

### Using Tree Rings Analysis to Reconstruct Paleoclimate and Streamflows

*Using tree rings to determine historic climate conditions in Utah*

#### Bottom Line

Studying rings from various tree species can provide longer records of climate impacts for better future planning.

#### Better, Faster, Cheaper

Recorded data for streamflows only goes back a century. However, tree ring analysis provides indicators to project historic weather conditions and streamflows back to 800 years.

#### Principal Investigator

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#### Collaborators

- Utah State University
- Columbia University, Lamont-Doherty Earth Observatory
- Brigham Young University, Provo, Utah

#### Problem

City planners and others in the Wasatch Front area of Utah need a way to determine previous climate impacts and forecast supplies in the future.

The Wasatch Front metropolitan region, from Logan through Ogden, Salt Lake City, and past Provo in Utah, depends on mountain snow for its water supply. About 2 million people consume treated, potable water impounded from snow runoff or pumped from percolated ground water for indoor personal use and outdoor irrigation of largely turfgrass landscapes. This area, like many in the urbanizing West, faces uncertain water supplies that are being strained and threatened. Utah has one of the highest population growth rates in the country, nearly 30 percent from 1990 - 2000, and a similar trajectory since then. High population growth and very high per-capita water use rates will create future demand that is projected to exceed limited existing supplies. Water wholesalers and the Utah State Division of Water Resources are focused on bringing future water demand and supply into balance.

Determining the need for water is complicated by climate change, increasing temperatures, greater evaporative demand, possible earlier snowmelt and late season shortages, and cyclic droughts. Moreover, drought over the past 50 years in northern Utah has been very mild compared to the historical record. While our climate records only extend back approximately 150 years, evidence indicates greater shifts in water availability in this area.

— continued

*Coring an old Utah Juniper.*



## Solution

Most tree species slow their growth when temperatures cause too much water to evaporate from their leaves and stems (transpiration), particularly when transpiration depletes soil water to the point that the tree becomes stressed. We can re-create the records of past precipitation and streamflow data by examining the tree ring widths over time that relate to water and temperature stress. Water wholesalers in Colorado are already using tree ring analysis in developing future water management strategies.

## Application

This Science and Technology Program research project is using tree species native to the Wasatch Front range to re-construct paleoclimate and river flows of the major urban watersheds in the greater Salt Lake City metropolitan region. These native trees have very different responses to drought—from the Utah Juniper’s “use it or lose it” strategy of depleting upper zone water and then surviving droughts with a deep root system, to the Douglas fir’s “save it for a rainy day” strategy of using more surface roots. The trees also have a wide geographic range—from the Limber pine in open stands on ridges 5,000 to 9,000 feet in elevation, to the Utah Juniper’s lower elevation habitat. The Salt Lake City region has a climate record dating back to the mid-1800s that can be used to calibrate a tree ring record to climate and streamflows. Once calibrated, comparing the climate responses of the investigated tree species chosen allowed us to re-construct past streamflows and will help water suppliers estimate past precipitation and evaporative demand.

## Future Plans

In the next phase, tree ring analyses will be correlated with streamflow data to re-construct flows 800 years back.

The results of these studies will be used to:

1. Expand the dendrochronology record in the eastern Great Basin area of the United States.
2. Determine if other species (such as Rock Mountain Juniper, Rock Mountain Maple, and Mountain Mahogany) can be used to reconstruct streamflow data and/or identify other seasonal information on climate.
3. Identify where wet and dry cycles change and correlate this with other climate research.
4. Prepare stream re-construction from dendrochronology data on the Logan River, Provo River, American Fork River, and Weber River as funding allows.

We will provide Reclamation managers and water districts with important information on cyclic wet and dry periods to help water managers:

- Identify future water storage needs and/or distribution options within a changing climate.
- Better project potential water supplies 2 to 3 years in advance for improved water management.
- Implement water conservation practices to preserve and protect socio-economic resources such as industries, recreation, wildlife, etc.

***“This information confirms the climate change that we have been seeing in our annual operations, and we can use this information in future planning.”***

**Fred Liljegren**  
Outdoor Recreation Planner,  
Reclamation

## Sharing Information

We held roundtable meetings with water managers to discuss information from this research and related research, and received input and direction from their perspectives. Water districts participating in these roundtable discussions included: Central Utah Water Conservancy District, Jordan Valley Water Conservancy District, Weber Basin Water Conservancy District, Salt Lake City Public Utilities, Metropolitan Water Conservancy District, Provo River Water Users Association, and Sandy City Water Conservancy District.

## More Information

Science and Technology  
Program Research Project:

Back to the Future, Part 1:  
[www.usbr.gov/research/  
projects/detail.cfm?id=7855](http://www.usbr.gov/research/projects/detail.cfm?id=7855)

Back to the Future, Part 2:  
[www.usbr.gov/research/  
projects/detail.cfm?id=1967](http://www.usbr.gov/research/projects/detail.cfm?id=1967)

