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Radiocarbon Based Occupation Patterns of the San Antonio River Basin

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Summary

We explore the utility of summed probabilities on calibrated radiocarbon dates as a gross measure of regional occupational intensity. Our data consists of 321 dated contexts, most of which are features, from over 40 sites within the San Antonio River Basin (SARB). Interpreting the summed date patterns is complex given shifting research interests, deterioration of bone and charcoal over time, differential geomorphic exposures, sampling issues, and the non-linear pattern of the calibration curve. We investigate two of these complications and explore ways to lessen their impacts. This allows us to highlight several periods where occupation in the basin may be more (e.g., ca. 5000-4200) or less (e.g., ca. 1800-1000 BP) intensive that require additional investigation.

Location, Sample Selection, and Initial Treatment

The SARB covers an area of ca. 10,500 km^2 (Fig. 1). Our dates come from 6 counties, though most are concentrated in a roughly 3,025 km^2 area in and around Bexar County. Most of the dates are from sites along major rivers or springs. Locations away from water are underrepresented. The dates used here, then, likely contain a variety of spatial and temporal biases.

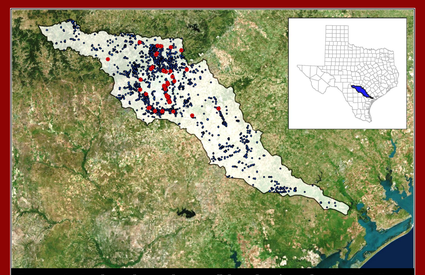

Figure 1- Archaeological Sites (blue dots) in the SARB . Sites with dates used here are shown with a red buffer.

From the literature and our current project (Mission Reach), we amassed an initial sample of over 400 radiocarbon dates within the SARB. We culled those dates not run on charcoal or bone and those not directly associated with archaeological contexts. We eliminated those with standard errors above +/-100. The remaining dates come from 6 labs and were all run within the last 30 years.

Each date was individually calibrated with OxCAL v4.2.4, and dates with a significant probability of having a modern signature, as well as those with median dates prior to 9000 cal BP, were cut to reduce boundary issues. Multiple dates from the same contexts were examined, and where appropriate, dates were averaged using the OxCAL R-combine function. The resulting data set contains 321 dated contexts. The original 321 corrected dates were then calibrated with OxCAL using the summed probability function to create Figure 2.

The Summed Probability Patterns

The peaks, shifts, and troughs in Figure 2 are the result of numerous processes beyond changes in the number of people and/or the number and variety of activities (occupational intensity). To use the patterns as a gross proxy for occupational intensity, we need to understand and control those other processes. We discuss two of these other processes in the following sections.

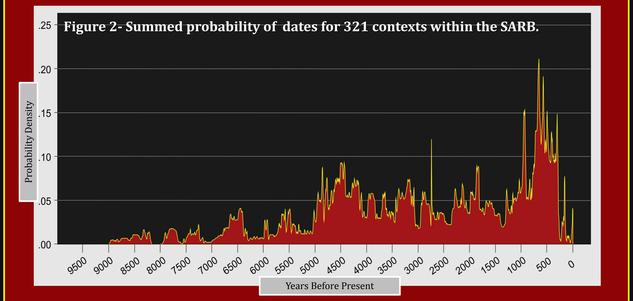

Figure 2- Summed probability of dates for 321 contexts within the SARB.

Taphonomic Loss

Figure 2 (above) shows more dates late and fewer dates early. This may reflect occupation patterns, but it also reflects deterioration of datable material over time. The rate of this taphonomic loss can be estimated. Several researchers (e.g., Surovell et al. 2009; Williams 2012, 2013) propose correction factors based on comparisons of radiocarbon dated volcanic eruptions (Bryson et al. 2006) and the representation of these same eruptions in Greenland ice cores. Using the median dates from the calibrated SARB data and one of these correction equations, we produced Figure 3.

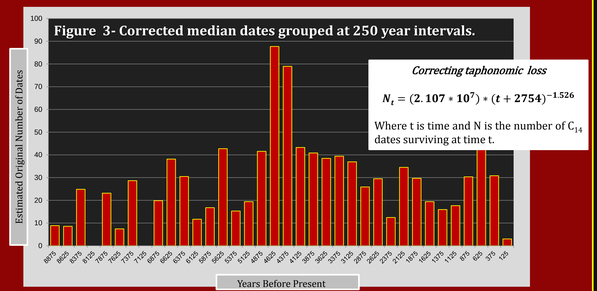

Figure 3- Corrected median dates grouped at 250 year intervals.

Comparisons with Figure 2 shows a reduction in the relative magnitude of the late peak, an increase in the strength of the 4500 BP peak, and an increased, yet variable, early pattern of dates.

Calibration Issues

A second source of the variability in Figure 2 is the calibration procedure as there is not a 1:1 relationship between the radiocarbon and calendar scales. The non-linear relationship clusters calendar dates at some time periods and discriminates against others. To assess this, we created a simulated sequence. We divided the overall SARB timeframe into 2000 year intervals and looked at the number of dates (e.g., 90) and the average standard error (e.g., +/- 41) for the SARB dates in a given 2000 year period. We created an artificial data set for that period assuming equally spaced dates (e.g., 1 date per 22.2 years) and constant standard error (e.g., +/- 41). We did this for each 2000 year period and then summed the calibrated probabilities to produce Figure 4. Comparisons with Figure 2 (left) suggest similarities.

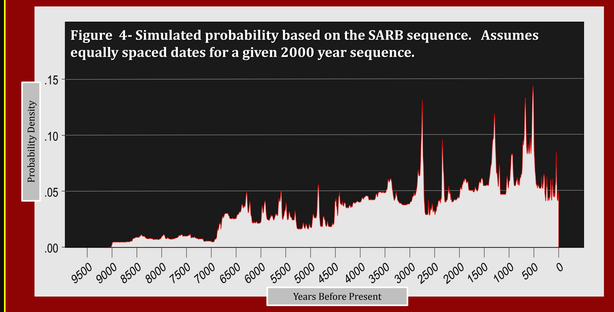

Figure 4- Simulated probability based on the SARB sequence. Assumes equally spaced dates for a given 2000 year sequence.

In an attempt to lessen the calibration bias evident in Figure 4, we standardized and subtracted the Figure 4 simulation from the Figure 2 SARB data to produce an index (Figure 5). Positive (white) spikes have more than expected dates and negative (red) spikes have less than expected.

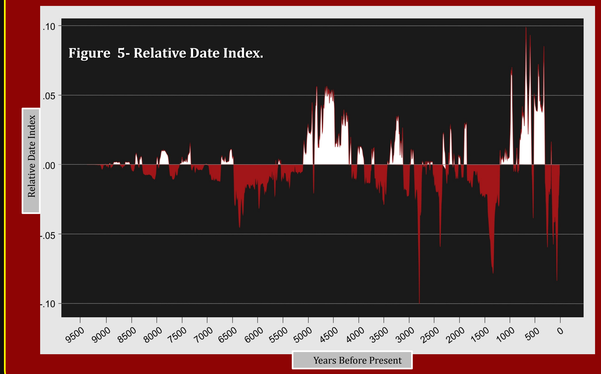

Figure 5- Relative Date Index.

Ongoing Research

Increased human activity on a landscape should, in most cases, produce a stronger occupational signal, including a higher overall frequency of datable material. However, using dates as a proxy for occupational intensity is complicated by many factors, only two of which we have considered. Taphonomic loss and calibration simulation can produce peaks and valleys in summed probability distributions that significantly distort the underlying pattern. In the case of the SARB data, when we assess and try and control for these factors, the underlying patterns still suggest several periods (e.g., ca. 5000-4200, 1000-250 BP) that could reflect intensive use, as well as several suggestive of lower use intensity (e.g., ca. 6250-5000, 1800-1000 BP). We are conducting additional investigations, including spatial comparisons based on factors such as distance to rivers and springs, soil types, and landforms.

An example of another type of comparison that we have undertaken is shown in Figure 6 where we contrast 136 dates from the roughly 8 km long Mission Reach segment of the San Antonio River with the remaining SARB dates. Differences at this scale are less a function of calibration or temporal bias and, therefore, may highlight other processes that need investigation.

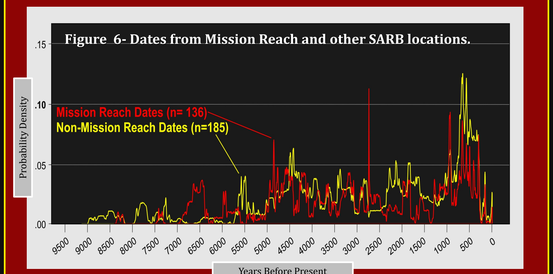

Figure 6- Dates from Mission Reach and other SARB locations.

The raw SARB data will be available on the Digital Archaeological Record (t-DAR) and on the CAR-UTSA website shortly in an open-access format. We encourage others to use the data set and to upload new or overlooked radiocarbon dates from the SARB, as well as other locations in Central and South Texas, for researchers to share. Comments on this research are encouraged and should be sent to the authors.

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