DROUGHTS IN MEXICO

What do scientific papers say about the occurrence of droughts in Mexico?
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Climate alarmists warn of all sorts of weather disasters, including droughts, as the Earth recovers from the debilitating chill of the Little Ice Age and begins to experience the more benign temperatures of the Current Warm Period. Does history vindicate them? This question is explored via brief reviews of several papers investigating the occurrence of droughts in Mexico.

Stahle et al. (2000)\(^1\) developed a long-term history of drought over much of North America from reconstructions of the Palmer Drought Severity Index, based on analyses of many lengthy tree-ring records. This history revealed the occurrence of a 16th-century drought in Mexico that persisted from the 1540s to the 1580s. Writing of this anomalous period of much-reduced precipitation, they say that "the 'megadrought' of the 16th century far exceeded any drought of the 20th century," during the latter of which periods the world's climate alarmists claim the planet experienced a level of warmth that was unprecedented over the past two millennia and which therefore, according to their reasoning, should have been host to the most extreme lack of moisture of the studied period.

Diaz et al. (2002)\(^2\) constructed a history of winter-spring (November-April) precipitation -- which accounts for one-third of the yearly total -- for the Mexican state of Chihuahua for the period 1647-1992, based on earlywood width chronologies of over 300 Douglas fir trees growing at four locations along the western and southern borders of Chihuahua and at two locations in the United States just above Chihuahua's northeast border. On the basis of these reconstructions, they note that "three of the 5 worst winter-spring drought years in the past three-and-a-half centuries are estimated to have occurred during the 20th century." Although this observation tends to make the 20th century look highly anomalous in this regard, it is not; for two of those three worst drought years occurred during a period of average to slightly-above-average precipitation.

Diaz et al. also note that "the longest drought indicated by the smoothed reconstruction lasted 17 years (1948-1964)," which is again indicative of abnormally dry conditions during the 20th century. However, for several of the 17 years of that below-normal-precipitation interval, precipitation values were only slightly below normal. For all practical purposes, therefore, there were four very similar dry periods interspersed throughout the preceding two and a half centuries: one in the late 1850s and early 1860s, one in the late 1790s and early 1800s, one in the late 1720s and early 1730s, and one in the late 1660s and early 1670s.

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\(^1\) http://www.co2science.org/articles/V3/N13/C1.php.
With respect to the 20th century alone, there was also a long period of high winter-spring precipitation that stretched from 1905 to 1932; and following the major drought of the 1950s, precipitation remained at or just slightly above normal for the remainder of the record. Finally, with respect to the entire 346 years, there was no long-term trend in the data, nor was there evidence of any sustained departure from that trend over the course of the 20th century, indicating that neither 20th century anthropogenic CO₂ emissions nor 20th century warming significantly impacted rainfall in the Mexican state of Chihuahua.

Cleaveland et al. (2003)³ constructed a winter-spring (November-March) precipitation history for the period 1386-1993 for Durango, Mexico, based on earlywood width chronologies of Douglas-fir tree rings collected at two sites in the Sierra Madre Occidental. They report that this record "shows droughts of greater magnitude and longer duration than the worst historical drought that occurred in the 1950s and 1960s." These earlier dramatic droughts included the long dry spell of the 1850s-1860s and what they called the megadrought of the mid- to late-16th century. Their work clearly demonstrates, therefore, that the worst droughts of the past 600 years did not occur during the period of greatest warmth. Instead, they occurred during the Little Ice Age, which was perhaps the coldest period of the current interglacial.

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Investigating the same approximate time period, Hodell et al. (2005b)⁴ analyzed a 5.1-m sediment core they retrieved from Aguada X'caamal, a small sinkhole lake in northwest Yucatan, Mexico, finding that an important hydrologic change occurred there during the 15th century AD, as documented by the appearance of A. beccarii in the sediment profile, a decline in the abundance of charophytes, and an increase in the δ¹⁸O of gastropods and ostracods. In addition, they report that "the salinity and ¹⁸O content of the lake water increased as a result of reduced precipitation and/or increased evaporation in the mid- to late 1500s." These several changes, as well as many others they cite, were, as they describe it, "part of a larger pattern of oceanic and atmospheric change associated with the Little Ice Age that included cooling throughout the subtropical gyre (Lund and Curry, 2004)." Their assessment of the situation was that the "climate became drier on the Yucatan Peninsula in the 15th century AD near the onset of the Little Ice Age," as is also suggested by Maya and Aztec chronicles that "contain references to cold, drought and famine in the period AD 1441-1460."

Going back even further in time, Hodell et al. (1995) had provided evidence for a protracted drought during the Terminal Classic Period of Mayan civilization (AD 800-1000), based on their analysis of a single sediment core retrieved in 1993 from Lake Chichanacanab in the center of Mayan civilization (AD 800-1000), based on their analysis of a single sediment core retrieved in 1993 from Lake Chichanacanab in the center of

the northern Yucatan Peninsula of Mexico. Subsequently, based on two additional sediment cores retrieved from the same location in 2000, Hodell et al. (2001)\(^5\) determined that the massive drought likely occurred in two distinct phases (750-875 and 1000-1075). Reconstructing the climatic history of the region over the past 2600 years and applying spectral analysis to the data also revealed a significant recurrent drought periodicity of 208 years that matched well with a cosmic ray-produced \(^{14}\)C record preserved in tree rings, which is believed to reflect variations in solar activity; and because of the good correspondence between the two data sets, they concluded that "a significant component of century-scale variability in Yucatan droughts is explained by solar forcing."

In a still-later study, Hodell et al. (2005a)\(^6\) returned to Lake Chichancanab in March of 2004 and retrieved a number of additional sediment cores in some of the deeper parts in the lake, with multiple cores being taken from its deepest point, from which depth profiles of bulk density were obtained by means of gamma-ray attenuation, as were profiles of reflected red, green and blue light via a digital color line-scan camera. As they describe their findings, "the data reveal in great detail the climatic events that comprised the Terminal Classic Drought and coincided with the demise of Classic Maya civilization." In this regard, they again report that "the Terminal Classic Drought was not a single, two-century-long megadrought, but rather consisted of a series of dry events separated by intervening periods of relatively moister conditions," and that it "included an early phase (ca 770-870) and late phase (ca 920-1100)."

Last of all, they say that "the bipartite drought history inferred from Chichancanab is supported by oxygen isotope records from nearby Punta Laguna," and that "the general pattern is also consistent with findings from the Cariaco Basin off northern Venezuela (Haug et al., 2003), suggesting that the Terminal Classic Drought was a widespread phenomenon and not limited to north-central Yucatan."

Concurrent with the study of Hodell et al. (2005a), Almeida-Lenero et al. (2005)\(^7\) analyzed pollen profiles derived from sediment cores retrieved from Lake Zempoala and nearby Lake Quila in the central Mexican highlands about 65 km southwest of Mexico City, determining that it was generally more humid than at present in the central Mexican highlands during the mid-Holocene. Thereafter, however, there was a gradual drying of the climate; and their data from Lake Zempoala indicate that "the interval from 1300 to 1100 cal yr BP was driest and represents an extreme since the mid-Holocene," noting further that this interval of 200 years "coincides with the collapse of the Maya civilization." Likewise, they report that their data from Lake Quila are also "indicative of the most arid period reported during the middle to late Holocene from c. 1300 to 1100 cal yr BP." In addition, they note that "climatic aridity during this time was also

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\(^5\) http://www.co2science.org/articles/V4/N23/C2.php
\(^6\) http://www.co2science.org/articles/V8/N51/C2.php
\(^7\) http://www.co2science.org/articles/V8/N50/C2.php
noted by Metcalfe et al. (1991) for the Lerma Basin [central Mexico]," that "dry climatic conditions were also reported from Lake Patzcuaro, central Mexico by Watts and Bradbury (1982)," and that "dry conditions were also reported for [Mexico's] Zacapu Basin (Metcalfe, 1995) and for [Mexico's] Yucatan Peninsula (Curtis et al., 1996, 1998; Hodell et al., 1995, 2001)."

Also working in central Mexico was Therrell et al. (2006), who "developed a continuous, exactly dated, tree-ring reconstruction of maize yield variability" over the period 1474 to 2001 in an effort to provide "new insight into the history of climate and food availability in the heartland of the Mesoamerican cultural province." This work was made possible by latewood-width data they derived from what they describe as "the second-most southerly native stand of Douglas-fir (Pseudotsuga menziesii) trees known in the Americas." In addition, the authors compared their reconstruction to "historical records of crop failure and famine in order to cross-validate the tree-ring and historical records." So what did the researchers' work reveal?

Therrell et al.'s plot of reconstructed drought-induced maize-yield anomalies exposed a total of seven major decadal-scale yield shortfalls over the past 500 years, with a mean rate of occurrence of 1.5 per century over the 400-year period AD 1500-1900. Over the 20th century, however, there was only one such multi-year famine, and its magnitude paled in comparison to that of the average such event of the preceding four centuries. Thus, it appears that the so-called unprecedented warming of the 20th century did not produce the alarmist-predicted effect on drought in central Mexico. In fact, the threat of major drought-induced famines in this part of the world appears to have lessened with increased warming.

In moving toward a consensus on current and historical drought in Mexico, Metcalfe and Davies (2007) synthesized the findings of a variety of paleoclimate studies based on analyses of the sediment records of several crater lakes and lakes formed by lava dams that are scattered across the Trans Mexican Volcanic Belt of central Mexico and that have an absolute chronology provided by radiocarbon dates extending back to 1500 $^{14}$C yr BP. Noting that the degree of coherence among the records "is remarkable," Metcalf and Davis report - in what is perhaps the key finding of their analysis - that "dry conditions, probably the driest of the Holocene [italics added], are recorded over the period 1400 to 800 $^{14}$C yr BP (ca. AD 700-1200)," the significance of which finding is augmented by their observation that "the present day climate of central Mexico is typical of most of the country." Giving the result even broader significance is the fact

that it is, in the words of the two researchers, "consistent with results from the Yucatan Peninsula (Hodell et al., 1995, 2005) ... and from the Cariaco basin (Haug et al., 2003) and the Isthmus of Panama (Lachniet et al., 2004)."

One year later, Dominguez-Vazquez and Islebe (2008) derived a 2000-year history of regional drought for the Lacandon Forest Region in the state of Chiapas, southeastern Mexico. Based on radiocarbon dating and pollen analyses of a sediment core retrieved from the shore of Naja Lake (16°59′27.6″N, 91°35′29.6″W), the two authors reported finding "a marked increase in Pinus pollen, together with a reduction in lower montane rain forest taxa, [that they] interpreted as evidence for a strong, protracted drought from 1260 to 730 years BP," which they characterized as "the most severe," while noting that it "coincides with the Maya classic collapse."

Returning to the Yucatan Peninsula, Escobar et al. (2010) examined sediment cores from Lakes Punta Laguna, Chichancanab, and Peten Itza as a proxy measure for high-frequency climate variability. In doing so the five researchers say their results indicated that "relatively dry periods were persistently dry [italics added], whereas relatively wet periods were composed of wet and dry times." Further, they say their findings "confirm the interpretations of Hodell et al. (1995, 2007) and Curtis et al. (1996) that there were persistent dry climate episodes associated with the Terminal Classic Maya Period." In fact, they find that "the Terminal Classic Period from ca. AD 910 to 990 was not only the driest period in the last 3,000 years, but also a persistently dry period [italics added]." And in further support of this interpretation, they note that "the core section encompassing the Classic Maya collapse has the lowest sedimentation rate among all layers and the lowest oxygen isotope variability."

In one final study, working in the Sierra de Manantlan Biosphere Reserve (SMBR) in west-central Mexico, Figueroa-Rangel et al. (2010) constructed a 1300-year history of the reserve's cloud forest vegetation dynamics via analyses of fossil pollen, microfossil charcoal and organic and inorganic sediment data obtained from a 96-cm core of black organic material retrieved from a small forest hollow (19°35′32″N, 104°16′56″W). In doing so the authors found that "during intervals of aridity, cloud forest taxa tend to become reduced," while, in contrast, "during intervals of increased humidity, the cloud forest thrives." And based on these facts, they determined from their data that there was a major dry period that lasted from approximately AD 800 to 1200 in the SMBR.

It is evident that throughout much of Mexico some of the driest conditions and worst droughts of the Late Holocene occurred prior to the late 20th and early 21st centuries. These observations do much to discredit the climate-alarmist claim that droughts will only get worse as air temperatures rise.

Quoting the four researchers, "results from this study corroborate the existence of a dry period from 1200 to 800 cal years BP in mountain forests of the region (B.L. Figueroa-Rangel, unpublished data); in central Mexico (Metcalf and Hales, 1994; Metcalfe, 1995; Arnauld et al., 1997; O'Hara and Metcalfe, 1997; Almeida-Lenero et al., 2005; Ludlow-Wiechers et al., 2005; Metcalfe et al., 2007); lowlands of the Yucatan Peninsula (Hodell et al., 1995, 2001, 2005a,b) and the Cariaco Basin in Venezuela (Haug et al., 2003)." In addition, they write that "the causes associated to this phase of climate change have been attributed to solar activity (Hodell et al., 2001; Haug et al., 2003), changes in the latitudinal migration of the Intertropical Convergence Zone (ITCZ, Metcalfe et al., 2000; Hodell et al., 2005a,b; Berrio et al., 2006) and to ENSO variability (Metcalfe, 2006)."

Based on the many results described above, it is evident that throughout much of Mexico some of the driest conditions and worst droughts of the Late Holocene occurred prior to the late 20th and early 21st centuries. These observations do much to discredit the climate-alarmist claim that droughts will only get worse as air temperatures rise, especially when it is realized that all of the Mexican droughts of the 20th century/early 21st century (when climate alarmists claim the planet warmed at a rate and to a level that were both unprecedented over the past two millennia) were much milder than many of the droughts that occurred during the much colder centuries of the Little Ice Age, as well as the warmer centuries of the Medieval Warm Period, the latter of which observations suggests that for climate-alarmists to be right about warmth causing droughts, they would have to admit that the Medieval Warm Period (which held sway from about AD 800-1300) was much warmer than anything earth has experienced over the past several decades, which, of course, they simply will not do.

REFERENCES


Cover photo of Mitla archeological site in Oaxaca, Mexico provided by Microsoft.