National Park | NC,TN

Park Alerts ▼

Increased Bear Activity

Bears are very active in the park at this time. Learn how to stay safe in bear country! **More » (http://www.nps.gov/grsm/naturescience/black-bears.htm)**

Partner profile: Trees tell the history of fire

Issue 8 (http://www.nps.gov/grsm/naturescience/dff8-main.htm) >
Partner profile

This slice of tree shows a wealth of historical information about forest growth and fire.

NPS photo.

As it turns out, trees have a lot to say about fire history. After all, they've been there for years--sometimes centuries--to see it! Researchers Dr. Henri Grissino-Mayer, Dr. Sally Horn, and their graduate students from the Department of Geography at the University of Tennessee have spent years figuring out just where, when, and how fire burned in these mountains in the past. Whether living or dead, trees are the key: as they grow they put on wood in rings, similar in some ways to how we grow taller and put on weight. Each tree ring consists of a layer of thin-walled cells formed early in the growing season (called earlywood) and thicker-walled cells produced later in the growing season (called latewood), Professor Grissino-Mayer explains. The distance between the beginning of the earlywood formation and the end of the latewood formation is one annual ring.

These fire scars show regular fires in this Shortleaf pine's life.

NPS photo.

These rings can tell us stories: their **width** tells us how much a tree grew each year (wide rings mean lots of growth), their **shape and evenness** from year to year tells us about disturbance (for example, if a gap opened and they were able to burst into the canopy), and their **patterns** overall compared with other trees' rings tell us about events such as fires or damaging insects at the landscape level.

In particular, Henri Grissino-Mayer and his research team are interested in fire history. Knowing when, where, and how fire happened in the past helps us plan for—and, in the case of the national park, manage—fires in our forests' future. The study of tree rings to understand the past is called dendrochronology: dendron = tree, chronos = time, logos = the science of. The study of tree rings to understand fire history has an added piece:

"pyro," to make it dendropyrochronology. You can read more about these terms and much more about tree ring research at **The Ultimate Tree Ring Web Pages (http://web.utk.edu/~grissino/)** .

How do scientists see the rings inside trees? We don't usually cut down living trees just to see inside, although that was pretty common in the past (**read about the martyred bristlecone pine (http://sonic.net/bristlecone/Martyr.html)**). Instead, scientists can take samples of trees in two ways: (1) if a tree has died, they can cut a slice out of the standing snag (trunk) or fallen log, or (2) if the tree is alive, they can extract a narrow core from the tree in a way that doesn't harm it. Tree coring, as the second option is called, is very common. It results in a pencil-shaped section of tree that shows rings from its outer edge, at the bark, to its inner core.

What materials would you need to core a tree?

Supplies to find your study site & make measurements

- a **dbh tape** (also called "d-tape") - a tape measure that is calibrated so when you stretch it around the tree, you read the diameter, or distance through the tree. Because you're measuring the diameter at breast height, it's called a dbh tape
- **plastic flagging** – comes in pink, orange, and other bright colors that you can see through the woods. Used to mark your trees, plot boundaries, etc. Dr. Grissino-Mayer recommends wrapping some of this around the ends of your tools, too, so you can see them
- **dendrometers** – a tool used to measure how quickly a tree is growing in the field. A dendrometer band is an open metal ring (like an expandable bracelet) placed around a tree's trunk. A spring connecting the ends of the metal allows the tree to expand under the band, and marks on the metal show how much the tree has grown from year to year
- **dendrograph** - another tool to measure tree growth in the field

Supplies to core the tree

- **increment borer starter** (optional) - a plate that fits between your chest and the borer that you will use to take the sample. The starter holds the borer steady while you get it started in the tree
- **increment borer -** to bore a pencil-shaped section out of a tree. A borer is like an auger; it's an instrument with a hollow shaft that is screwed into the trunk of a tree, and from which an increment core (or tree core)

is extracted using an extractor (a long spoon inserted into the shaft that pulls out the tree core).

Recording your data

- tree-ring sample form
- waterproof field notebooks
- permanent black felt-tip markers—fine-point and thick-point

Keeping your cores safe

- plastic wrap – to hold together pieces from a cross section of a tree
- 2" strapping tape (optional) - ideal for holding together pieces from a cross section of a tree, if you don't have any plastic wrap (see above)
- core mounts – to secure and display cores
- straws – to hold your cores
- map tubes – to hold the straws that are in turn holding your tree cores

Supplies to keep your other supplies in tip-top shape

- Oil lubricant/protectant to keep your increment borer clean and rust-free
- a sharpening kit - for your increment borers, a must in the field

Back at the lab

- sanding supplies - sandpaper, finishing film, belt sanders, band saws, hand planers
- microscopes
- beanbags - tiny beanbags about 2-3" long to hold and position your increment cores on the measuring stage
- dissecting probes – sharp tools with handles (similar to what your dentist uses on your teeth) to mark decadal rings of wood once they've been crossdated: one tiny hole for each decade ring (e.g., 1960, 1970, 1980, etc.), two for each 50th year (e.g., 1850, 1950, etc.), and three for the century years (e.g., 1700, 1800, 1900, etc.)
- graph paper - to graph narrow tree rings when you construct a diagram called a skeleton plot
- mechanical pencils – to make preliminary markings on your tree rings before using the dissecting probe
- single-edge ("Treat") or double-edge razor blades - these are used to put a clean, flat surface on a core, but this takes practice. Don't attempt to surface a core with a razor unless you've been trained!

- artists' (or "gummy") erasers - place these between your fingers and small strips of your sandpaper when fine-sanding your increment cores. Also good for erasing mistakes on your skeleton plots as they don't chew up the graph paper
- steel wool (fine) - used to remove resin from a very resinous increment core. Burnish the surface lightly, and the rings will appear!
- scissors - to cut your graph paper, glue - to glue down your cores on wooden mounts, string or masking tape - to hold the cores tight on the mount as they dry

According to Dr. Grissino-Mayer, you might also need:

- archaeological tools
- micro-drills
- measuring systems - Velmex or Lintab
- densitometry equipment – to measure the density of a tree
- chain saws – to access sites and take "slices" of dead trees

This information is adapted from Dr. Henri-Grissino-Mayer's webpage.

Pine-oak forests such as this on a high ridge in the western part of the park depend on fire. Even with fire suppression, lightning ignited fires here through the 20th century.

NPS photo.

What have tree rings told us about fire? While the story is pretty complex, tree rings from the oldest trees in the park—those that were saplings in the early 1700s—tell us that fire used to be common, especially on ridges, on south-facing slopes, and in the western side of the park. All of these locations are drier than the areas surrounding them. Every five to seven years or so, small fires used to burn away the underbrush, leaf litter, and small trees that couldn't tolerate the flames. These left tall, open stands of yellow pines (such as Shortleaf pine) and oak, all fire-tolerant species. They also left tell-tale evidence of their regular occurence in fire scars on the lower portion of pine trees. In most areas of the park, it's very clear when this pattern of regular fires stopped: in the early 1930s, the park began suppressing fire, and tree rings changed. It's hard to find fire scars from the mid-20th century on trees in many areas (the tree pictured above, showing fires in the 1940s and 1960s being an exception). The forests' fire-intolerant species, such as red maple, white pine, and black gum, began to thrive. Stands of these species have taken over some areas since fire disappeared, which changes the types of animals that live there, too. With the reintroduction of some controlled fire, the stands start to return to the mix of pines and oaks that existed for centuries before.

What effect do fires have on the forest? University of Tennessee research asks that and many other fire history questions.

NPS photo.

Fire and climate research in the Smokies

Here's what Dr. Henri Grissino-Mayer and Dr. Sally Horn, both professors in the Department of Geography at the University of Tennessee, have studied in the park with graduate students and other collaborators. Click on each study title to read about what scientific questions researchers asked, how they collected data in the park, and what discoveries they made as they pieced together the history of Smoky Mountain forests and fires.

1. Fire History and Age Structure of Table Mountain Pine (*Pinus pungens*) in the Southern Appalachian Mountains. (http://www.nps.gov/grsm/naturescience/dff8-agestruc.htm) M.S. Thesis. Michael Armbrister and Henri Grissino-Mayer, 2000–2002. You can read the whole thesis by **clicking here (http://web.utk.edu/~grissino/downloads/Michael%20Armbrister%20thesis.p** (this will download a PDF from the University of Tennessee).

2. Dendrochronological investigation of Shortleaf pine (*Pinus echinata Mill.*) in Great Smoky Mountains National Park. (http://www.nps.gov/grsm/naturescience/dff8-dendrochron.htm) Lisa LaForest, Jessica Slayton, and Henri Grissino-Mayer, 2005–2006.

3. Climate Response of Shortleaf Pine Trees in Great Smoky Mountains. (http://www.nps.gov/grsm/naturescience/dff8-climateresponse.htm) MS Thesis. Christine Biermann and Henri Grissino-Mayer. 2008-2009. You can read the whole thesis by **clicking here (http://web.utk.edu/~grissino/downloads/Christine%20Biermann%20thesis.p** (this will download a PDF from the University of Tennessee).

4. Fire Regimes of the Southern Appalachian Mountains. (http://www.nps.gov/grsm/naturescience/dff8-fireregime.htm) Lisa LaForest, Henri Grissino-Mayer, Chris Underwood from the University of Tennessee, and Charles Lafon and Will Flatley from Texas A & M University, 2007–2009.

5. Soil and Sedimentary Charcoal as Evidence of Fire History in Great Smoky Mountains National Park. (http://www.nps.gov/grsm/naturescience/dff8-sediment.htm) Sally Horn, Alisa Hass, Chris Underwood, and Matthew Valente, 2004-2009.

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