**Middle Bear**

Introduction to Dendrochronology

* A.E. Douglass

A.E. Douglass served at the Harvard College Observatory before Percival Lowell chose him to be his principle assistant in 1894 at the Lowell Observatory on Mars Hill in Flagstaff. After a falling out with Lowell, Douglass moved to Tucson to set up the astronomy and physics program.

A.E. Douglass joined the faculty at the University of Arizona in 1906. He was an astronomer who mounted a campaign to bring a major astronomical observatory to Tucson. He founded the Laboratory of Tree-Ring Research at the University of Arizona in 1937, although he had been doing research and teaching dendrochronology course for many years prior.

Douglass always wanted to find evidence of climatic cycles in tree-rings; however, he was unable to make a definite link between sun spot cycles and tree-ring growth. He did however, link tree-ring growth with climate processes such as precipitation.

*Dendrochronology: the study of time using trees, specifically the annual growth rings in trees*

I like to ask folks what they observe when looking at the ZMT cross-sections. They often note the different colors, rings, varying size of rings, and symmetry (or lack thereof) of the rings.

Counting Rings: (Very simplified)

If we know the outer date (the year a tree was cut down), and count in towards the center to the pith, we know how old the tree was. This gives us our time frame or chronology. We can also tell if the tree was cut down during the growing season or not based on the presence of early wood or late wood.

While he was at the Lowell Observatory in Flagstaff, Douglass noted that the arid climate of the region had an important impact on tree growth: that is, trees responded chiefly to precipitation in their growth patterns. This characteristic resulted in a record of total precipitation variation displayed in terms of tree ring widths.

Wide rings indicate years when there was plenty of precipitation during the growing season, narrow rings indicate years when there was not enough precipitation during the growing season.

This method is overly simplified - it’s really takes more work than just looking at patterns of wide and narrow rings. When you look at a number of cross-sections of trees within a region, you’ll see the same patterns. From these patterns we can link to patterns in a region’s climate – periods of drought or plenty of precipitation. Temperature always plays a role in ring development.

Middle Bear Site

*Erosion in Wash*

Students in LTRR were tasked to determine if the recreational use in the Middle Bear area may be contributing to increased erosion on adjacent slopes using dendrochronology methods.

Because no direct measurements of slope erosion have been made for the Middle Bear Canyon area, we used dendrogeomorphological methods to estimate approximate dates of large erosional events as well as to infer the amount of erosion that has occurred in the area since the establishment of the sampled trees.

At least 2 cores were taken from approximately 30 trees, many of which were leaning and about half of which were rooted directly on the slopes affected by erosion.

Several fire scarred stumps were sampled in the vicinity as well in order to determine fire frequency and history for the site.

Changes in growth were noted around 1890, the 1920s, the 1940s, and ca. 1960. A tree by the creek had a wound late in the 1914 ring possibly the result of summer flooding. Many of the older trees had a wound in 1879 (a fire date).

The group of twisted trees near profile “E” probably began growth on the high bank which was undercut and slumped in the 1850s - resulting in the twisted forms as the trees re-oriented to vertical. These trees began growing in the 1830s or 40s (age estimated when correcting for coring height). Tree size and tree age were not well related as these trees proved similar in age to much larger individuals above and below that had not been affected by the bank slump.

The large tree with the massive expose roots provided evidence of erosion prior to 1850. A large root was wounded on its upper surface by fire in 1819. By 1851 enough erosion had occurred to expose the bottom and it was scarred by a fire in 1851 on its lower surface.

*Fire-scarred root*

 Was the wash bank erosion human-caused? The tree is located on a slope above the wash. The roots were exposed due to erosion. We sampled the exposed root and dated the sample. The sample showed fire scars during the 19th C. These fire scars indicate that the root was exposed due to periodic erosional events (flood events in the wash) prior to the construction of the picnic area. The roots were exposed, and then scarred by fire events. The tree was fairly old – about 400 years. The tree is dead now.

Tree mortality was likely due to beetle infestation. The tree was stressed – and released a chemical or pheromone, that the beetles picked up on. Drought and temperature increase the effects of beetles on trees – makes it more difficult for the trees to resists the infestation. Dry years leave the tree with little or no reserves to push the beetles out. This mechanism is called pitch –a beetle bores into the tree and the tree floods the hold with sap. If low temperatures have not been consistent, i.e.: no freezes that kill beetles – then the trees have no break from the insect infestation.

Coring - Fire Suppression & Climate Change

We want to look for mature trees to core. We always want to core on the side of the tree, not up or downslope. The up or downward slope sides may show reaction wood. Mature tree can be identified by larger branches. In a healthy ecosystem, the crowns of these larger trees would not touch. Beneath these trees, there would be non-competing shrubs and understory growth. Areas where fires have been suppressed are identified by the crowns of these larger trees touching with more mature understory growth crowding the area. This new landscape changes the fire behavior by bringing the fire to the crowns of the mature trees. My more destructive fires happen as a result – the trees have not adapted to deal with these types of destructive fires.

For climate studies, trees on steep slopes are better candidates for coring. They show stress indicators more clearly because they are more dependent on rainfall than the water table. For age studies, we’d sample close to the ground. For climate studies, we sample at breast height – about 1.3 meters. There is a cleaner signal with no interference from the growth of the tree.