Quaternary Science Reviews 86 (2014) 89–98

Contents lists available at ScienceDirect

Quaternary Science Reviews

journal homepage: www.elsevier.com/locate/quascirev

Beyond the Mayan Lowlands: impacts of the Terminal Classic Drought in the Caribbean Antilles

Chad S. Lane [a,*], Sally P. Horn [b], Matthew T. Kerr [a,b]

[a] Department of Geography and Geology, University of North Carolina Wilmington, Wilmington, NC 28403, USA
[b] Department of Geography, University of Tennessee, Knoxville, TN 37996, USA

ARTICLE INFO

Article history:
Received 5 November 2013
Received in revised form
17 December 2013
Accepted 18 December 2013
Available online 21 January 2014

Keywords:
Hispaniola
Dominican Republic
Ostionoid
Maize
Hydrogen isotope
Deuterium
Alkane
Mayan collapse

ABSTRACT

High-resolution paleoclimate records from the Mayan Lowlands and the Cariaco Basin have shown that the collapse of the Mayan socio-political structure at the end of the Classic period ~1000 C.E. was linked to a series of severe, multi-decadal drought events, collectively termed the 'Terminal Classic Drought' (TCD), between ~750 and 1100 C.E. Here we present proxy evidence indicating that increased aridity leading up to and during the TCD also strongly affected the Caribbean Antilles. Additionally, the timing of the TCD corresponds with cultural and demographic shifts in the Greater Antilles, including the appearance of Ostionoid cultural traditions, the colonization of new islands, and the intensification of agriculture. We propose that these multi-decadal droughts affected not only the very large and complex socio-political structures governing large populations like that of the Late Classic Maya, but also smaller and less politically complex societies across the Caribbean. However, instead of resulting in societal collapses as suspected in the Mayan Lowlands, these climatic events may have spurred a cultural transition across the Caribbean Antilles that ultimately led to the development of Taíno cultural traditions encountered by Christopher Columbus upon his arrival in 1492 C.E.

1. Introduction

Efforts to assess impacts of climate change on prehistoric human societies contribute to long-standing debates regarding the effects of environmental change on culture and may provide models for potential responses of modern societies to future climate change (deMenocal, 2001; Turner and Sabloff, 2012). Shifts in climate have been put forward as explanations for varied instances of societal change, conflict, and collapse during prehistory (deMenocal, 2001 and references therein; Brooks, 2006; Kumar et al., 2006; Carrión et al., 2007; Polk et al., 2007; Zhang et al., 2008; Buckley et al., 2010; Hsiang et al., 2011, 2013; Kelley et al., 2013; Taylor et al., 2013). Perhaps none of these societal changes has attracted more attention than the disintegration of the Classic Mayan civilization between 800 and 1100 C.E. following a ~700 year period as a dominant socio-political entity in Mesoamerica. While numerous hypotheses have been advanced (Gill, 2000), the political instability that led to the collapse of the Classic Maya has been tied to a series of extended droughts that resulted from a more southerly mean annual position of the intertropical convergence zone (ITCZ), likely driven by perturbations in Walker Circulation (Haug et al., 2003; Hodell et al., 2005; Peterson and Haug, 2006; Gill et al., 2007; Kennett et al., 2012; Luzzadder-Beach et al., 2012).

Because the ITCZ plays a significant role in global circulation patterns, changes in ITCZ mobility or behavior during the TCD should have impacts that extend far beyond the Mayan lowlands. For example, Yancheva et al. (2007) presented evidence of increased aridity in China coincident with the TCD that they attributed to a more southerly mean annual position of the ITCZ and weakened summer monsoon. Yancheva et al. also pointed out that this drought was coincident with the collapse of the Tang Dynasty in China, highlighting potentially global ramifications of alterations in ITCZ behavior on complex societies. Despite the close proximity of the Caribbean Antilles to the Mayan lowlands, uncertainty exists over the severity of the TCD in this region and its possible impacts on the relatively small populations then inhabiting the islands. Assessment of climate change impacts on these smaller and less politically complex populations could yield new insights into societal responses to climate change and provide a case study contrasting with that of the large and complex socio-political structures of the Classic Maya and Chinese Dynasties.

Here we present evidence of the TCD at a mid-elevation site on the Caribbean island of Hispaniola derived from proxies in sediment cores recovered from two small lakes, Laguna Castilla and

* Corresponding author. Tel.: +1 910 962 3466; fax: +1 910 962 7077.
E-mail address: lanec@uncw.edu (C.S. Lane).

0277-3791/$ – see front matter © 2013 Elsevier Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.quascirev.2013.12.017

Laguna de Salvador, on the Caribbean slope of the Cordillera Central of the Dominican Republic. We previously presented reconstructions of paleoclimate spanning the last ~3000 years from these lakes (Lane et al., 2009), but here we specifically focus on the time period of the TCD and include new high-resolution paleohydrological data from Laguna Castilla derived from compound-specific hydrogen isotope analyses of terrestrially derived n-alkanes (δD_{alkane}), which have shown exceptional promise as proxies of evapotranspiration (Sachse et al., 2012). We compare the resulting proxy data with a comprehensive archaeological record of the Antilles to assess potential impacts of the TCD on prehistoric Antillean populations.

2. Study site

2.1. Sediment core locations

Laguna Castilla (18°47′51″N, 70°52′33″W, 976 m) and Laguna de Salvador (18°47′45″ N, 70°53′13″ W, 990 m) are small lakes in the Dominican Republic with surface areas of 1.2 and 0.5 ha, respectively (Fig. 1). They are located in the village of Las Lagunas, approximately 40 km northwest of Azua, and occupy basins formed on a massive slump rotation block in the unconsolidated sediments that make up the walls of the Río Cuevas valley (Lane et al., 2009).

While the ITCZ never reaches Hispaniola during its annual migration, precipitation around Las Lagunas is controlled primarily by ITCZ migrational dynamics. Rainfall is highest in the northern hemisphere summer when the ITCZ is located in its most northerly position and proximal doldrum dynamics allow for onshore flow of moisture-laden air in the form of sea breezes that are then orographically modified. Limited meteorological data from Azua indicate a mean annual precipitation value of ~700 mm at sea level, but Las Lagunas at higher elevation likely receives closer to 1000 mm annually (Izzo et al., 2010). Further details regarding the physical setting for this study are in Lane et al. (2009).

2.2. Human prehistory in the Caribbean Antilles

Knowledge of human prehistory in the Caribbean Antilles has changed significantly since the seminal work of Rouse (1992). With an increase in the number of archaeological excavations and related studies has come a more complex picture of demographic and cultural dynamics in the region (Keegan et al., 2013). Initial occupation of the Antilles began ~4000 B.C.E when the Casimioroid, a lithic culture, began settling the Greater Antilles from southern Mesoamerica. Around 2000 B.C.E. a new migration from the Orinoco River valley, the Ortoiroid, began colonizing the Lesser and Greater Antilles. The Ortoiroid were also a lithic culture, but did apparently cultivate some crops as part of their subsistence base (Keegan et al., 2013). Around 400 B.C.E. the Saladoid began colonizing the Lesser Antilles and Puerto Rico from the Orinoco River region, though not necessarily in that order (Fitzpatrick, 2013), but their expansion apparently stopped at the Mona Passage and the Saladoid did not occupy the remainder of the Greater Antilles at this time. The Saladoid were primarily a horticultural society that relied on crops, particularly manioc, for much of their subsistence.

What happened next in the human history of the Caribbean is currently in debate (Fitzpatrick, 2013), but sometime around 600 C.E. a new cultural tradition, the Ostionoid, appeared throughout the Greater Antilles and then apparently spread into the Lesser Antilles. It remains unclear if the Ostionoid tradition arose from Saladoid roots in Puerto Rico or if it developed in isolation on Hispaniola, where no evidence of Saladoid occupation exists, and then spread through the remaining Greater Antilles, the Lesser Antilles, and The Bahamas (Keegan, 2006; Sinelli, 2013). In either case, the Ostionoid culture is characterized by a change in ceramic tradition and an intensification of agricultural practices (Newsom and Deagan, 1994; Wilson, 1997; Newsom, 2006), particularly in the Cibao valley of the Dominican Republic (Sinelli, 2013). Around 1200 C.E. the Chican Ostionoid tradition became dominant throughout the Greater Antilles; this culture is generally considered the forebearer to the Classic Taíno culture encountered by Europeans upon their arrival in 1492 C.E.

No archaeological studies have been conducted in the Las Lagunas region specifically, but prior lake sediment analyses indicate human occupation of the Laguna Castilla and Laguna de Salvador watersheds between ~1060 and 1250 C.E., placing this occupation within the Ostionoid cultural period (Lane et al., 2009). Declines in arboreal pollen types, increased charcoal fragment abundance, and increased sedimentation rates indicate intensive deforestation and agricultural activity around the lakes during the period (Lane et al., 2009). High abundances of maize pollen and stable carbon isotope signatures indicative of C_4 crops and weeds indicate that maize was a primary cultigen in agricultural fields surrounding the lakes, which is contrary to archaeological interpretations of maize being a very minor component of prehistoric Caribbean diets (Lane et al., 2008a, 2008b).

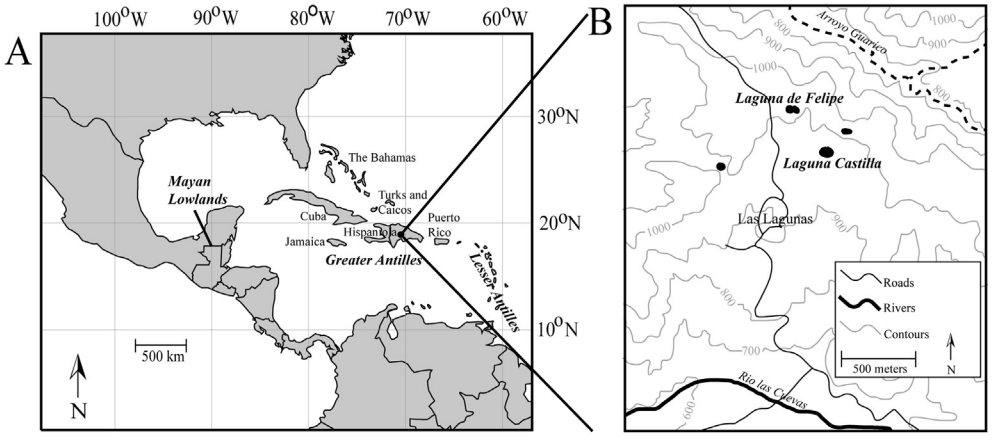

Fig. 1. (A) Locations of Laguna Castilla and Laguna de Salvador along with other islands and geographical regions (Mayan lowlands, Greater Antilles, and Lesser Antilles) discussed in the text. (B) Topographic map of the Las Lagunas area showing positions of Laguna Castilla and Laguna de Salvador. Contours are in meters.