

Mary Nielsen
 Monmouth University
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Reconstructing Precipitation Based on Tree Rings to Assess Inhabitation at Mesa Verde Archaeological Sites

MONMOUTH
 UNIVERSITY
 SCHOLARSHIP WEEK

Purpose:

- Estimate prehistoric precipitation levels based on tree ring width
- Assess precipitation in great drought of 1276-1299
- Great drought associated with maize production collapse and population decline of ancestral Pueblo people in Mesa Verde

How does precipitation relate to prehistoric inhabitation at Mesa Verde archaeological sites?

Methods:

Modern precipitation data compared to tree ring data in a univariate regression (Figures 2 and 3)

$$\text{Precipitation} = \text{intercept} + \text{coefficient} \times (\text{tree ring width})$$

Prehistoric precipitation calculated using the above formula

Calculated precipitation compared to the lower threshold of precipitation necessary to grow maize, 11.81 inches (Figures 4 and 5)

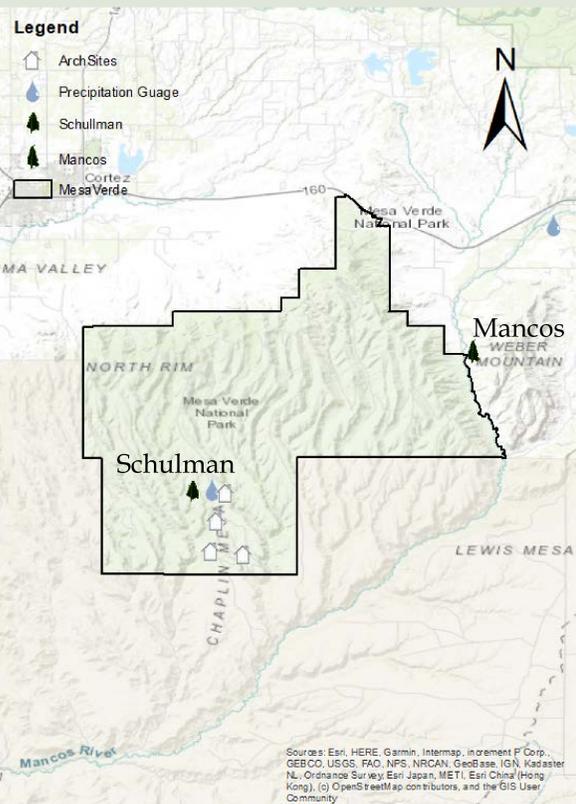


Figure 1: Map of Mesa Verde tree ring sites, precipitation gauges, and prehistoric settlements

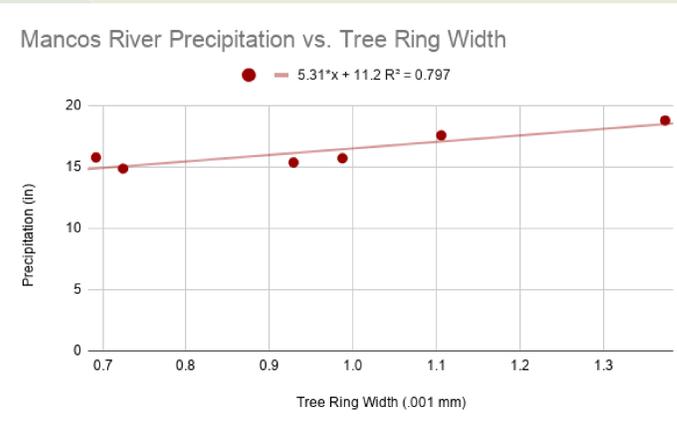


Figure 2: Scatter plot of relation between precipitation and tree ring data for the Mancos River site

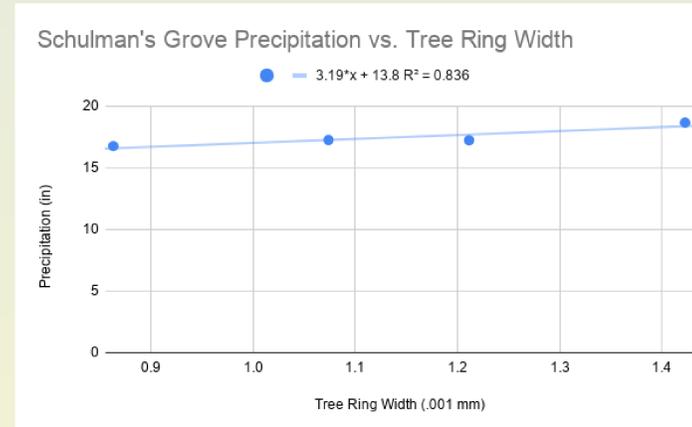


Figure 3: Scatter plot of relation between precipitation and tree ring data for the Schulman's Grove site

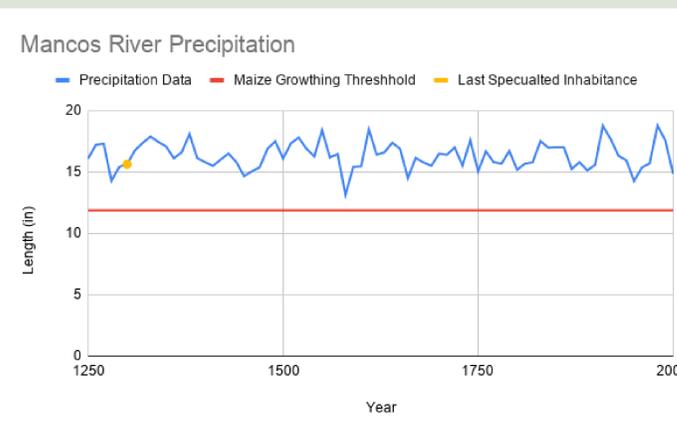


Figure 4: Calculated precipitation from 1250 to 2000 based on univariate regression of tree ring data

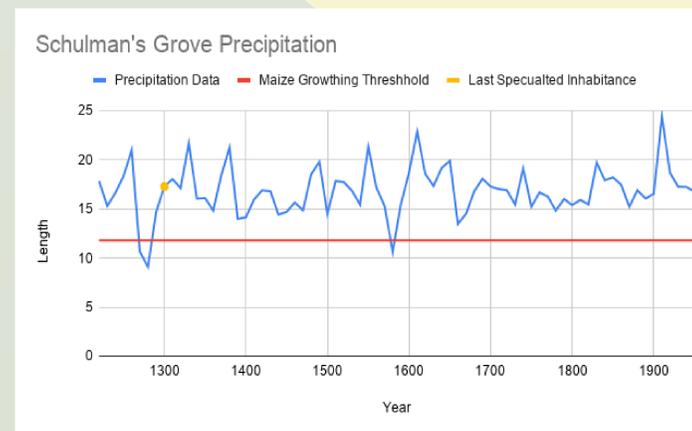


Figure 5: Calculated precipitation from 1220 to 1960 based on univariate regression of tree ring data

Outcomes:

- Mancos River precipitation = $5.31 + 11.2 \times (\text{tree ring width})$
 Regression diagnostics:
 p-value < 0.01
 Standard error: 0.113
 R-squared: 0.797
 Breusch-Pagan test: p-value = 0.73, homoscedastic residuals and model assumptions preserved
- Schulman's Grove precipitation = $3.19 + 13.8 \times (\text{tree ring width})$
 Regression diagnostics:
 p-value < 0.01
 Standard error: 0.044
 R-squared: 0.836
 Breusch-Pagan test: p-value = 0.44, homoscedastic residuals and model assumptions preserved

Conclusions:

- Limited sample shows potential for developing future models (strong fit between precipitation and tree rings)
- Mancos River site shows decline in precipitation during great drought, but not below maize growing threshold (Figure 4)
- Schulman's Grove, closer to ancestral Pueblo sites, reflects great drought and dips below maize growing threshold (Figure 5)
- Need more precipitation and tree ring data to develop future models

Contact Information:

Mary Nielsen: s0932833@monmouth.edu
 Geoffrey Fouad: gfouad@monmouth.edu