term changes in the tropical Pacific. Among the suspects are volcanic eruptions, which temporarily cool the surface of the planet, and cyclical ups and downs in the sun's luminosity that occur on time scales ranging from decades to centuries.

Climate models run by the University of Miami's climatologist Amy Clement and her colleagues suggest that the key to the puzzle may lie not in the eastern basin of the tropical Pacific--the area El Nino and La Nina so profoundly affect--but rather in a pool of warm water positioned to the west. In the models, when the so-called western warm pool cools off just a bit or when it warms a tad more, the eastern basin of the tropical Pacific tends to respond by doing the opposite. In recent years, it so happens, the western basin of the tropical Pacific--along with the neighboring Indian Ocean--has been the warmest it has been for at least 150 years. And what that adds up to, says Martin Hoerling, a research meteorologist with the National Oceanic and Atmospheric Administration, is "the perfect ocean for drought."

But there is more to the story than just the tropical Pacific, thinks paleoclimatologist Julio Betancourt of the U.S. Geological Survey's Desert Laboratory in Tucson, Ariz. Along with several colleagues, Betancourt has investigated the influence on Western drought of sea surface temperatures outside the tropics. The North Atlantic, they have found, seems to play a central role. When the surface of the North Atlantic warms, the stage appears to be set for both 1930s-and 1950s-style droughts. Tree-ring records taken from the Atlantic basin suggest that one such warming occurred in the late 1500s, coinciding with the 16th century megadrought.

What tips the balance between a 1930s-and a 1950s-style drought? Betancourt, for one, believes the answer may lie off the West Coast of the U.S. Sea surface temperatures in the North Pacific, an accumulating body of evidence suggests, undergo distinctive patterns of warming and cooling every 20 to 30 years (in response, some think, to long-term changes in the tropics). Accompanying these changes in sea surface temperatures are seesaws in atmospheric pressure that alter storm tracks across the North American continent. When waters off the coast of California warm in synch with those of the North Atlantic, as happened in the 1930s, summer rainfall tends to fail, particularly in the Plains states. But when these same waters cool, as occurred in the 1950s and again in the late 1990s, winter precipitation can falter as well.

This is important because in the West most precipitation falls as snow at higher elevations. Thus, a city like Reno, Nevada, gets, on average, just over 7 in. of precipitation a year, vs. some 70 in. at the top of nearby Mount Rose. During the 1950s drought, for example, a very large portion of the West, along with a big chunk of the Southeast and Great Plains, experienced long-term shortfalls of both winter snows and summer rains. "This is the kind of drought we worry about a lot," says Betancourt--and it's the kind of drought that the present configuration of sea surface temperatures in the North Pacific and North Atlantic seems primed to produce.

WHAT HAPPENS NEXT?

That question gnaws at Douglas Kenney, a professor of natural resources law at the University of Colorado in Boulder. As he sees it, "Everyone's pretty clear that the earth's getting warmer, but it's unclear just what that means. It might mean a wetter future or a dryer future. It might even mean a wetter future with no net gain." How is that possible? The answer lies in the impact rising temperatures are likely to have on the vast reservoirs of water locked up in the mountains in the form of snow and ice.

Scientists have documented a troubling shrinkage of the snowpack across the West, owing at least in part to the fact that rising temperatures are inexorably forcing the snow line higher. They have also found that the snowmelt is starting earlier in spring, as many as four weeks earlier in the Sierra Nevada and the Cascades. And that likewise poses a problem. Why? Snow and ice are like natural dams that hold water back during the winter months, when the risk of flooding is highest, and then melt and release it during the dry months of summer when moisture is at a premium.

"Drought is more than a precipitation deficit," observes University of Washington climatologist Philip Mote. The real problem, he says, "is that you don't have as much water as you'd like at a given point in time." And that goes for plants as well as people. For accompanying an earlier snowmelt, scientists note, is an earlier start to the growing season, which means that the demand for water by forests, marshes and grasslands--not to mention agricultural crops, lawns and putting greens--is bound to rise. In this context, a "normal" amount of precipitation may not be sufficient; and when precipitation drops below normal, as it has in recent years, the stress on trees and plants is all the more extreme.

Consider, for example, the massive forest diebacks occurring across the West. "People tend to think of forests as pretty slow changing," says Craig Allen, an ecologist with the U.S. Geological Survey. "But once certain thresholds are exceeded, very rapid changes can occur." In some cases, thirsting trees perish because their circulatory systems--the long tubular columns in the trunk that transport water from the roots to the crown--collapse. In other cases, the trees become so weak they can no longer fend off insects and disease.

Indeed, the bark-beetle infestations that are killing trees across the West are attributed to drought (complicated by decades of fire suppression that have resulted in an overgrowth of trees). And nowhere is the beetle infestation worse than in the mountains of Southern California, whose stressed-out forests harbor hundreds of thousands of beetle-killed trees. These trees, some with rust-colored needles still hanging from their limbs, serve as standing fuel for fires, and an effort is under way to remove as many as possible along the roads inhabitants in the San Jacinto, San Bernardino and San Gabriel mountains must take when fire comes to call.

The connection between drought and wildfires is strong, says Thomas Swetnam, head of the University of Arizona's Laboratory of Tree-Ring Research. And the most dangerous fires, he says, occur when droughts follow years that are unusually wet. That's because generous rains encourage trees, shrubs and grasses to grow, providing the fuel that stokes forest fires. This pattern of wet preceding dry, Swetnam thinks, helped feed the intense blazes that raged through the Southwest shortly after 1850, taking out huge stands of conifers. So, if a new El Nino materializes later this year, as some experts expect, it may bring rains that temporarily ease the fire danger only to increase it later.

The past is an imperfect lens through which to peer into the future, but looking backward provides a glimpse, at least, of the sorts of extended dry spells that those who live in this drought-prone region today should be prepared to endure. The West, observed writer Marc Reisner, has a "desert heart," and we ignore it at our peril.