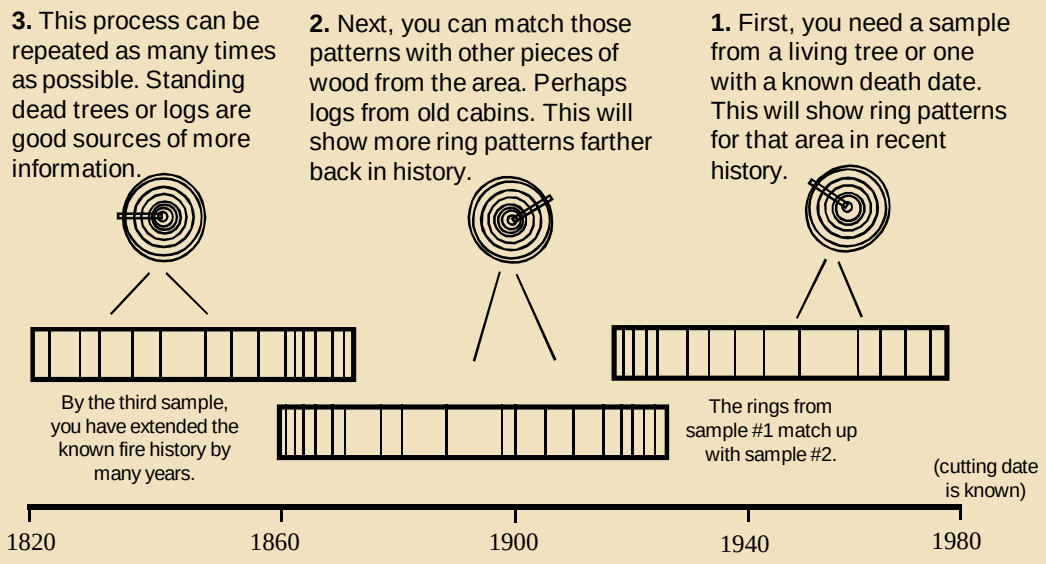
Making Maps Out of Tree Rings

How Crossdating Works (Read figure from right to left)



What were fires like 100 years ago in these parks? What about 2000 years ago? Who was alive back then to keep a record? The trees!

The science of "dendrochronology" studies the annual growth rings of trees. Each year, trees in temperate climates add a new ring of growth to their cambium layer, just below the bark. In addition to showing a tree's age, the rings serve as a history book of past events. Scientists are trained to see the visual clues in tree rings that give information about past fires and precipitation. What are these clues?

pinpoint the exact dates of past events. If a cross-section of a living tree is taken in 1999 and it shows a fire scar fifteen growth rings from the outer edge, we know that the fire burned in 1984. If many trees in the same area show similar scars, we know the fire was large. For example, samples taken in the Middle Fork of the Kaweah drainage show widespread fires in 1707 and 1873 as well as 18 other years in between.

While some fire history samples are removed as wedges from living trees, the bulk of the material comes from dead trees or old logs. How can information be extracted from dead trees when we do not know when they died?

trees in the area. Trees that were young at the time of the drought have those small rings near their center. If scientists find a dead tree with that pattern near its outer edge, they know that it was older during that drought. They are able to crossdate backwards from those known rings and provide dates for other scars and patterns on that previously "dateless" piece of wood. If they find other distinctive patterns, they repeat the process again, finding progressively older trees.

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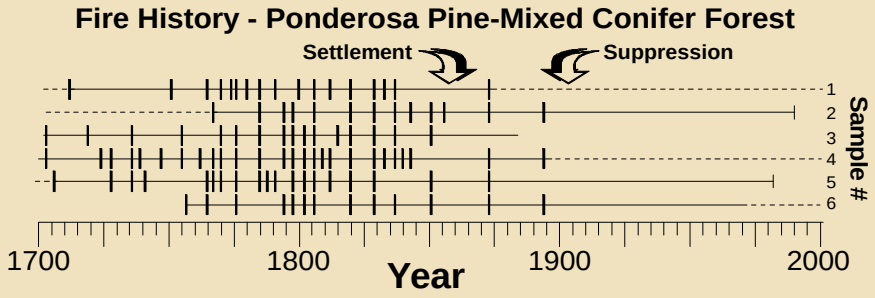
With crossdating, the 3,000 year old giant sequoias are the richest history books around! Crossdating is frequently used in Sequoia and Kings Canyon because it does not harm living trees. For example, the Kaweah drainage study mentioned already sampled a total of 91 trees, only 15 of which were living.

information help us plan for the future? One way is for fire managers to take the information and computerize it using a system called Geographic Information Systems (GIS). The GIS can hold and analyze data and create maps with it. Above is a simple GIS map depicting the areas in the park that have missed five to16 of their natural fire return intervals due to human intervention. The map is made by layering different kinds of data: vegetation type, historic fire return intervals, and actual fires that have burned in this century. So the map combines what we know about fire cycles with what has actually occurred. By using this information to plan prescribed burns, managers can reintroduce fire into the areas with the greatest need for its beneficial effects.

Fire History - Ponderosa Pine-Mixed Conifer Forest



The six horizontal lines represent six different tree ring samples. Each vertical hash-mark represents the date of a fire scar on that sample. Notice the number of fires that occurred pre-settlement. Why are fire scars missing from trees after 1900?

Clue #1: Fire Scars = Past Fires

Fire scars are lesions on annual growth rings where the tree's cambium layer is heated and killed by fire. The tree no longer grows in the scarred area. In subsequent years, the tree might slowly cover over this scar as new rings extend from the living portions of the tree.

Clue #2: Ring Size = Past Precipitation

Annual rings vary in width from year to year depending on weather and other growth conditions. For example, drought results in very little growth, so rings are thin. Wet years let trees grow thicker rings.

Living Trees as Calendars

Living trees are good sources of information because they allow us to

Using Clues to Crossdate

Scientists put all of the visual clues to work in a technique called crossdating. This technique compares growth rings from live trees with those of much older dead trees in the same area. Since growth rings vary in width from year to year (as previously discussed), it is possible to correlate live and dead trees by matching up the ring-width patterns.

Imagine that there was a documented drought in the 1860s that caused 10 very small annual growth rings in most trees. Because the date of this ring pattern is known, scientists use it as a reference point to date older dead

Fire Cycles

Fire scars not only highlight specific large fires in the past, they help us understand "fire return intervals." This is the average amount of time between fires. Fire return intervals vary in different vegetation types. For example, a Ponderosa Pine forest (4,000-5,000 feet in elevation) has a short interval of three to nine years (figure at right), whereas a Subalpine Conifer forest (9,500-11,000 feet) has a large interval of 187 to 508 years. Fires became much less frequent at all elevations after 1900 due to European settlement in the area, livestock grazing (which removed fuels), and fire suppression.

Planning for the Future

So how does all this fire history

Sequoia & Kings Canyon Status of Fire Return Intervals