READING THE TREES ON THE LAMONT CAMPUS FOREST

Created by Tamara Browning, Donald Goldstein,
Laurence Hoard, Michael B. Labat, Cristiana Assumpção,
Frederico D. Baggio, and Michael J. Passow

Earth2Class Workshops for Teachers
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Reading the trees on the Lamont campus forest

[Image: Ned Barnard]

This virtual tour is inspired by the nature walks led by Neil Pederson of the LDEO Tree Ring Lab (TRL.) Neil recently completed his Ph.D. at Columbia and will continue his research as a faculty member at Eastern Kentucky University. Much of his work and the highpoints of this walk through the forest around the Lamont campus are based on dendrochronology and related tree studies.

We have organized this tour around a number of questions posed by Dr. Pederson and participants on the walks. We ask you to imagine that you are with us as we go from stop to stop.

The Lamont campus lies atop the Palisades, above the Hudson River. You can examine a topographic map and an aerial photograph of the area at the end of this description. Our tour begins at the rear of the parking lot outside the Geochemistry building, as we follow a pathway among the trees. (Watch out for the poison ivy!)

What is *dendrochronology*?

Dendrochronology means finding the age of trees and past climates by studying tree rings. You can find more information about the science of tree rings here. You can also learn more through Earth2Class Workshops for Teachers featuring Nicole Davi of the TRL:
http://www.earth2class.org/k12/w5_s2005/index.php

One of the benefits of studying tree rings is the ability to establish exact dating of past events. Dendrochronology began in the 1920s when A.E. Douglas started to investigate the correlation between droughts and solar activity in Arizona. He noticed that tree stumps in a field all showed similar ring patterns, and recognized that they were responding to environmental conditions. This insight opened up research about climate changes during the past 1,000-2000 years using trees from all over the world.

What can we learn from trees in the Eastern forests, such as we see around Lamont?

Lamont's campus lies in the Lower Hudson River Valley in the Eastern deciduous forest. This region now acts as a transition zone between **dominant vegetation** types typical of areas to the south and the north. The area also serves as a natural laboratory **for the study of climate change on forested ecosystems**. You can learn more about this region through these Tree Ring Lab web pages
http://www.ldeo.columbia.edu/res/fac/trl/research/HV/HVover.html

http://www.ldeo.columbia.edu/res/fac/trl/research/HV/HVnatlab.html

We'll continue walking along the path for about 50 m and stop in a gap in the forest canopy, surrounded by a wide variety of trees and shrubs.

Stop 1 – "The Good, The Bad, and The Ugly"

At this stop, Neil introduced us to the diversity of tree species in this forest. Trees and other plants continuously compete for light and space to put down roots. Change over time is another constant at any location. Diversity benefits a habitat because it allows for better responses to environmental stress: even if some of the species die, others are present and will survive to replace them.

What are some of the trees we can see here?

About 10,000 years ago, glaciers retreated from this region and left it as bare rock. **Pioneer plants** such as mosses and lichens began the process of weathering the rocks and creating soil. Over millennia, other plants came into the region as the climate warmed. At first, these included **tundra** plants, typical of the far north today, and later coniferous forest trees (**taiga**) such as pines and other evergreens. As climate continued to warm, broad-leafed shrubs and trees took over. The **vegetational community** today in the Lamont Forest is unusual because trees typical of regions much farther to the south and north can be found at a **range margin** in this area .

Are all the trees we see native to this area?

Neil explained that we also find a number of trees and other plants that have been accidentally or intentionally introduced. The Hudson River region contains major ports, to which ships from all over the world have transported seeds, insects, fungi, and other organisms hidden in cargo or bilgewater. They may escape and, if conditions are suitable, become established. Most have no or few predators in this environment to control them, so they spread rapidly.

When trees die, they leave gaps within the forest. Non-native species may rapidly take over the available space. Some examples seen here are the Chinese Tree of Heaven (left) and wineberry shrub (right).

These alien species may replace the native species over time. In a decade or two, you might see a quite different forest from what you see now. Some of the invaders are not very obvious to casual observers because of their small size. These include insects, fungi, and viruses. The image below shows fungal disease on a leaf.

Are dead trees 'bad and ugly'?

At first glance, a dead tree may seem like an eyesore. But to the animals and plants of the forest, what remains of the tree serves in many beneficial ways. So, dead trees really belong in the 'good' category. Dead trees slowly release carbon and other nutrients into the environment. They increase the organic matter content of the soil, which improves soil water holding capacity and therefore, soil quality. They also provide home for insects, birds, mammals, and other organisms. One important concept to realize is the time scale involved: it may take decades for a large tree to decompose completely.

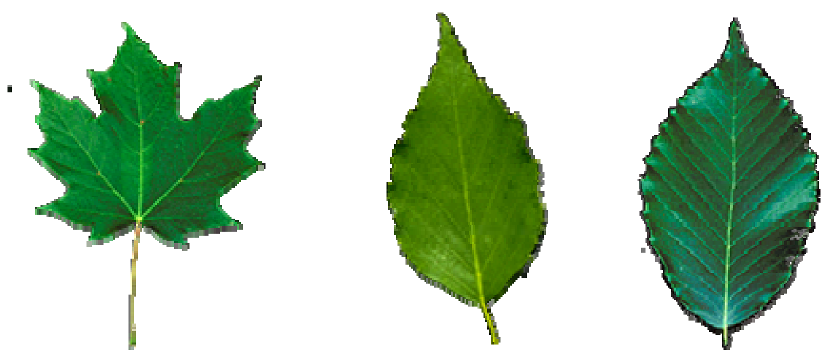
Now we'll continue the walk another hundred meters or so along the path to the next stop.

Stop 2 – Welcome to the Southern Biomes! Welcome to the Northern Biomes!

What are some of the trees we can see here?

One of the most interesting things about the Lamont Forest and nearby parts of the Lower Hudson Valley is that within a short walk one can see tree species that are typical of both Northern Deciduous forests (such as Sugar Maple, Eastern Hemlock, Yellow Birch, and American Beech) and Southern forests (such as Pignut Hickory, Sweetgum, Tulip Tree, and Scarlet Oak). As noted above, this results from lying in a transition zone of range limits.

From left: Sugar Maple, Birch, Beech; below, Eastern Hemlock



From left: Pignut Hickory, Sweetgum, Tulip Tree (Yellow Poplar), Sscarlet Oak

[Images from: http://www.fw.vt.edu/dendro/forsite/key/intro.htm; http://www.cnr.vt.edu/dendro/wpina/index.html; http://www.radford.edu/~jbailey2/bio335project/easternhemlock.html]

How does this forest help us understand climate change?

Scientists are interested in monitoring climate alterations caused by global warming and cooling. One of the signals that can be used for this purpose is expansion or contraction in the range of a species at its limit. For example, Sweetgum is currently at the northernmost limit of its range just north of Lamont-Doherty. Scientists will try to document any northward expansion over the next few decades, which may occur as a result of climate warming.

Here are more TRL links for those interested in this topic:
http://www.ldeo.columbia.edu/res/fac/trl/research/HV/HVclimateChange.html

http://www.ldeo.columbia.edu/res/fac/trl/research/HV/HVlargeScale.html

Another factor that varies geographically is the duration and amount of winter **snowpack.** Snow acts as an insulator protecting the surface roots from freezing. In places where snowpack lasts for shorter times, roots may freeze. Loss of these roots stunts tree growth, and will affect tree ring width.

In the Adirondacks and locations to the north, longer snowpack season benefits trees. The shorter season of snowpack in the lower Hudson Valley may have a negative effect trees. Long-term changes in snowpack duration as local climate shifts play a role in tree distribution.

Stop 3 Reading Eastern Climate History from Tree Rings

We'll continue walking along the path to our next stop. At this stop, we can look to our left downhill towards a small stream bed, where we see trees rooted in deep soil on a flat surface. To our right on the hillside, we see trees growing out of cracks in the bedrock. This situation creates an example of a stressed growing condition that would result in tree ring variation between wetter and dryer seasons.

Can tree rings reveal climate change in the Eastern forests?

When tree ring studies were developed in Arizona, it was thought that this technique would not be useful for Eastern forests because the range of annual precipitation is less drastic than in the West. In the New York area, we receive about 10 – 15 cm of precipitation every month, whereas in Arizona there are more distinct wet and dry seasons and lower levels of annual precipitation.

However, in the 1970s scientists at the TRL showed that tree ring analysis is valid for eastern trees. Trees growing on steep slopes and outcrops live in conditions with lower amounts of soil water and are thus dependent in the amount of rainfall received each season. Therefore, variations in the ring widths of trees living in these conditions can be used as sensitive indicators of climate change. This discovery opened many new regions for dendrochronology investigations, and revealed much about past climates.

What have we learned about drought in the Hudson Valley?

In the early 1960s, much of this region experienced a very intense drought. Severe restrictions on water usage were imposed. Increased precipitation eventually ended this episode, but drought conditions have recurred several times since then. The 1970 studies mentioned above clearly showed evidence of the 1960s drought conditions.

At that time, this drought was thought to be an unusually severe event. However, Tree Ring Lab studies produced a drought pattern record dating back into 1600s. (Recent work may extend the story into the 1400s.) Some episodes lasted for decades. This gives us pause for thought as to whether we are prepared for future droughts.

Here is a link to the TRL web site:
http://www.ldeo.columbia.edu/res/fac/trl/research/HV/HVdrought.html

Stop 4 Tree Ring Analysis and Human History

At the final stop, Neil described how tree rings may be used to help re-create the historical record.

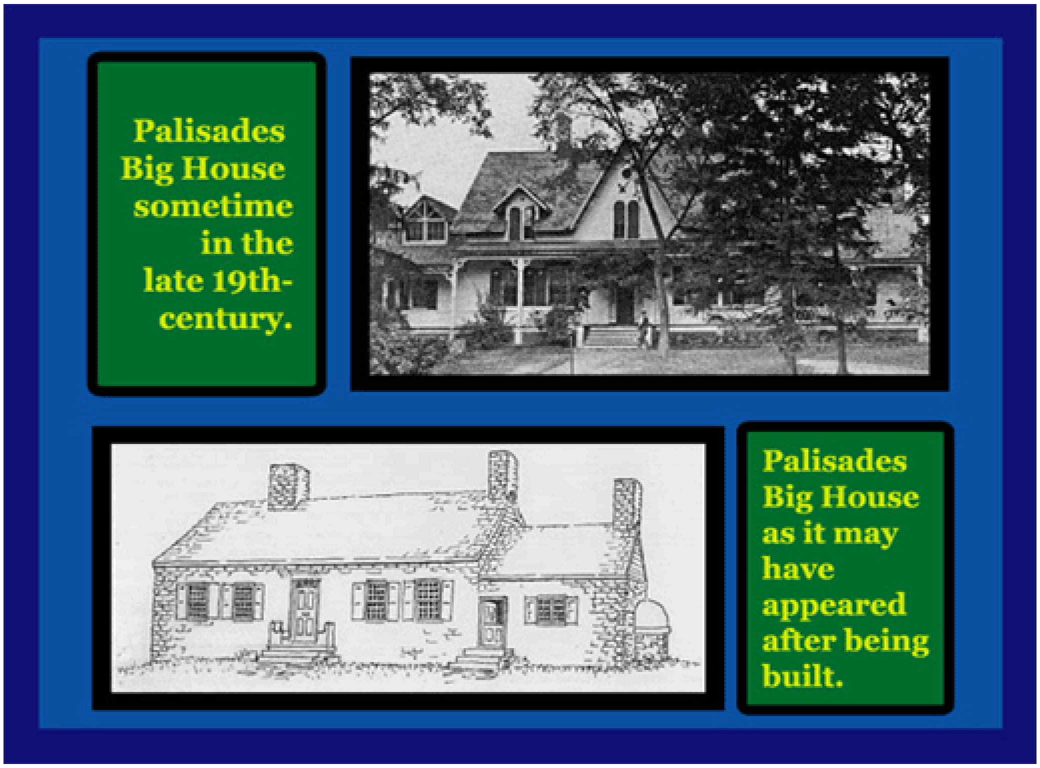
Some investigators looking at the area stated that this was an "**Old Growth**" forest, unaffected by human activities. They reached this conclusion based on the size and bark characteristics of the trees, such as the one at the left. But coring this one and others has revealed that they are almost all relatively young, generally only a century or so old. This forest consists of trees that replaced the ones cut down in the 18^{th} and 19^{th} centuries for fuel and building materials.

Looking on either side of the path you can see small trees struggling to grow in the shadow of the taller trees. As disease, age, or people fell one of these mature trees, the smaller trees would experience growth spurts, which could be read in a core as a wider set of rings.

What can be learned about human habitation?

For more than three thousand years, this area was the hunting grounds for the Eastern Woodland Indians. The first Europeans came in the early 1600s as Dutch settlers arrived to establish New Netherlands. The English took control in 1664. The boundary line they established between New York and New Jersey runs right at the edge of the Lamont property.

One of the earliest mansions built in the area was the "Palisades Big House." Although the exact date for construction was not clear from local records, it was usually claimed that the house dated to the 1690s. However, when TRL scientists took cores from the floor beams, they found that the house was built around 1738. Here's a link for more information:
http://www.ldeo.columbia.edu/res/fac/trl/research/HV/HVhisto.html



Getting back to our virtual walk stop, we see remains of a cellar hole and stone wall. This may have been one of the farms in **Skunk Hollow**. This was a 19th century community founded by descendants of free blacks from Manhattan, former slaves and two black landowners who were among Tappan's original settlers. The area is now part of the Lamont Forest and Palisades Interstate Park, and Skunk Hollow is a fading memory. But tree rings might give us approximate dates when the community thrived and then was abandoned. For more information about the local history, including Skunk Hollow:
http://www.thejournalnews.com/LivingHere/rockland/features/history.html.

This marks the end of our virtual tour. Go up the hill about a hundred meters and you'll come out near the gatehouse to return to the Lamont campus.

Images by Michael J. Passow, unless otherwise credited.

For more information about the Tree Ring Lab research and discoveries:
http://www.ldeo.columbia.edu/res/fac/trl/research/HV/HVpubs.html

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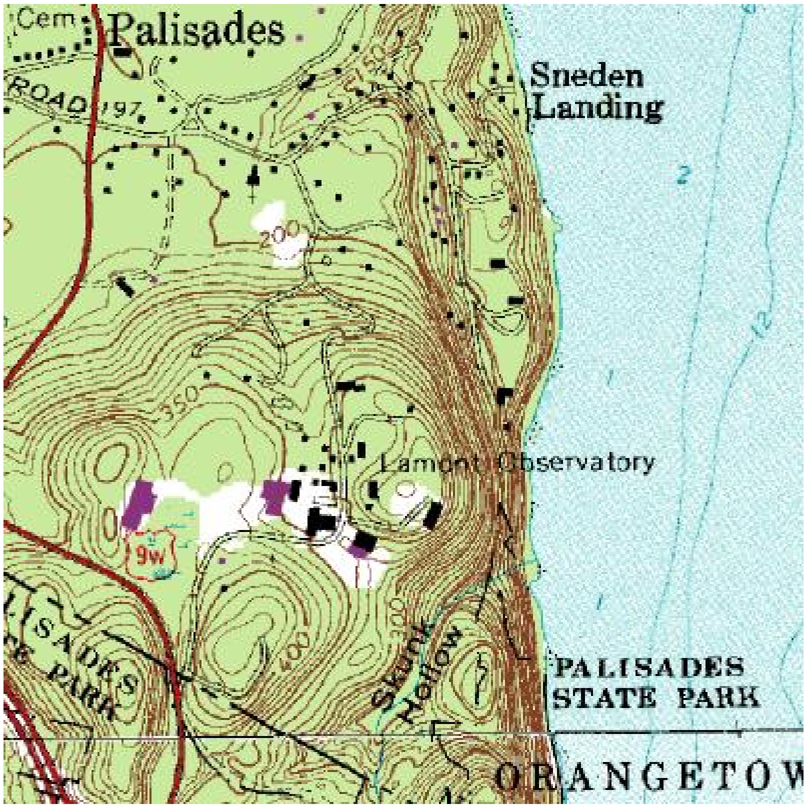
The topographic map below comes from Terra-Server. You can click on the link to explore further.



Topographic map (1979)
http://www.terraserver.microsoft.com/image.aspx?T=2&S=12&Z=18&X=740&Y=5674&W=1&qs=%7cpalisades%7cny%7c

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This aerial image of the Lamont campus, as well as images from many other locations, comes from http://earth.google.com. Click on "Download" and then "Install." The zip code for Lamont is 10964. You can zoom in, change the viewpoint, and play around with the software image in many other ways. Enjoy!

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