Linking streamflow to riparian tree growth and water-use efficiency in wilderness streams of the Verde River basin, Arizona

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Background & Rationale

- The Verde River Basin in central Arizona contains a network of tributaries protected by the Wilderness Act of 1964 for their undisturbed character.
- Riparian vegetation in the arid southwest is adapted to a wide range of flows and flood disturbance.
- Groundwater withdrawal and climate stressors can reduce flows in perennial and intermittent reaches.
- Drought stress induces stomatal closure, increasing fixation of carbon-13 during photosynthesis.
- Climate and water availability is reflected in tree ring width and stable carbon isotope ratios (δ13C).
- Riparian forest response to varying water availability helps inform our knowledge of ecosystem vulnerability to hydrologic alteration, and guides management of wilderness areas to retain their undisturbed and natural character.

Figure 1: (left) Pressure transducer gage frozen in West Clear Creek; (right) meteorological station in Oak Creek.

Figure 2: Sycamore Creek in Sycamore Canyon Wilderness shortly before confluence with the Verde River.

Research Objectives

Characterize flow regimes according to components of variability

Dendrochronology and stable carbon isotope analysis of annual growth rings of Fremont cottonwood

Evaluate relationships between flow, climate, and physiological response of riparian trees

Acknowledgements & References

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Methods

- Indicators of Hydrologic Alteration (IHA) software identifies parameters of variability from hydrographs.
- Crossdating and establishment dating of tree cores.
- δ13C stable isotope analysis by mass spectrometry of α-cellulose extracted from annual growth rings.
- Statistical analysis to relate hydrologic metrics to annual growth and isotope signals across perennial and ephemeral sites and years.

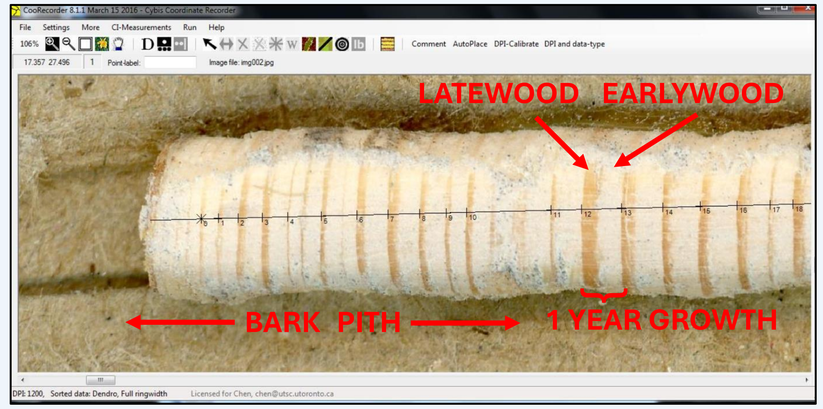

Figure 3: Example delineation of tree rings for age determination (photo: EESA01 Laboratory, Andrew Apostoli).

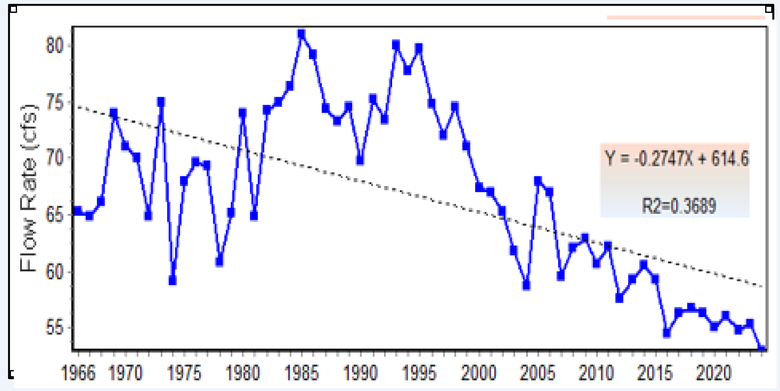

Figure 4: Indicators of Hydrologic Alteration time series of 7-day minimum flows on the Verde River show a declining trend (data from USGS NWIS gage 09506000).