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Climate Change and Deer Consumption of Maize at the Turpin Site, ca. A.D. 700-1300

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Maize is commonly found on archaeology sites from the late Late Woodland period (ca. A.D. 700-1000) of the Middle Ohio Valley, including in abundance at the Turpin Site on the lower Little Miami River. However, direct evidence of its consumption by humans at Turpin before about A.D. 1000 is scarce (Cook and Price 2015; Cook 2017). In an effort to study the role of maize at Turpin, we analyzed carbon and oxygen isotope data from 59 deer teeth from both late Late Woodland and Early Fort Ancient (ca. A.D. 1000-1300) contexts. The main goal of the study was to assess the level to which deer were consuming maize during the late Late Woodland as we know that maize was present in large quantities in the macrobotanical samples from the site for this time interval (Weiland 2019; see also Cook 2017 for direct dates on maize).

The hypothesis was that deer would be consuming maize during the late Late Woodland as during the Fort Ancient periods if maize was initially added to the earlier fields to attract deer—what we call the "niche hypothesis." This constructed niche could then explain the lag between the introduction of maize into the region and its subsequent transition to a staple crop for humans. Oxygen isotopes were analyzed from the same teeth to further examine whether there was a pronounced climatic shift that is alluded to in Palmer Drought Severity Index (PDSI) data but with a very small sample (n=1 grid point) (Figure 1).

There were two significant results from our study, both showing a change from Late Woodland to Fort Ancient times (Figure 2). First, our data show that there was a shift in the consumption of corn by deer between the late Late Woodland ($t = -49.38$) and the Early Fort Ancient periods ($t = -20.08$) ($p<0.05$), particularly those deer deposited in Feature 100, a pit which may contain the residue of a feast (see Figure 2; Comstock 2017). However, Late Woodland deer were not eating much if any maize; hence, we did not find support for the niche hypothesis. These findings likely track the clearance of forested environments for maize fields as well as garden hunting by Fort Ancient farmers. This pattern is much like what we see today in Ohio.

Second, there is also a significant change in the oxygen levels between the late Late Woodland ($t = -17.09$) and Early Fort Ancient periods ($t = -20.01$) ($p<0.05$). This matches our hunch from the PDSI data point, but thus far this result is specific to the Turpin site. Change in oxygen levels, particularly $\delta^{18}O$, directly results from temperature fluctuations, with higher values in cold climates and lower ones in warmer climates. Reasons for this change are explained in detail below:

> This trend occurs because of the effects of precipitation and evaporation. Since it is lighter than ^{18}O, ^{16}O evaporates first, so in warm, tropical areas, the ocean is high in ^{18}O. Additionally, as water vapor condenses to form rain, water droplets rich in ^{18}O precipitate first because it is heavier than ^{16}O. Thus, the cold, polar regions are depleted in ^{18}O as it all precipitates out in the lower latitudes, but they are high in ^{16}O. On the other hand, the Tropics possess a large amount of ^{18}O but have little ^{16}O. This state is not permanent,

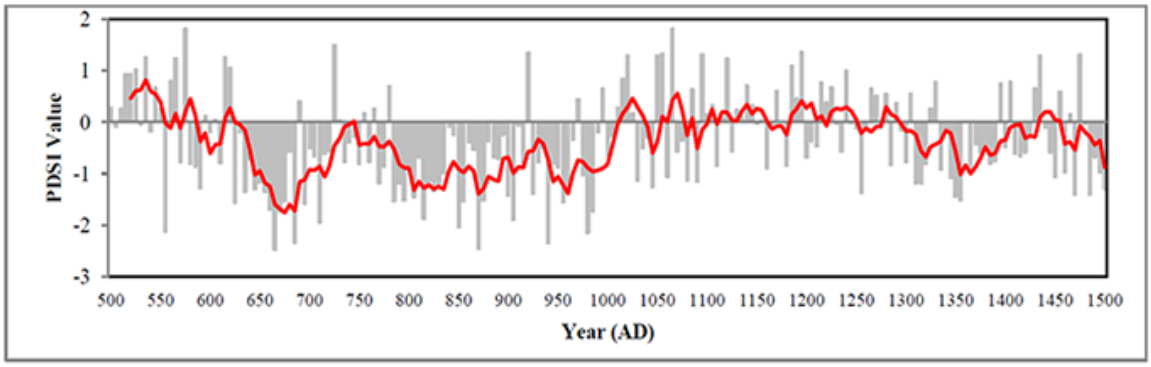

Figure 1. PDSI data from single Grid Point 236 (Ohio) (from Comstock 2017: Figure 5.16).

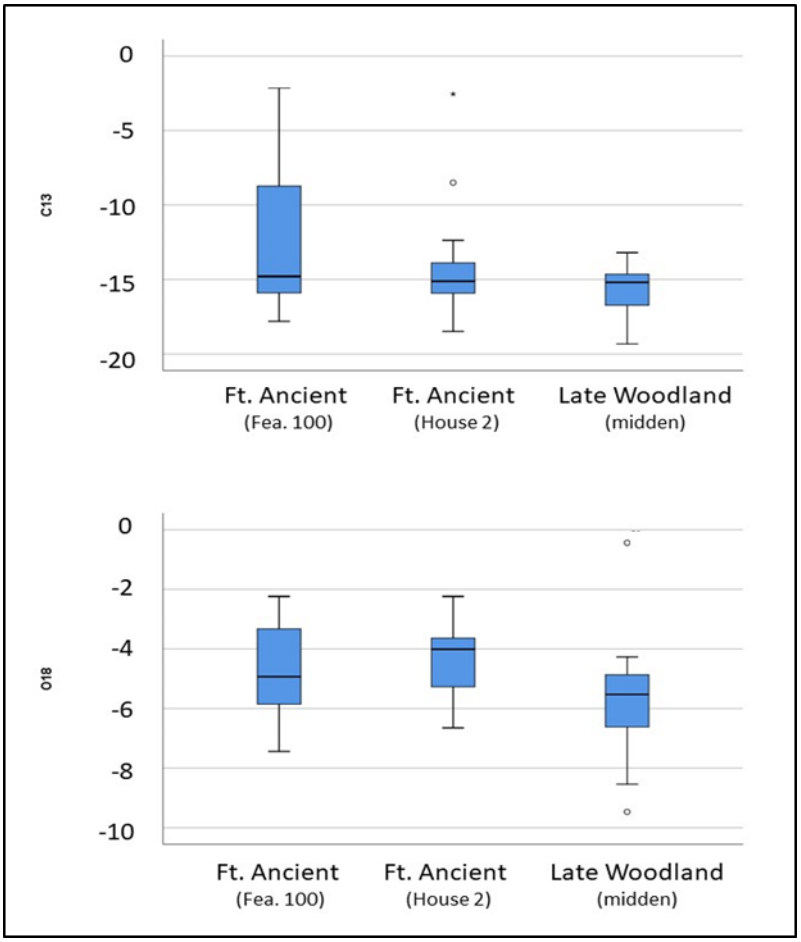

Figure 2. Box and whisker plots of carbon (top) and oxygen (bottom) analyses of deer enamel from Turpin.

however, because evaporation and precipitation are highly correlated with temperature. Changes in the climate can greatly affect the ratio of ^{18}O and ^{16}O and can alter their distribution throughout the globe. (Source: www.seas.harvard.edu/climate/eli/research/equable/isotope.html)

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