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Climate Change and the Collapse of Slavery at the Stratford Hall Plantation in Late 1700s Westmoreland County, Virginia

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Introduction

Stratford Hall Plantation, which was owned by Civil War General Robert E. Lee's family, went into economic decline in the late 1700s. Douglas Sanford (1999) found that many of the plantation's slave quarters were backfilled in the 1770s or 1780s, despite increased numbers of slaves going to other plantations near the Chesapeake Bay at this time (Kulikoff, 1978). It's surprising that the slave quarters were infilled while slavery was still such a large part of the economy. Thus, there is the possibility that local climate changes during the Little Ice Age (LIA) (1550-1850 AD) may have been a factor in the economic decline seen at Stratford Hall in the late 1700s.

Eastern oysters (*Crassostrea virginica*) are found throughout the Chesapeake Bay and the shells of these bivalves contain oxygen isotopes that can be used to reconstruct past climates (e.g., Surge et al., 2001). Those found in the infilled sites at Stratford Hall can be used to determine climatic conditions of the late 1700s.

The purpose of this study is to determine if local climate change played a role in the reduction of slave quarters and economic decline at the Stratford Hall plantation in the late 1700s.

Study Location

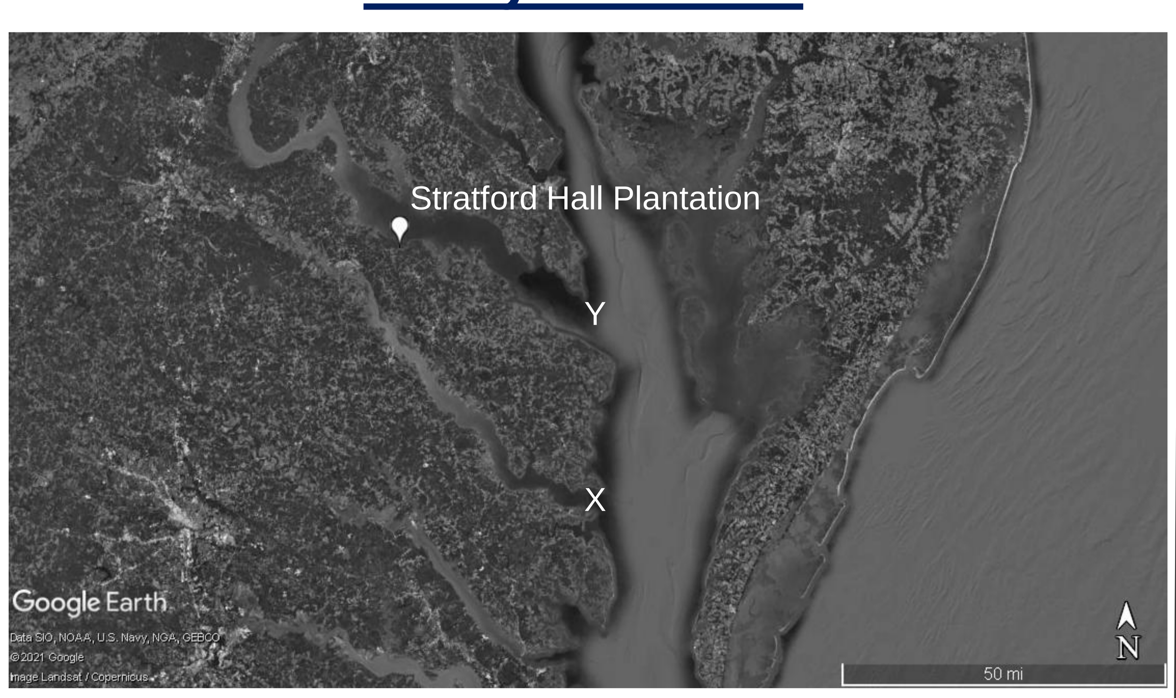


Figure 1 Location of Stratford Hall Plantation as well as NOAA's Lower Potomac (Y) and Stringray Point (X) buoys, at the mouth of the Potomac River and at the mouth of the Rappahannock River, respectively.

Methods

- Oyster shells were slabbed and drilled into with a 0.7 mm drill bit to obtain low-resolution powdered calcite, as described by Surge et al. (2001). Samples were sent to the University of Saskatchewan to be run through a mass spectrometer which calculates oxygen and carbon isotope ($\delta^{18}O$ and $\delta^{13}C$) concentrations.
- Water temperature and salinity data recorded at the time of modern oyster collection were used to create a predicted model, in accordance with the methods of Harding et al. (2010),
- Fossil oysters were analyzed using a scanning electron microscope (SEM) at the University of Mary Washington, following the methods of Wurster et al. (1999).
- Historical records, such as Thomas Jefferson's Farm Book and Garden Book (1766-1824), were also collected so that the results can be compared to them.

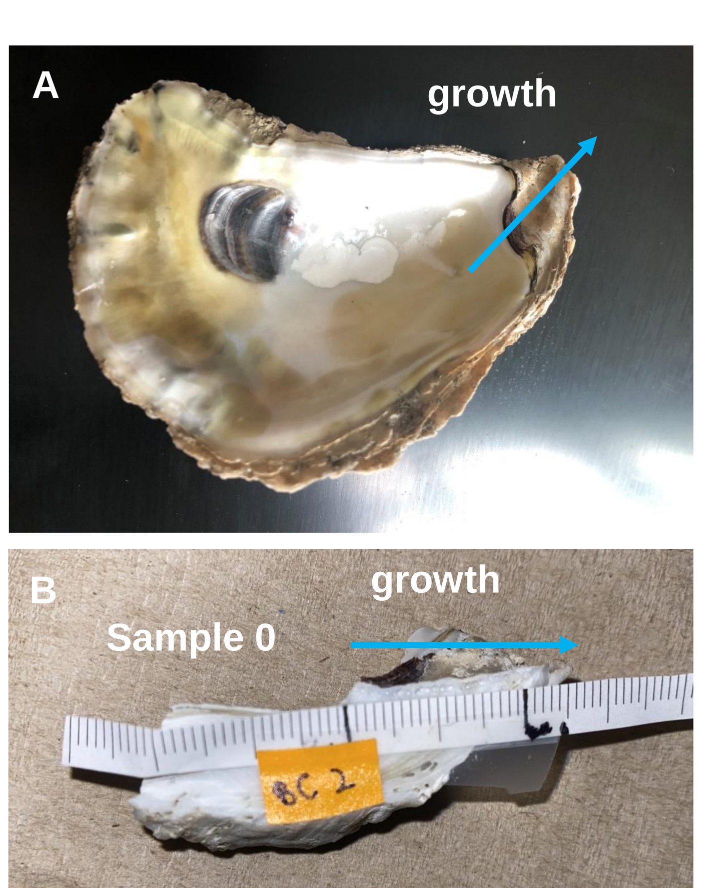
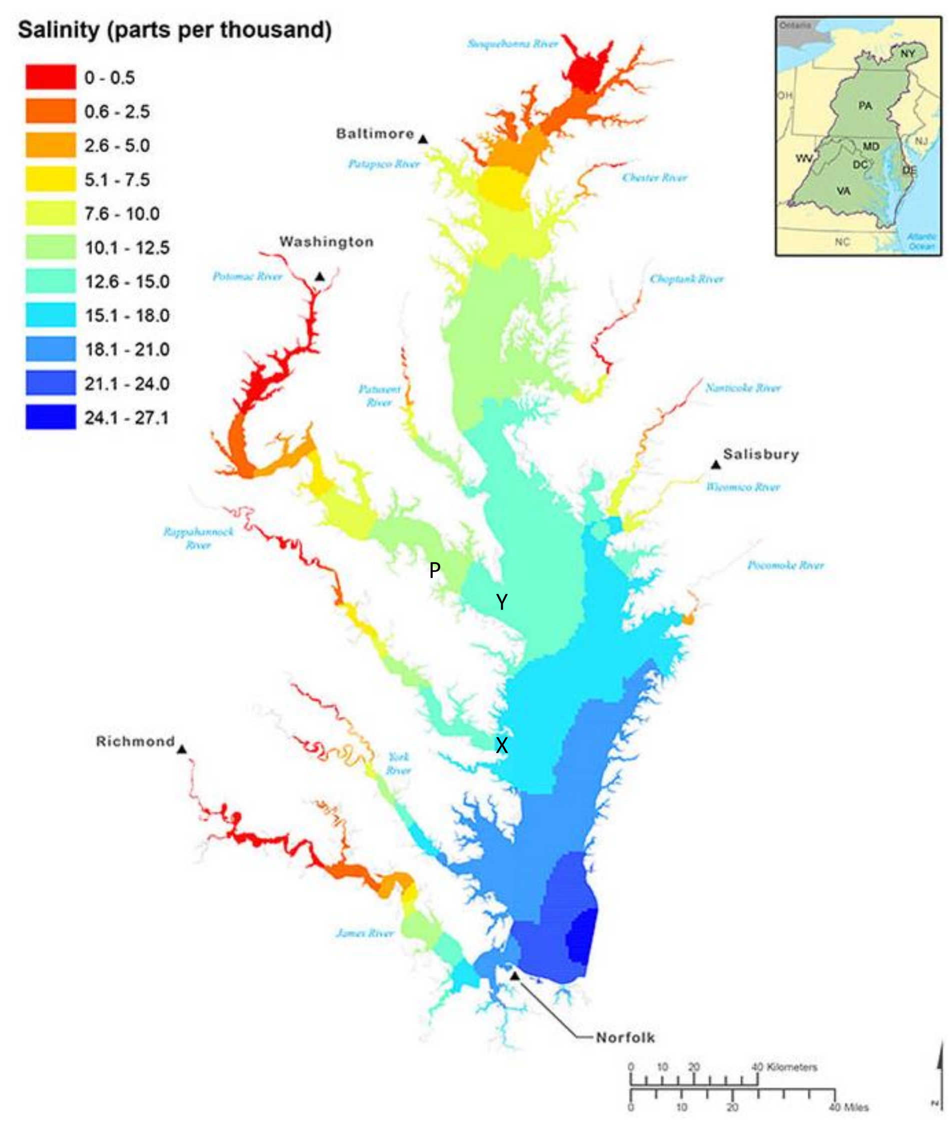


Figure 2 Example of sampling procedure. A) Full left valve of an oyster. B) Same oyster after slabbing with drill holes along its hinge.



Results

Figure 3 Map of mean surface salinity for the Chesapeake Bay from the Chesapeake Bay Program (2019). This study focuses on the Potomac and Rappahannock Rivers (middle of the map). The mouth of the Potomac River is fresher (12.6 to 15.0 parts per thousand) than the mouth of the Rappahannock River (15.1 to 18.0 parts per thousand). Thus, measurements from the Lower Potomac buoy (Y) are fresher than those taken at the Stingray Point buoy (X). Stratford Hall Plantation is denoted with a P.

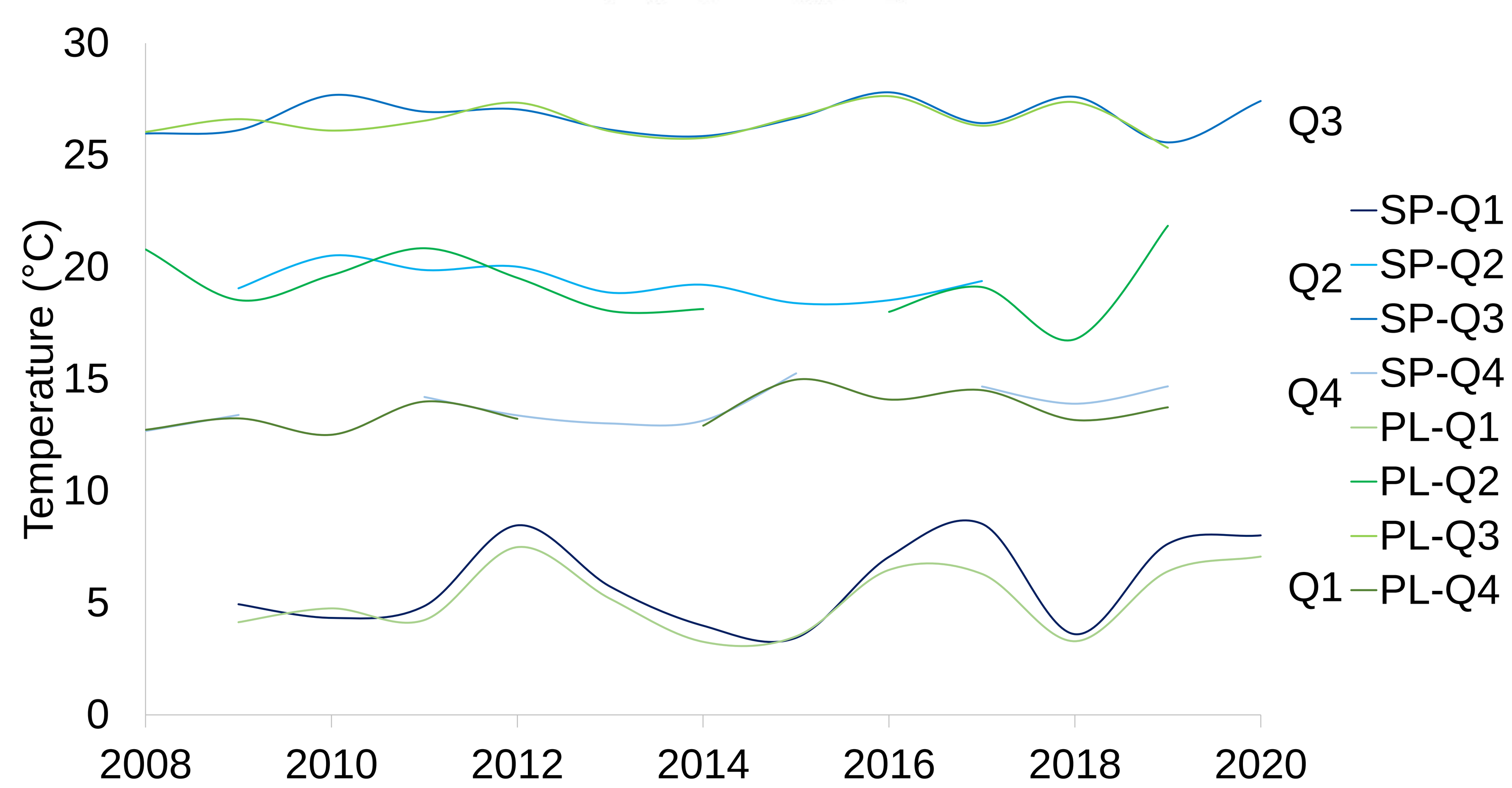


Figure 4 Comparison of water temperatures for Stingray Point (SP) and Lower Potomac (PL) buoys by quarter.

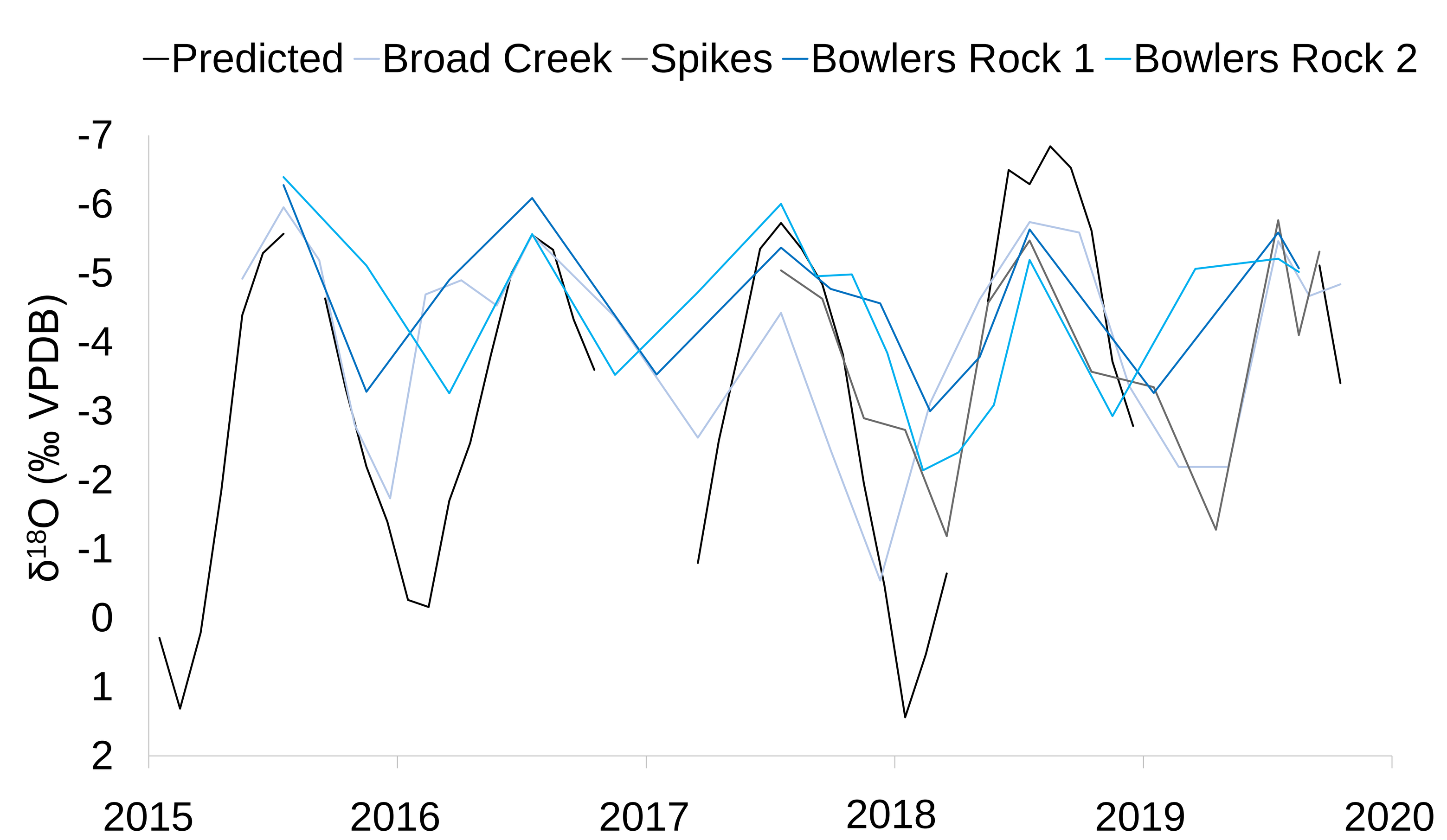


Figure 5 Age model comparing predicted $\delta^{18}O_{calcite}$ and actual $\delta^{18}O_{calcite}$ for oysters living recently. Broad Creek through Bowlers Rock are locations of oyster collection and water sampling.

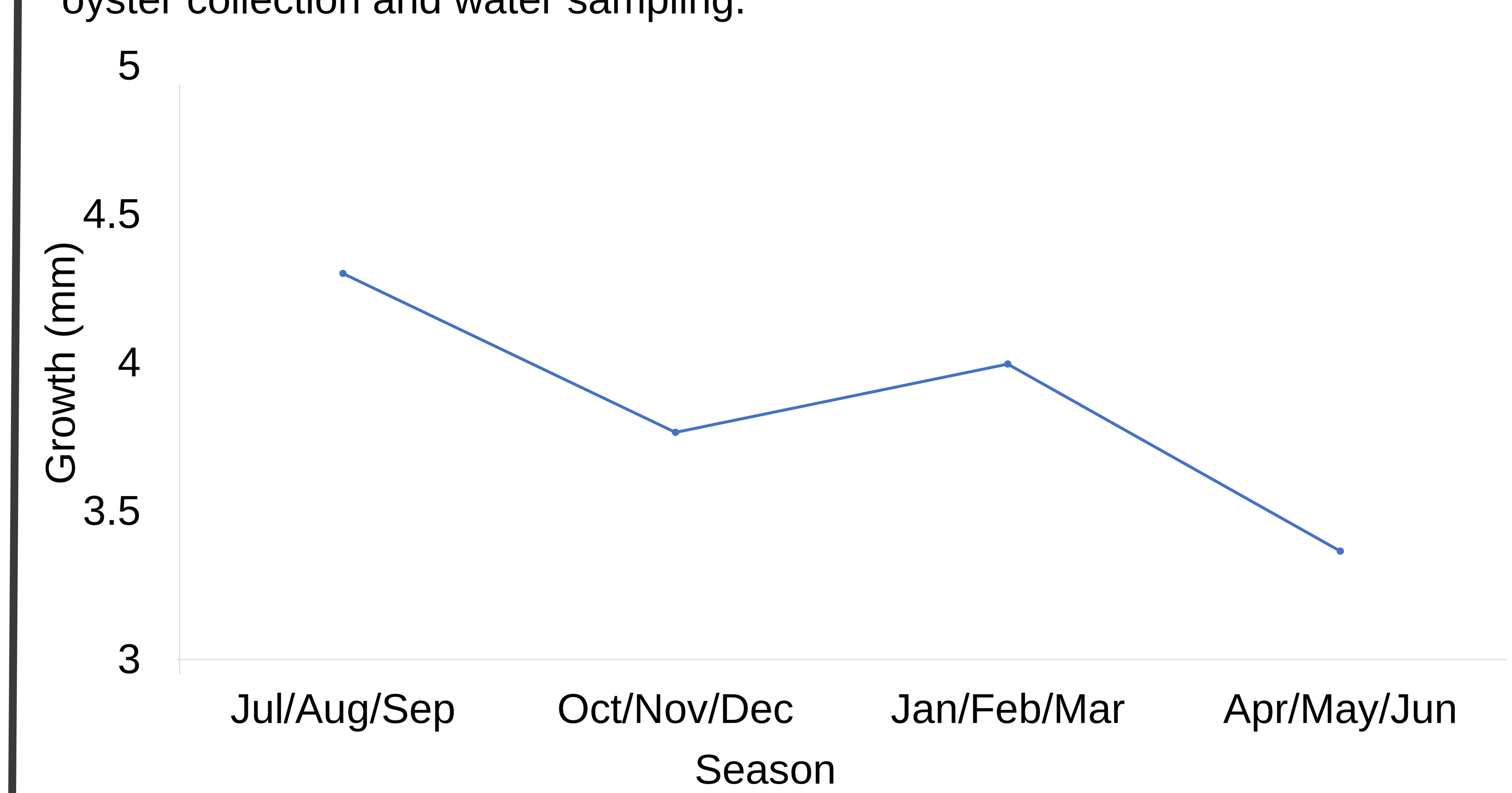


Figure 6 Average seasonal growth rates of fossil oyster shells from Stratford Hall.

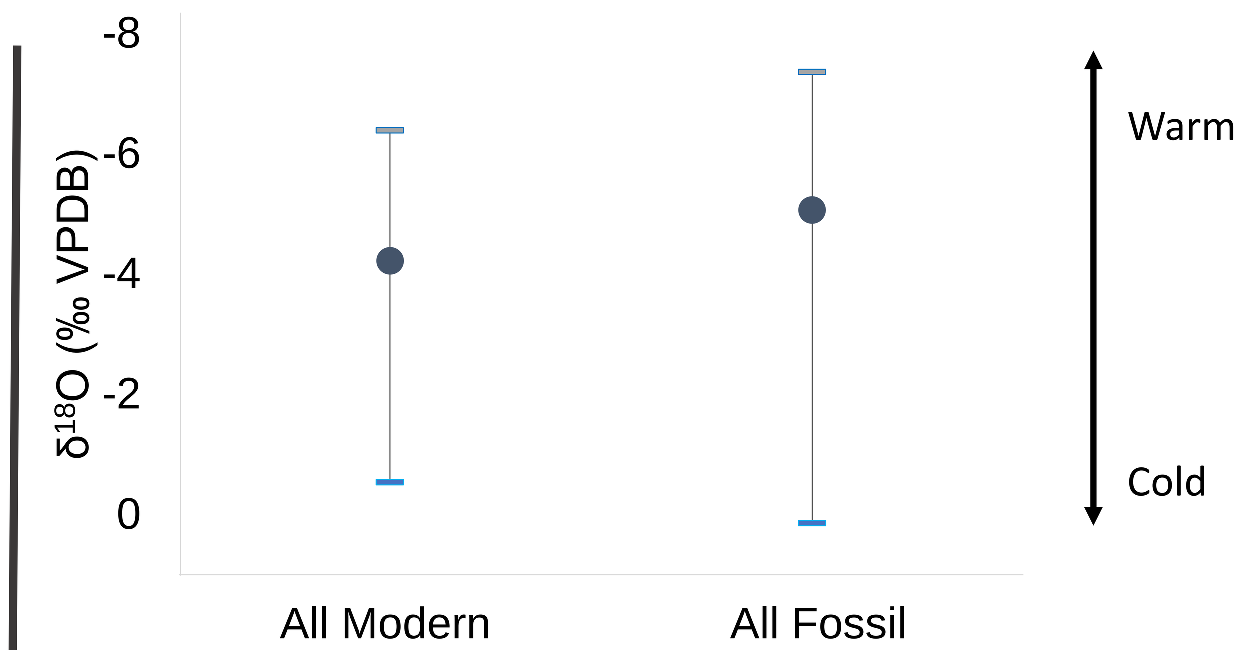


Figure 7 Average, minimum, and maximum of actual $\delta^{18}O_{calcite}$ for fossil oysters vs. modern oysters.

Discussion

- Using fossil oysters from the Potomac River and modern oysters from the Rappahannock River is acceptable because water temperatures are similar for the two rivers (Fig. 4).
- The age model that compares predicted $\delta^{18}O_{calcite}$ and actual $\delta^{18}O_{calcite}$ for the modern oysters indicates that the oysters record climate conditions while growing as expected and are a viable proxy to use for reconstructing Chesapeake Bay climate in the 1700s (Fig. 5).
- SEM analysis of the fossil oysters at Stratford Hall reveals that the oysters had the greatest seasonal growth between the months of July and September, but the least seasonal growth between April and June (Fig. 6). These results will need to be compared to SEM analysis of the modern oysters to make further conclusions.
- The average $\delta^{18}O_{calcite}$ for the modern oysters is higher than for the fossil oysters (Fig. 7); however, further examination to determine the effect that the differences in salinity (Fig. 3) have on the oxygen isotopes must be conducted before drawing conclusions.

Further Research

- ❑ Radiocarbon date fossil oysters to ensure that they correspond with the century being studied.
- ❑ Run high-resolution analysis of at least one modern oyster sample to ensure that the low-resolution pass isn't missing any climate fluctuations.
- ❑ Analyze modern oysters using the SEM to determine their growth rates.
- ❑ Perform a low-resolution Mg/Ca ratio analysis to see differences between temperature and salinity, as $\delta^{18}O$ measures both.

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