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ON THE COMPATIBILITY OF EPIGRAPHIC, GEOGRAPHIC, AND ARCHAEOLOGICAL DATA, WITH A DROUGHT-BASED EXPLANATION FOR THE CLASSIC MAYA COLLAPSE

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Abstract

The demographic and cultural Collapse of the ancient lowland Maya civilization in the ninth century A.D. has long been of fascination to both scholars and the general public. A large number of hypotheses has been offered to explain this event. Evidence derived from several independent lines of investigation during the 1990s indicates the time of the Maya Collapse was one in which severe drought conditions prevailed over much of the lowlands. Drought is now considered a potential primary causal factor for the Collapse. This paper cites some of the evidence for the presence of drought conditions at the time of the Collapse and then considers the degree to which a drought-based explanation for the Collapse is compatible with what is currently known about the Collapse's occurrence. There are problematic aspects to the temporal and spatial development of the Collapse that suggest that the Terminal Classic-period drought did not constitute a single, overwhelming blow that rendered collapse inevitable. It is suggested, instead, that culture-historical events and ecological factors interplayed with the Terminal Classic-period drought in such a way as to render the Collapse possible.

The Terminal Classic period Collapse of Maya society and culture is a phenomenon that has long attracted the attention of scholars and the broader public. The Collapse clearly was a demographic disaster that greatly reduced human population within the southern half of the Maya Lowlands, leaving that area largely uninhabited, even until the present day. The Collapse was also accompanied by disruptions, setbacks, and a change in cultural patterns for those areas of the Maya Lowlands that survived.

Seminal studies of the Collapse and its possible causes, such as the volume edited by T. Patrick Culbert (1973) and the study by John Lowe (1985), largely ignored drought as a possible primary cause. Since 1994, however, increasing evidence indicates that severe, extended droughts occurred in the lowlands at the time of the Collapse. These new data suggest the possibility that droughts may have presented challenges that major portions of Classic Maya peoples were unable to overcome. This paper briefly reviews some of the recent evidence for droughts during Terminal Classic and early Postclassic times, then considers the compatibility of available evidence about the Collapse's occurrence with the hypothesis that drought was the primary or sole cause for the Classic Maya Collapse (hereafter referred to as the *drought hypothesis*).

EVIDENCE FOR DROUGHT AT THE TIME OF THE COLLAPSE

Evidence for severe, extended drought conditions at the time of the Collapse now comes from at least three sources, each of which is based on a different line of evidence. Joel Gunn, William Folan, and Hubert Robichaux (1994, 1995) matched thirty-two years of river-flow data for the Río Candelaria in southern Campeche, Mexico, with the average temperature of the atmosphere of the Northern Hemisphere during the same time period. In that study, the water flow measured in the river served as a surrogate for precipitation within the Río Candelaria's catchment basin. These data indicate a clear pattern in which warmer Northern Hemisphere average temperatures resulted in more precipitation (river flow) in the catchment basin, and colder temperatures in less precipitation. A mathematical model that considered variations in solar output, El Niño events, and volcanic activity permitted retrodiction of this precipitation-to-temperature relationship back for several thousand years. The retrodiction indicated that the period A.D. 750–950 was an unusually cold time that was accompanied by substantially less precipitation in the Río Candelaria catchment basin.

In a separate study, Richardson B. Gill (1994) marshaled a wide variety of data, including meteorological, paleoclimatic, and ethnohistoric evidence, to establish a similar correlation that indicates that colder temperatures in Europe and North America were accompanied by droughts in the Maya Lowlands. Gill's examination of a drought cause for the Collapse is expansive and comprehensive, and he concludes that a series of severe droughts in the Maya lowlands from A.D. 790–950 were the *sole cause* of the Collapse (Gill 1994:456). Further, he concludes that most Maya in the collapsed areas died from lack of water to drink (Gill 1994:476).

In a third study, Hodell and colleagues (1995) and Curtis and colleagues (1996) discovered physical evidence indicating that extended, severe droughts occurred in the northern lowlands at the time of the Collapse. They analyzed oxygen-18:oxygen-16 ratios for shells of gastropods and ostracods found in sediment cores extracted from Lakes Chichancanab and Punta Laguna, which are located in the northern Maya Lowlands. Higher values of this ratio are associated with drier times, and lower values with wetter times. Carbon-14 dating of organic material in the cores provided a temporal framework in which to observe the changes in the ratios. The data from both lakes indicate that the Collapse time was an exceedingly dry time in the vicinity of both lakes.

These three independent sets of data and analysis are uniform in indicating that precipitation was very low in the lowlands at the time of the Collapse. The Río Candelaria model and the lake-sediment studies, by their nature, have greatest applicability to the specific geographical areas that were investigated but possibly have application to the broader lowland area. Gill's method of analysis tends to make his results applicable to the entire Maya Lowlands. Given the similar results of these three studies, it seems increasing likely that drought was a relevant factor in the development of the Collapse, but questions are raised. Was the Terminal Classic drought so severe that the Maya succumbed directly because of its effects alone, as Gill has suggested? Or was drought but one of a number of debilitating factors that combined in some way to fell the Maya? Epigraphic, geographical, and archaeological issues relevant to this question are considered in the following sections.

EPIGRAPHIC AND GEOGRAPHIC DATA AS THEY RELATE TO THE COLLAPSE

Although great advances have been made in understanding the Maya script over the past fifteen years, and many new readings (both firm and hypothetical) have become available, no texts appear to mention droughts during Terminal Classic and Early Postclassic times. This is consistent with the general patterning of text topics during Classic times, when monumental, ceramic, and other texts dealt almost exclusively with issues and events relating to the lives of rulers and other elites. There are possible references to drought in the Late Postclassic Dresden Codex (Kelley 1976:171, 207), but the passages there are vague in meaning and thus far of little explanatory value with regard to the Collapse. At this point, the most relevant data in the texts are the dates on those monuments that represent the last monuments erected at individual Maya sites. The dates on these monuments presumably mark the approximate time at which individual sites were abandoned (Adams 1991:264; Culbert 1993:115–116; Schele and Freidel 1990:381–393).

The patterning of the "last monuments" presents two problematic aspects of the drought hypothesis. First, the monument data indicate that the lowland sites that suffered the Collapse did not all fade out at the same time. Instead, they declined sequentially over about 150 years. This calls into question drought as the sole or ultimate cause of the Collapse. Even given that different sites and regions had varying hydrologic situations, and that drought conditions may have made their way slowly across the lowlands, this very long period of time suggests that other factors may have been relevant and that the drought's effect was not totally overwhelming.

Second, the particular temporal and spatial sequencing of the Collapse, as indicated by dated monuments (Gill 1994:402–406; Lowe 1985:205; Schele and Freidel 1990:26–33, 381), is inconsistent with drought being the dominant factor in provoking the Collapse. The monument data indicate that sites were first abandoned in the southwestern region of the lowlands, then subsequently in the southeastern region, and finally in the central and more northern areas of the southern lowlands (Figure 1). In particular, the apparent very early demise of sites such as Piedras Negras (ca. A.D. 810) and Yaxchilan (ca. A.D. 808) that are advantageously situated on the banks of the very large Usumacinta River calls into question a drought-provoked decline for these sites. The Usumacinta has a very large catchment basin that in normal years receives the highest rainfall in the entire Maya Lowlands. It also has a significant catchment area in the Guatemala highlands (Henderson 1981:49), an area that clearly was not affected as severely by the Collapse and presumably was not as affected by drought conditions (Figure 2). Further, there appears to be no historical precedent for the Usumacinta ever going dry (Gill 1994:327). If severe drought was the sole cause of the Collapse, why would sites with large water resources such as Yaxchilan and Piedras Negras be among the first to be abandoned? And why do similarly advantageously situated sites in the southeastern lowlands such as Lamanai continue without a similar total collapse? And finally, in this regard, why are sites that are located in the center of the southern and central lowlands such as Tikal (A.D. 879) and Xultun (A.D. 889), which were totally dependent for survival on rainfall within their immediate vicinity, among the last to fade out? These last sites, lacking permanent water sources, are generally agreed to have had a more difficult hydrologic situation and would seem more vulnerable to drier climatic conditions—and, consequently, more likely to collapse first.

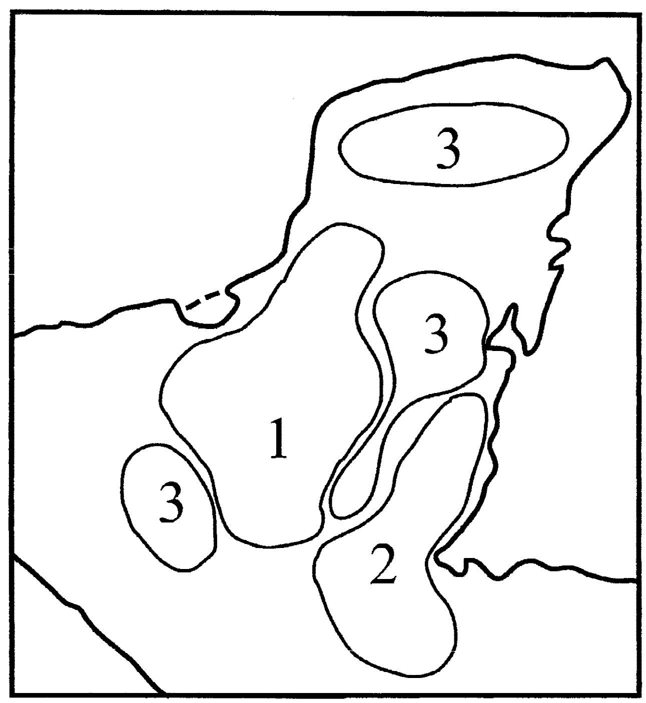

Figure 1. Map of the Maya region showing the sequential zones through which the Maya Collapse progressed, based on the dates on the "last monuments" found at individual sites. Approximate times for the Collapse in each zone were A.D. 761–810 (Zone 1), A.D. 811–860 (Zone 2), and A.D. 861–909 (Zone 3); after Gill (1994:405).

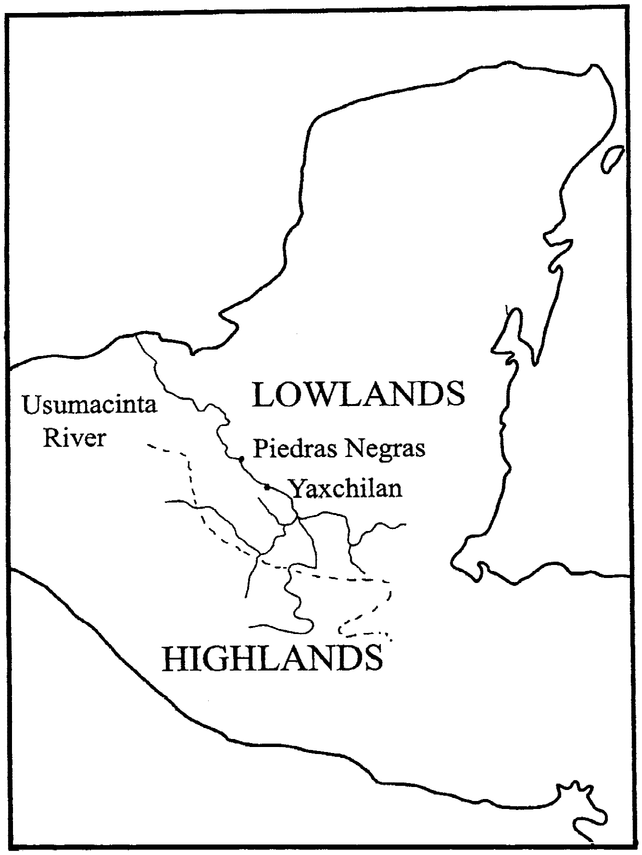

Figure 2. Map showing the location of the Usumacinta River and its tributaries and the ancient sites of Piedras Negras and Yaxchilan (after Henderson 1981:49).

Gill (1994) considered the "last monument" data in his analyses but also suggested that some relevant monuments may remain undiscovered for chance reasons and that these missing monuments might alter our understanding of the sequence of the Collapse. In this regard, it is important to note that since the Classic Maya Collapse was first recognized by archaeologists more than fifty years ago, many stelae have been discovered (e.g., the recent find of Tikal Stela 40), but the dates on these monuments have not altered the long-held understanding of when the Collapse occurred. The monument data, as it is currently known, remains a key element in our knowledge of how the Collapse event transpired, and it should continue to apply until new data contradict or alter it.

ARCHAEOLOGICAL DATA AS IT RELATES TO THE COLLAPSE

Continuing archaeological investigation at numerous locations in the lowlands over the past fifteen years has added many sites to the list of those that suffered the Collapse. For example, Rio Azul, La Milpa, Dos Hombres, Blue Creek, Chan Chich, and others sites in the Three Rivers region of northeastern Guatemala and northwestern Belize all have been shown to have been abandoned at the time of the Collapse (Adams 1999; Guderjan 1997; Houk 1996, 1997; Robichaux 1995; Tourtellot et al. 1994:123). In general, recent research has served strongly to reaffirm the Collapse event and to provide a finer resolution to its spatial scope.

An important subset of archaeological data that relates directly to the topic of drought is that of ancient water management. The remainder of this paper will briefly consider one facet of such ancient efforts: the shallow water well. The well-known fact that a 600-foot-deep well dug at Tikal to support the 1960s archaeological project did not encounter water (Puleston 1973:238) has had the unfortunate effect of characterizing the areas that suffered the Collapse as areas in which wells could not have been a significant component of ancient water-management efforts (Lowe 1985:114). Recent data, and experience concerning the use of ancient shallow wells in the northeastern Peten and adjacent areas during modern times, have generated a greater appreciation of such wells and their utility, as well as recognition of their possible relevance to the Collapse and to the drought hypothesis.

Archaeologists working in the Three Rivers region in northeastern Guatemala and northwestern Belize are familiar with two such shallow wells. Both are located near modern forest trails. One is just off the trail from Uaxactun to Rio Azul near an old chicle camp known as El Cedro (Graham 1967:33–34; personal observation 1990, 1991). The El Cedro well has been used in modern times as a water source by the government guards assigned to Rio Azul during their travels (personal observation, 1991). The other well is on adjacent Programme for Belize (PFB) land in Belize. Known as "Poza Maya" (Guderjan et al. 1991:76), that ancient well has at times been the primary water source for PFB Rio Bravo Station personnel; it has also has served as a primary water supply for the large, nearby University of Texas Archaeological Field Camp over a period of several field seasons that occurred during the dry season. The Poza Maya well alone supported as many as one hundred persons over several months per year during the dry season, providing water for drinking, showering, cooking, laundry, and more (Scarborough et al.1992:77; personal observations 1992, 1993, 1994). Tom Guderjan and colleagues (1991:76) note that the Poza Maya well has never been known to go dry.

The El Cedro and Poza Maya ancient wells are both shallow in depth, the former being 4.3 m deep (personal observation, 1991), and the latter 4.2 m (Scarborough et al. 1992:77). When measured on April 21, 1991, near the end of a very dry dry season, the El Cedro well contained a column of water 2 m tall (personal observation, 1991). The Poza Maya well on the PFB property had a strong discharge rate of about 37.14 liters (9.8 gallons) per minute during the dry season of 1992 (Scarborough et al. 1992:77). Fred Valdez (1995) and Lynne Tovar (1995) report the discovery of a similar well at a small site, El Arroyo, on the PFB property within a few kilometers of Poza Maya.

The El Cedro and Poza Maya ancient wells in the northeastern Peten area are separated by an east–west distance of 45 km (27 miles). Both appear to be situated within ancient rural areas. Ivan Sprajc (2001:23–24) recently found two ancient wells near the newly discovered site of Los Angeles in southeastern Campeche (55 km northeast of the large site of Rio Azul in Guatemala). The Los Angeles wells were first noted ten years ago by local farmers who now use them in times of drought. Reynaldo Acevedo (2000) has discovered three wells at Uaxactun: one near the site center, and two on the outskirts of the site. One of these wells is described as being about 7 m deep and containing a column of water about 4 m deep. William Bullard (1960:363) reported a similar ancient well used by modern peoples to the south near Dos Aguadas (lo-

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cated ca. 25 km east of Tikal), which is at least 5 m deep. It is described as being the most reliable water source in its vicinity. Brainerd (as cited in Bullard 1960:363) reported Classic-period wells to the north in the Chenes area of Campeche. Rubentino Chi and William Folan (1991) provide specific data on twenty-eight wells in the Chenes region. Also, Fred Nelson (1973:33–37) reports nineteen wells at the Chenes site of Dzibilnocac, northern Campeche, along with *chultun*s and *aguada*s as Late Classic-period water sources. One well excavated by Nelson was 13.6 m deep. All of the wells cited in this paper are located near ancient settlement remains. The shallow wells most commonly are associated with people living in rural areas.

It seems reasonable to hypothesize that there were many additional wells in this sizable area, and perhaps beyond it. The known wells have small surface openings, generally a meter or less in diameter, and a surveyor must pass very close to one to note it in the brush. There is also a distinct possibility that some "*chultun*s" encountered in rapid surveys may actually have been similar shallow wells. With debris in them, and only a casual inspection, these wells resemble *chultun*s. These shallow wells are apparently made possible by the presence of perched water tables that rest on impermeable geologic strata. These and other such wells represent a water resource that has received very little attention and consideration in the archaeological literature of the southern lowlands. Present insight suggests that water may have been removed from the wells in ceramic pots lowered and raised by rope; however, it is possible that a more efficient method was devised to extract and distribute water from these wells. Ray Matheny and Deanne Gurr (1979:444–446) have demonstrated the ancient use of various types of wells in the Chiapas highlands, an area that survived the Collapse.

The demographic collapse of the Terminal Classic period affected rural as well as urban populations. The demonstrated potential robustness of shallow wells under dry-season conditions in modern times, as cited here, raises questions about their utility and importance in ancient times for rural populations. Because shallow wells have largely been discounted and underestimated by scholars as a possible significant water source for the ancient peoples in the collapsed areas, there is a need for more study and consideration of shallow wells in the context of the drought hypothesis.

CONCLUSION

Recent archaeological research has served to confirm the Collapse event and to add many sites to the list of those that were abandoned at the time of the Collapse. This paper has summarized some of the data that indicate severe droughts within large portions, or all, of the lowlands, accompanied the abandonment of these sites, and the collapse of the Maya civilization.

Despite this growing awareness that drought may have been an important factor in the development of the Collapse, there are still problematic aspects in the Collapse's occurrence, such as the long time required for it to run its course and its apparent initial impact being on water-advantaged sites in the southwest of the lowlands rather than on apparently less-advantaged sites in the center such as Tikal, which caution against viewing drought as the sole cause of the Collapse. These problematic aspects suggest the likelihood that cultural factors and events also played important roles in the development of the Collapse. The degree to which foreign military intrusions, internal conflict, political and economic mismanagement, and other cultural factors were relevant to the Collapse, and how they interplayed with the presence of drought, remains to be worked out.

RESUMEN

El reconocido "Derrumbe" demográfico y cultural de la antigua civilización maya durante el noveno centenario d.C. ha sido por mucho tiempo la facinación de catedráticos y el público en general. Un gran número de hypotesis han ofrecido una explicación sobre este evento. Durante los años 1990s diferentes fuentes de investigación indican que el tiempo del Derrumbe de la civilización maya ocurrió durante el tiempo de severas sequías que prevaleciera en esa región. La sequía es ahora considerada un principal factor potencial del Derrumbe. Este artículo hace mención de alguna evidencia sobre la presencia de las condiciones de sequía al tiempo del Derrumbe, y luego considera a que grado una explicación basada en la sequía al tiempo del Derrumbe es compatible con lo que se sabe actualmente sobre el suceso del Derrumbe. Hay aspectos problemáticos temporales y espaciales al desarrollo del Derrumbe que sugiere que la sequía del período clasico terminal no constituyó un golpe abrumador que hizo el Derrumbe inevitable. En su lugar, la evidencia sugiere que eventos culturales-históricos y factores ecológicos, mezclados con la sequía del período clasico terminal en tal forma que permitieron que el Derrumbe sucediera.

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