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Southwest drought could persist despite monsoon, El Niño

by Melanie Lenart
Science Writer

Drought defies a precise definition. It's in the eye of the beholder. But more and more Southwest residents, including climatologists, are concurring that Arizona and New Mexico are indeed in a drought. Worse, climatologists see little hope for long-lasting relief from monsoonal rains—or even the predicted El Niño.

By the start of spring, most climatologists agreed that a drought had descended upon the Southwest. By then it seemed clear no winter rainstorms would come along to bail out these parched southwestern lands. Arizona was declared a drought disaster area on May 17 by U.S. Secretary of Agriculture Ann M. Veneman. In New Mexico, the Rio Grande's streamflow in early June was lower than it had been in the 102-year instrumental record, according to the National Climatic Data Center website operated by the National Oceanic and Atmospheric Administration (NOAA).

Both states are considered to be in "extreme drought" by the U.S. Drought Monitor. Even worse areas of "exceptional drought" are located in the northern parts of the Southwest, encompassing much of

the Navajo Nation and the Grand Canyon in Arizona, as well as Santa Fe and a wide swath to the northwest in New Mexico.

Unfortunately, climatologists agree that the best southwesterners can hope for is an end with the coming year's winter rainfall, long after the wildfires have burned out and the shriveled grasslands have led ranchers to sell off their cattle. The worst we can fear goes beyond the worst droughts of the 20th century, generally acknowledged to be the 1950s drought for New Mexico or the early 1900s drought for Arizona, times when the only money to be made from cattle involved selling their bones as fertilizer.

Water supply and demand

Some parts of the Southwest have been in a state of drought since about the winter of 1996-97, noted Kelly Redmond, a climatologist with the Western Regional Climate Center in Reno, Nevada.

There is no definitive definition of drought based on measurable processes, so climatologists must interpret it by considering its impact on vegetation, water resources, and people.

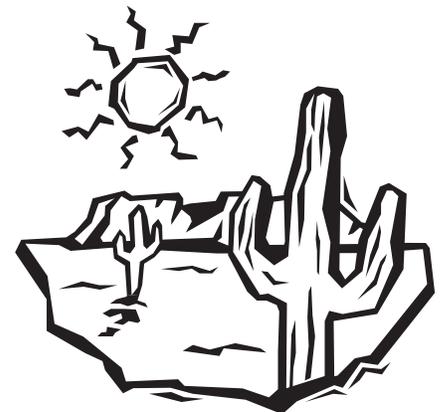
"I use a definition of drought that has supply and demand built into

it," Redmond said. "Basically, it's not enough water for what you need."

The NRCS's designation of extreme drought is used when there are threats to agriculture and of severe wildfire. An exceptional drought includes those threats as well as threats to shortages of water in reservoirs, streams, and wells.

Leaders from the Navajo and Tohono O'odham Nations are reporting concern over dwindling water supplies from wells near the surface and the disappearance of some streams thought to be perennial. However, residents of areas served by deeper wells or the Colorado River might be blithely unaware of the ongoing drought, although they might notice that even prickly pears are looking desiccated.

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“If you’re buffered from what the climate is doing out the window, to that extent you’re not really experiencing a drought,” Redmond noted.

Drought vs. dry

As one of the climatologists preparing the weekly Drought Monitor (<http://drought.unl.edu/dm/>), Redmond was among the first to call the current dry spell a drought. But he acknowledges it’s a tough call.

“Recognizing drought in a dry climate is a difficult one,” he explained. Because 10% to 15% of annual rainfall in the Southwest can come in one day, usually a winter day, some southwestern climatologists were hesitant to apply that label until almost the arrival of spring, typically the driest season in the Southwest.

Charlie Liles, a climatologist with the National Weather Service office in New Mexico, concurred.

“Drought is too complicated to attempt to use one index or cookbook approach,” he explained.

When asked to give an informal explanation of when he knew this was a drought, Liles responded, “When the number of people at our monthly drought monitoring meeting (Governor Johnson’s drought task force) suddenly doubled” in January. David S. Gutzler, a climate researcher and professor at the University of New Mexico in Albuquerque, gave this reply to the same question: “When no unusual springtime downbursts came along by the end of March to make up for a horribly deficient snowpack.”

Fire and ice

The Southwest received less than half the usual amount of snowfall

this past winter, with Arizona’s snowpack trailing at only about 25% of an average year, the NRCS reported. Snow can boost soil moisture for months as it gently melts and trickles down to aquifers and reservoirs, so the landscape and water supplies continue to suffer from its relative absence throughout the spring and even summer.

The continuing dryness combined with high temperatures makes June the riskiest month for wildfires in the Southwest. This past June was particularly flammable for Arizona. As of July 17, about 623,000 acres had burned in Arizona wildfires, along with about 298,000 acres in New Mexico, according to a multi-agency tally shown on a USDA Forest Service web site.

Comparing these figures to the annual acreage burned for the past decade, New Mexico’s total is only slightly higher than an average year, while Arizona’s total is already more than five times higher than its average amount of about 117,000 acres a year. (In New Mexico, however, half a million acres burned in both 1999 and 2000, also considered drought years by some.)

Fire officials worry that the arriving monsoon could be counterproductive if lightning strikes increase without appreciable rainfall to follow.

Monsoon relief temporary

Although monsoon rains can spell temporary relief for plant life, they generally cannot provide the kind of large-scale rainstorms that could alleviate a regional water shortage, Redmond explained. In fact, the time frame of the current drought encompasses the summer of 1999,

which was one of the four rainiest summers in the Arizona instrumental record.

“Summer provides a lot of splash and flash and a lot of glitz and glamour,” Redmond said, but not much moisture makes its way to the soil column or to reservoirs. “It’s so hot that a large part of it ends up evaporating and going right back up into the sky.”

Besides being short-lived, the benefits from monsoonal rains tend to be small-scale. Monsoon storms tend to be measured in tens of square kilometers, which means a particular thunderstorm might cover only a portion of cities the size of Tucson or Albuquerque. Winter rains, on the other hand, tend to stretch across thousands of square kilometers, so a rainfall event might stretch across several states.

That’s why winter rains provide the only real hope for relieving a drought as extensive as the one occurring now in the Southwest, Redmond said.

El Niño as savior?

There is some hope that winter rainfall could come through if the climatic pattern known as El Niño develops by this winter as is being predicted now (for more details, see the separate El Niño article). Unusually high sea surface temperatures in the eastern Pacific, the telltale sign of El Niño’s arrival, set up climatic conditions that favor greater precipitation in the southwestern United States and northwestern Mexico.

However, even a strong El Niño only increases the probability of precipitation in the Southwest—it does not guarantee it—so southwestern climatologists do not view

El Niño as a panacea for the drought. Currently, climatologists predict the El Niño will be weak to moderate.

“Even the moderate El Niño events can help New Mexico during the transitional seasons of autumn and (next) spring,” Liles said. “That said, I think that it is unlikely that a weak or moderate El Niño will break the drought.”

Another force: the PDO

Modern El Niño cycles tend to reverse every two to seven years, but there appears to be a climate pattern operating in a lengthier time frame of several decades, known as the Pacific Decadal Oscillation, or PDO. Redmond and others expressed concern that a switch in the PDO phase could set the stage for persistent drought in the Southwest. Unlike the El Niño pattern that governs the tropical Pacific, though, the PDO cycle of the northern Pacific Ocean remains somewhat speculative.

“With the PDO, we’ve had two phases since 1947. So we don’t have a lot of cases to go on,” Redmond explained. “We’re not even really quite sure if the PDO is a thing or not.”

The “negative” phase of cooler northern Pacific waters, which appears to have occurred between 1947 and 1976, seems to correlate with an increase in drought-like conditions in the Southwest. This covers the period of the 1950s drought, the worst drought of the century for New Mexico and no picnic for Arizona either. A composite instrumental record showing the hundred-year period from 1895 to 1995 shows Arizona faced drier hydrological conditions throughout much of the 1947-76 negative phase of the PDO (see illustration).

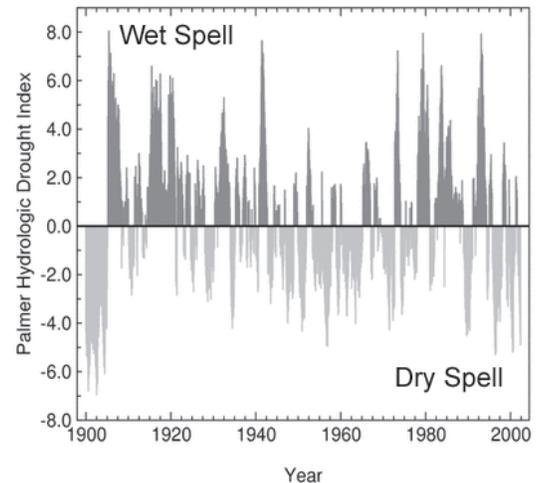
Many climatologists pinpoint 1976 as a time when the PDO switched abruptly into a “positive” phase, with a corresponding rise in sea surface temperatures in the northern Pacific. During that same time frame, the Southwest (and Arizona in particular, as reflected in the illustration) received a relative abundance of precipitation, along with an increasing number of El Niño events.

“Some people are starting to think that we’ve switched back into PDO shift that was occurring to 1947-76 period,” Redmond noted. “If that’s the case, the odds could favor droughty years more often. Therefore it’s sort of easier for a dry period to develop.”

Historical droughts

The worst-case scenario would include droughts as great or greater than the 1950s drought as far as extent and duration. Tree-ring records and other natural archives employed to reconstruct drought events of the past 1,000 years indicate the Southwest was much harder-hit by a severe drought in the latter two-thirds of the 16th Century. The event, which some call a “megadrought” in part because it lasted for decades with only occasional relief, was particularly severe for New Mexico and Texas.

Even reliving the 1950s drought would be a challenge for the Southwest, given the incredible influx of people since then. So climatologists and virtually everyone else hope to avoid a drought as extensive and long-lasting as the 16th century drought.



Arizona Statewide Palmer Hydrological Drought Index, January 1900 - May 2002. Note the abundance of dry spells and lack of wet conditions during the mid-1940s to the mid-1970s. Source: National Climatic Data Center/NESDIS/NOAA

“The same set of meteorological circumstances repeated with different demand structure—like gobs more people—leads to a different demand effect,” Redmond noted. Reliving the 1950s drought would be more difficult on southwestern residents now that there are so many more of them.

Sustained drought has been known to challenge, and perhaps even uproot, sophisticated southwestern cultures of the past. The ancestors of the Pueblo people, known as the Anasazi by anthropologists, abandoned dozens of multi-storied structures in the Four Corners area of the Southwest during a “Great Drought” that stretched across the turn of the 13th Century.

Coming next month: Monsoon Basics. The Climate Assessment for the Southwest (CLIMAS) project will be providing updates of the Southwest climate status for every month throughout the coming year. Visit our web at <http://www.ispe.arizona.edu/climas> or call (520) 792-8712 for more information.

