The importance and challenge of reconstructing past climate change and modern water quality in the Texas Hill Country

2025 Year-end Report on Travis County Scientific Research Permit for Reimer's Ranch and Hamilton Pool Preserve

Jay Banner and Jose Abella, Environmental Science Institute and Jackson School of Geosciences

Purpose of the Study

The objective of this project is to reconstruct past hydroclimatic variability and assess long-term water-quality conditions in the Texas Hill Country using bald cypress (*Taxodium distichum*) tree-ring records. Bald cypress trees are long-lived and sensitive to hydrologic conditions, making them valuable natural archives of past droughts, floods, and environmental change. These reconstructions provide important context for understanding current water-resource challenges and improving long-term management strategies in central Texas.

Field Activities Conducted Under Permit

Fieldwork was conducted in accordance with the methods and conditions outlined in the approved permit.

Water samples at Reimer's Ranch were collected on 11/17/2024, 2/21/2025, 4/10/2025, 6/25/2025. From Hamilton Pool, we collected samples from wells and springs on 11/17/2024, 2/21/2025, and 6/25/2025.

Increment cores were collected from three mature bald cypress trees at Reimer's Ranch on 11/15/2024, but only two were workable as the third one was mostly rotted on the inside. As bald cypress trees in Hamilton Pool appear to be young and we are seeking old trees that will extend past climate records to before the instrumental record (i.e., hundreds of years old), we didn't collect tree cores there.

Cores were extracted using standard, non-destructive dendrochronological techniques that do not compromise tree health. No permanent markers or site alterations were left in the field.

Laboratory Analysis

Tree-ring samples were air-dried, mounted, and planed following established dendrochemical protocols. Ring width was measured and annual growth rings were crossdated to ensure accurate calendar-year assignment using visual matching and statistical verification against regional reference chronologies. Tree growth variability was analyzed to evaluate ring width relationships with hydroclimate and water availability.

Results and Dissemination

The sampled trees are part of a tree-ring chronology that records major droughts and wet periods in the Hill Country. However, the trees sampled in Reimer's ranch were relatively young; 83 years (30.362990, -98.12425) and 91 years (30.362862, -98.124635).

Preliminary results demonstrate strong sensitivity of bald cypress growth to river flow and moisture availability and a significant influence of the karst system and table water levels. Findings from this work have been presented at two conferences and comprise the capstone research project of UT Environmental Science major William Eagle:

Eagle, W., J. Abella-Gutiérrez, J. Banner, A. Janelle. 2025. Reconstructing Climate Variability in the Pedernales River Basin, Central Texas. Geological Society of America 2025 Annual Meeting, San Antonio, TX, USA. DOI: 10.1130/abs/2025AM-10392

Eagle W., J. Abella-Gutiérrez, A. J. Janelle, J. L. Banner. 2025. Reconstructing Climate Variability in the Pedernales River Basin. Texas Water Research network Meeting, Austin, TX, USA

Abella-Gutiérrez, J., B. B. Black, J. L. Banner. 2025 Abrupt Shifts in Precipitation Recorded by Bald Cypress (Taxodium distichun) False Rings. Texas Water Research network Meeting, Austin, TX, USA

These results contribute to a broader effort to improve understanding of long-term climate variability and its influence on surface water and groundwater systems in central Texas. We continue to search for more trees in the region that can help extend the long-term climate records we are building.

Acknowledgments
We thank Travis and Hays Counties for granting permission to conduct this research at Reimer's Ranch Park, and Hamilton Pool Preserve. Access to these protected sites is essential for advancing scientific understanding of Texas Hill Country ecosystems and supporting informed conservation and water-management decisions.