FORUM Societal collapse

Drought and the Maya

The collapse of the Maya civilization is often attributed to drought, but is the explanation really as simple as that? On the basis of evidence from their respective fields, an archaeologist and a palaeoclimatologist call for a more nuanced assessment.

THE TOPIC IN BRIEF

- The Mesoamerican Maya civilization was one of the most successful on the planet, reaching the peak of its development from about AD 250 to 750.
- In the period known as the Terminal Classic (roughly AD 750 to 1050), the Maya civilization underwent a profound crisis that led to the abandonment of many sites.
- Palaeoclimate data have been used to argue that severe drought during the Terminal Classic may have caused this collapse.
- This argument, however, does not explain the complexity of the archaeological data, and is a matter of debate.

The story of the artefacts

JAMES AIMERS

For more than a century, the story of the Maya civilization has provided a narrative of precipitous rise followed by spectacular decline. Explanations offered for the demise of Maya civilization during the Terminal Classic period have varied in accordance with current events[1], ranging from war or political revolution to deforestation and climate change. Drought currently takes centre stage in many discussions. Some researchers espouse the extreme view that several crises throughout Maya history were caused by drought[2], whereas others offer more measured arguments. But the net result is that droughts are now routinely invoked[3,4] to explain a supposedly pan-Maya collapse.

As David Hodell will argue (see later), palaeoclimate data in support of the drought hypothesis are not always unambiguous, and must be interpreted with care. Tidy tales of Maya collapse are also countered by a complex narrative that has emerged from archaeological research. Evidence for the collapse of Maya sites runs the gamut from precisely dated monuments of conquest to evidence from human bone, fauna and flora (which can also be directly dated). The combination of many archaeological data sets over decades of research has made it clear that sites in a range of physical environments underwent a variety of changes in the Terminal Classic — some much more dramatic than others — rather than marching synchronously towards oblivion.

B. HAAS/NATIONAL GEOGRAPHIC STOCK

Figure 1 | Later than expected. The decline of Maya civilization was once thought to have occurred between AD 830 and 900, but some sites, such as Lamanai, Belize (shown), were not abandoned until the seventeenth century.

Although the Terminal Classic period was first dated to AD 830 to 900, we now know that the changes associated with it occurred at different times and rates across the Maya lowlands (Fig. 1). Sites in the Petexbatún region of Guatemala were abandoned as early as the mid-eighth century; others, such as Chichén Itzá in Mexico, were not deserted until the mid-eleventh century (Fig. 2). In the Mopan Valley of Guatemala, the Terminal Classic may have extended into the thirteenth century. Most surprising of all, sites such as Lamanai and Tipu in Belize, and sites in the Petén Lakes region of Guatemala, were not abandoned until well into the historic period — as late as 1697 for Tayasal in the Petén Lakes district.

Collapse may therefore not be the correct term to describe the variable, long-term process of Maya decline[5], and some archaeologists suspect that climate scientists emphasize droughts that correlate with known abandonments, but ignore those that occurred in periods of growth. In fact, Mesoamerican civilizations in general experienced multiple periods of growth and decline — the Maya were far from singular in this respect.

No one doubts that devastating droughts occurred in the Maya lowlands in the past, as they do now. But so too did long and destructive wars, which show direct links to some site abandonments[6]. The escalating economic and political inequities of the Terminal Classic may also have had a role — perhaps after the 'Arab Spring' of 2011 we will see revolution revisited as an explanation for the Maya collapse. Drought has been convincingly shown to have been an important cause of abandonment at only a handful of sites; in other cases, archaeologists have looked carefully for evidence, to no avail.

Despite its popular appeal, drought as an explanation for the Maya collapse flattens the complexity of the archaeological record and ignores the ability of the Maya to react and adapt. Archaeologists have been too willing to overlook the problems inherent in the interpretation of palaeoclimate data, whereas climate scientists have too often relied on obsolete archaeological information. Part of the problem is that researchers from both fields write and present in different venues for different audiences. We must do a better job of collaborating if we are to be considered more than just good storytellers.

James Aimers *is in the Department of Anthropology, State University of New York at Geneseo, Geneseo, New York 14454, USA.*
e-mail: aimers@geneseo.edu

Figure 2 | Dating decline and drought. Archaeological evidence (from sites marked in blue) suggests that the collapse of Maya civilization occurred at different rates at different places. Abandonments occurred at sites in the Petexbatún region in the eighth century, at Chichén Itzá in the eleventh century, and at sites at the Mopan Valley possibly as late as the thirteenth century. Lamanai, Tipu and some sites at the Petén Lakes were not abandoned until well into the historic period. Palaeoclimate evidence (from sites marked in red) tells the history of drought in Mesoamerica. Data from Lake Chichancanab show that drought occurred between AD 800 and 1000, whereas evidence from Barranca de Amealco dates drought more precisely from AD 897 to 922. Other data suggest that a series of droughts occurred, from AD 760 to 910 (evidence from the Cariaco Basin) and from AD 800 to 950 (evidence from Tecoh). The disparity between the timing of site abandonments and periods of drought casts doubt on theories that drought caused a pan-Maya collapse. Palaeoclimate data must also be considered in context — changes in rainfall around the Cariaco Basin do not necessarily explain what happened 2,700 kilometres away at the Maya site of Tikal.

Maya megadrought?

DAVID HODELL

There are ample palaeoclimate data that support the drought hypothesis for Maya collapse, but its interpretation is not straightforward. Instrumental meteorological data for Mesoamerica are available for only about the past century. Documenting past droughts therefore relies on proxy indicators for rainfall, which are preserved in natural archives such as speleothems (stalagmites), tree rings and lake and marine sediment cores. Each archive and proxy has inherent strengths, but also weaknesses that contribute uncertainty to palaeoclimate inferences. For example, palaeoclimate records require a chronology, and issues of dating accuracy (the absolute age of a sample), temporal resolution (the finest interval of time that can be resolved) and stratigraphic correlation lie at the heart of reconstructing past climate from such data.

So what is the evidence for drought in the Terminal Classic? The first physical evidence[7] came from measurements of oxygen isotopes in shells and gypsum found in sediment cores from Lake Chichancanab in the Yucatán Peninsula, Mexico (Fig. 2), which indicate that climate drying occurred between about AD 800 and 1000. Subsequent palaeoclimate studies have tried to define the nature and timing of this 'megadrought' more precisely. For example, variations in titanium concentrations in annual deposits contained in marine sediment cores from the Cariaco Basin, off northern Venezuela, indicate that multi-year droughts occurred at about AD 760, 810, 860 and 910 (ref. 8). Oxygen-isotope data from an annually banded speleothem found in a cave at Tecoh (in Yucatán, Mexico) reveal eight severe droughts in the period from AD 800 to 950, each lasting from 3 to 18 years[9]. And most recently, a 1,238-year tree-ring record from Barranca de Amealco (Querétaro, Mexico) has provided evidence for a megadrought between AD 897 and 922, with shorter events centred at AD 810 and 860 (ref. 10).

But palaeoclimate records must be evaluated with respect to their location, chronology and the rainfall proxy used. For example, the farther an archive is from the Maya lowlands, the less confident one can be that a rainfall reconstruction applies to the Maya area. So, does the rainfall record from the Cariaco Basin[8] really inform us about past precipitation at the Maya site at Tikal, Guatemala (abandoned about AD 900), some 2,700 kilometres away?

Another issue is the accuracy of dating droughts — annual resolution in a palaeoclimate record doesn't necessarily imply annual accuracy, because some chronologies are not anchored securely in time[8,9] (although tree-ring chronologies provide both high resolution and accuracy[10]). Furthermore, the calibration between a proxy and rainfall is not always straightforward.

In summary, there is robust palaeoclimate evidence for drought during the Terminal Classic, especially in the ninth and early tenth centuries AD, but details remain vague. There was undoubtedly considerable regional and local variability in the timing and distribution of droughts in the Maya lowlands at this time. Difficulties arise when comparing climate and archaeological records, because the data sets inadequately resolve spatial and temporal variability in climate and cultural systems, and both are dated with uncertainty[11]. Our current understanding of the relationship between climate and Maya cultural change during the Terminal Classic therefore remains fuzzy. Sharpening the evidence will require new high-resolution, accurately dated records, preferably on a local scale, from both archaeologists and palaeoclimatologists, and mutual cooperation when interpreting the results. ■

David Hodell *is in the Department of Earth Sciences, University of Cambridge, Cambridge CB1 1DS, UK.*
e-mail: dah73@cam.ac.uk

1. Wilk, R. *J. Anthropol. Res.* **41,** 307–326 (1985).
2. Gill, R. B. *The Great Maya Droughts: Water, Life, and Death* (Univ. New Mexico Press, 2000).
3. Hunt, B. G. & Elliott, T. I. *Clim. Change* **69,** 393–407 (2005).
4. Cecil, J. *The Fall of the Mayan Civilisation* www.bbc.co.uk/history/ancient/cultures/maya_01.shtml (2011).
5. Aimers, J. J. *J. Archaeol. Res.* **15,** 329–377 (2007).
6. Inomata, T. in *The Archaeology of Settlement Abandonment in Middle America* (eds Inomata, T. & Webb, R. W.) 43–60 (Univ. Utah Press, 2003).
7. Hodell, D. A., Curtis, J. H. & Brenner, M. *Nature* **375,** 391–394 (1995).
8. Haug, G. H. *et al. Science* **299,** 1731–1735 (2003).
9. Medina-Elizalde, M. *et al. Earth Planet. Sci. Lett.* **298,** 255–262 (2010).
10. Stahle, D. W. *et al. Geophys. Res. Lett.* **38,** L05703 http://dx.doi.org/10.1029/2010GL046472 (2011).
11. Yaeger, J. & Hodell, D. A. in *El Niño, Catastrophism, and Culture Change in Ancient America* (eds Sandweiss, D. H. & Quilter, J.) 187–242 (Harvard Univ. Press, 2008).