Aztec Ruins

National Park Service
U.S. Department of the Interior

National Monument

Dendrochronology

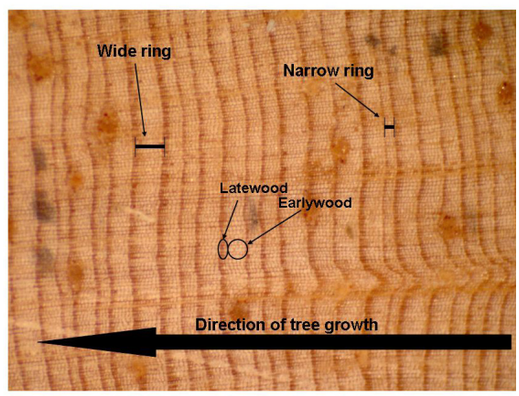
The present is the key to the past

The study of tree rings, dendrochronology, is far more than just counting rings - it's a method of scientific dating based on the analysis of tree ring growth patterns. Trees are excellent indicators of the natural environment and provide researchers with annual historical ecological information. Dendrochronology can answer important questions pertaining to when a structure was built, how long it was inhabited, when people left and why.

As you tour the site, take time to examine the remarkable intact wood that remains from the people that lived here 900 years ago. Due to high quality preservation, Aztec Ruins has more original wood than any other site in the Southwest making dendrochronology especially important here. In fact, the father of dendrochonology, Andrew E. Douglass, first dated beams pulled from this site and described Aztec as the structure "whose beams began the ancient tree-ring calendar."

Formation of a tree ring

We learn in elementary school that the number of rings on a tree corresponds to its age. This means that a tree adds a ring (a layer of wood cells) every year. After a winter of no growth, the wood cells in a tree begin to form in early spring. These fast-forming, thin-walled cells formed early in the spring appear lighter in color and are called earlywood. As the tree nears the end of its growing season, its growth slows and it produces thicker-walled cells, termed latewood. These latewood cells appear darker than the earlywood cells. The beginning of earlywood formation and the end of the latewood formation form one annual ring (see diagram).



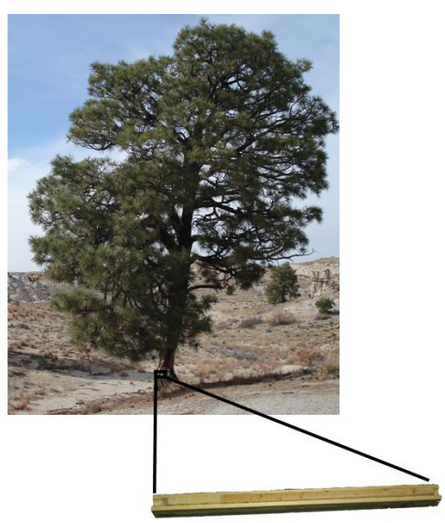
Indicators of Environmental Conditions

Increment borer used to extract tree core.

In order to examine tree ring patterns, dendrochronologists extract tree cores. A tree core is a pencil-sized sample of the radius of a tree.

Tree rings are excellent records of our natural environment. The size of a tree ring reflects the growing conditions that tree experienced during that year. In warm and wet years, trees form wide rings and in cool and dry years, trees form narrow rings.

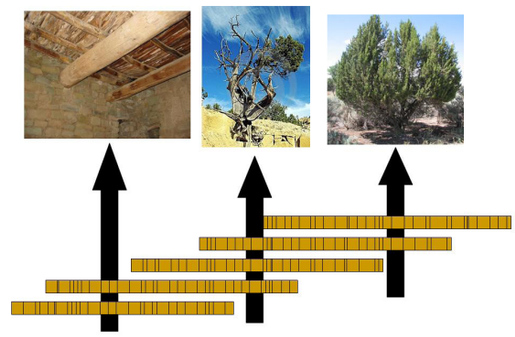
While temperature and precipitation are the major factors that influence tree ring widths, other factors can also influence growth. Forest fires, insect outbreaks, nutrient availability and other conditions such as competition from neighboring trees can also influence the size of a tree ring.



Tree core extracted from a ponderosa pine

Crossdating

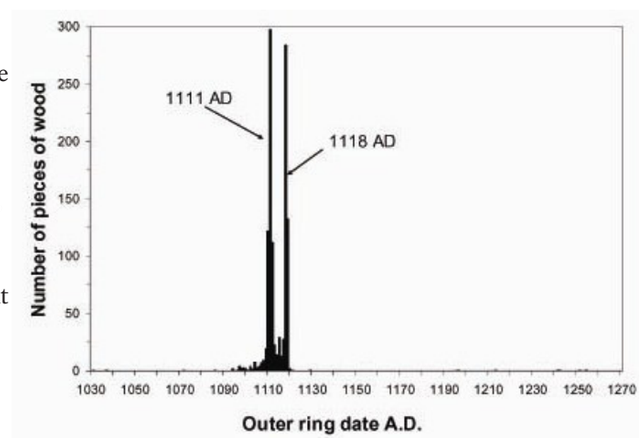
Because tree rings are influenced by climate and weather, trees growing in the same area, under relatively similar conditions will show similar growth patterns. Overlapping ring patterns from live trees, dead trees and ancient wood from the same region create long tree ring "chronologies". This ring-pattern matching process, called cross-dating, was developed in the early 1900s by Andrew E. Douglass. These chronologies provide an annual historical climatic timeline stretching back thousands of years.



Douglass's technique of extending chronologies back through time was a huge breakthrough because it enabled dendrochronologists to date wooden beams from ancient structures of unknown age.

Aztec Ruins tree rings

Tree rings from wood found here at Aztec Ruins can tell us about many aspects of ancestral Pueblo life. To determine the year in which the structure was built, dendrochronologists examine the outermost ring on wooden beams. This ring represents the year the tree was cut (the last year the tree was alive), and likely the year that this tree was used in construction. The graph to the right displays the outer ring date of beams recovered from the site. The graph clearly indicates that Aztec Ruins was built in two phases – one around 1111 and one around 1118. Tree rings also indicate that the structure was inhabited for approximately 200 years. During the habitation (1100s and 1200s), the people were constantly replacing broken beams in the structure. The last tree used in construction at Aztec was cut in 1269.



Tree rings from ancient wooden beams contain valuable historic climatic data. Through analysis of narrow and wide rings, we know that the ancestral Pueblo people weathered many droughts of several years during the 200 years they lived here. Two expecially severe droughts occured. The first began around 1130 and lasted 50-60 years. This drought may have encouraged migration from Chaco Canyon to the Animas River valley. The second began around 1276 and persisted at least 24 years. Without sufficient moisture, crops failed and storage supplies ran low. This severe drought, combined with inevitable resource depletion that occurred over time, is thought to have eventually led to the migration from the Four Corners area by 1300.

Tree rings not only tell us what year the tree was cut down but can even tell us what season ancestral Pueblos harvested their wood. In the rooms that contain mostly dates of 1118 AD we find a few timbers with dates of 1119. This indicates that harvesting took place in the early spring of 1119 AD. Most trees were still dormant when cut and had not put on a ring for 1119. Those would still show the date of 1118. The few trees that had started growing for the season were the ones with the 1119 date. Cutting the trees in spring before the sap flows would have resulted in stronger wood.

The past is the key to the future

Dendrochonology is an interdisciplinary science and its techniques have been used not only by archaeologists, but by ecologists, foresters, botanists, climatologists and historians. Among other uses, tree rings are used to reconstruct what forests looked like in the past and how often fires, insect outbreaks, and other natural disturbances occurred. This analysis of how environmental processes and conditions changed reveals what past conditions were like and also provides scientists with ideas about how these same environmental processes and conditions may operate in the future.
Archeologists at Aztec Ruins today continue to uncover ancient remnant wood. What will the tree rings in this wooden beam reveal about the ancestral people that once lived here?

Wooden beam uncovered at Aztec Ruins in 2009.