In today's class, we introduce → the Bristlecone pine project:

AT HOME: Individual Assignment (30 points)
→ due at beginning of class on Friday, April 4th

Questions on Bristlecone Pine and Data Collection Table

1) Answer questions based on Monday's lecture

2) Fill in a data table for five Bristlecone Pine Sites
→ *see the websites for the information*

IN CLASS NEXT FRIDAY: Group Activity (10 points):

Review additional data and test hypotheses about Bristlecone pine growth and climate

→ *This will take the entire class period, so you need to come prepared with your AT HOME assignment. If you are trying to finish your AT HOME assignment during class, then you might run out of time.*

Bristlecone pine trees

Very amazing and very old trees
→ living trees are 4,000 years old!

These trees grow at very high elevations

→ The White Mountains of California

Bristlecone pines are used for long temperature reconstructions

Bristlecone pine assignment:

In order to complete the assignment, we need to learn about the following concepts:

1) Crossdating

2) Site selection

3) moisture-sensitive vs. temperature-sensitive sites

4) Skeleton plot master

5) Ring width index

6) Frost Rings

Crossdating (method of tree-ring analysis):

Trees from the same site are sensitive to the same environmental variable (i.e., precipitation or temperature), and can be matched with each other

→ *patterns are matched* between multiple samples

In your activity on Friday, we determined whether tree samples are **sensitive**   *(i.e. suitable for crossdating)*

The image below shows a ***sensitive*** tree-ring sample with about thirty rings (every tenth ring is marked) – growing from left to right.
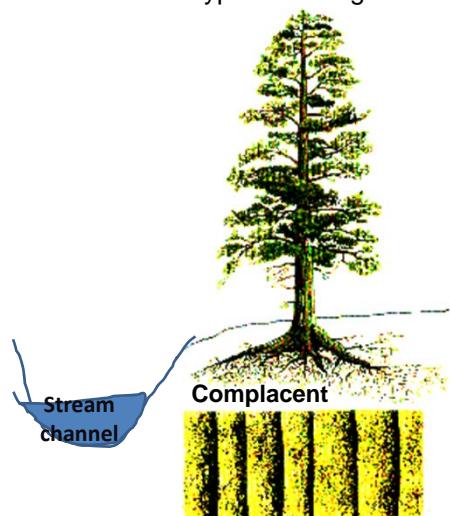

← Pith
(center of tree)

Bark →
(outside of tree)

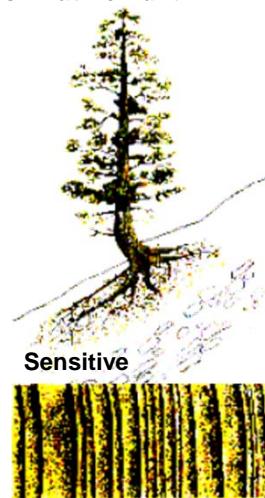Sensitive means that there is variation between ***wide*** and ***narrow*** rings

→ We use the pattern of narrow rings to match the tree growth between two different tree-ring samples

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There are two types of tree growth:

→ *This is what we want*

Stream channel

Complacent

Sensitive

Trees growing near a local water source have no variation in growth
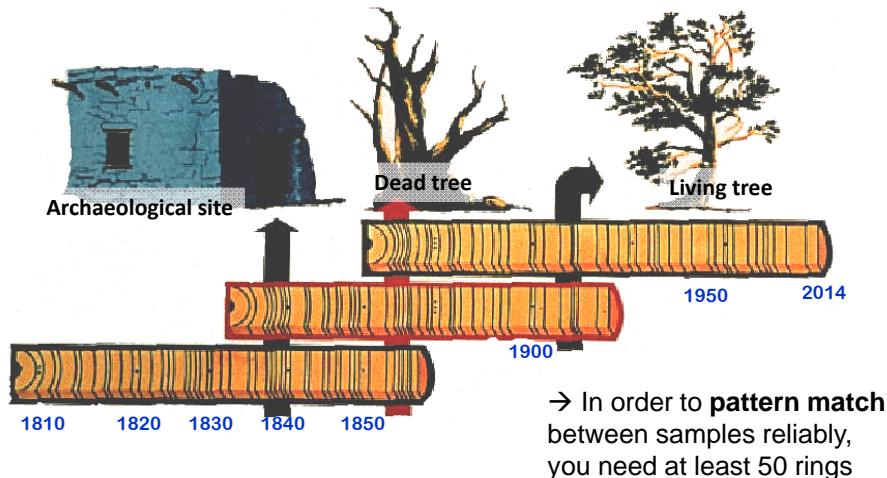→ There is always water available, even if the climate is dry in a particular year

Trees on steep slopes and rocky areas represent **regional** changes in climate (temperature or precipitation).

Crossdating: used for determining how old a sample is

Process of assigning calendar ages to individual rings (i.e. knowing how old a sample is). We use this procedure for both living trees and older wood from dead trees.
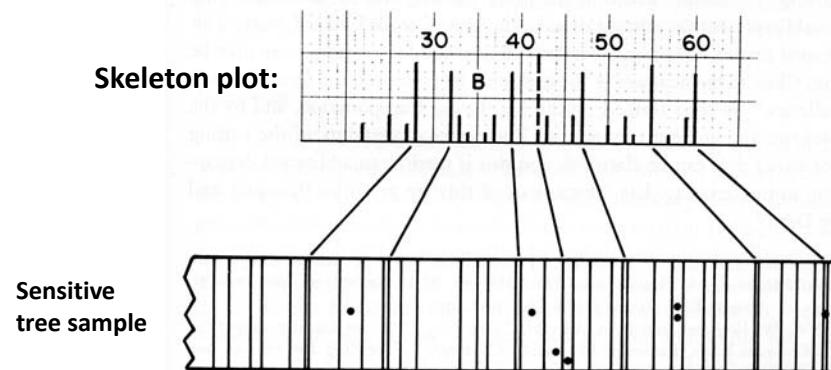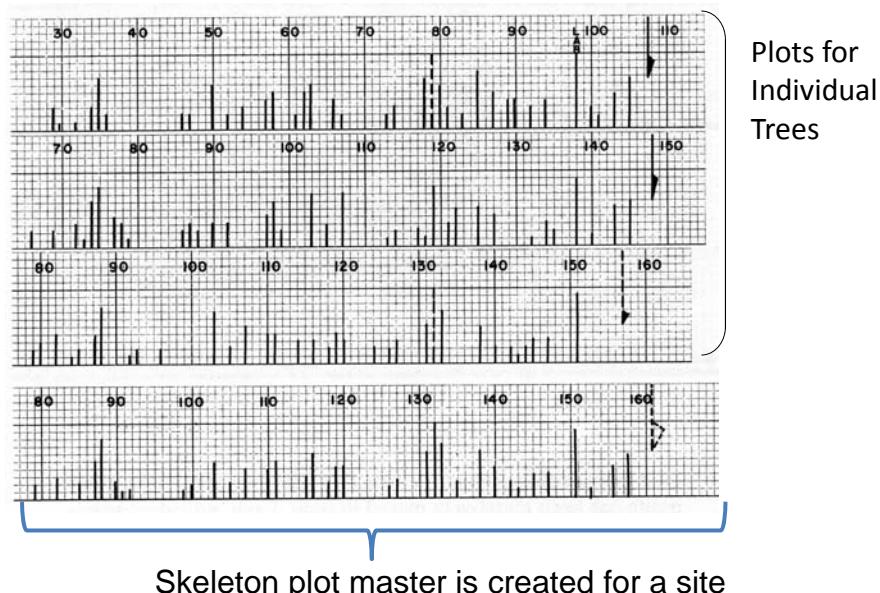

Archaeological site   **Dead tree**   **Living tree**

1950   2014

1900

1810   1820   1830   1840   1850

→ In order to **pattern match** between samples reliably, you need at least 50 rings

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Why not just count the rings?

Trees can have false rings or missing rings

If we core a tree here, we would miss this ring, and have the wrong age for the tree

False ring   **missing ring**

Crossdating involves creating a skeleton plot of the narrow rings in a sensitive tree sample:

Skeleton plot:

Sensitive tree sample

Multiple trees are compared at a site:

Plots for Individual Trees

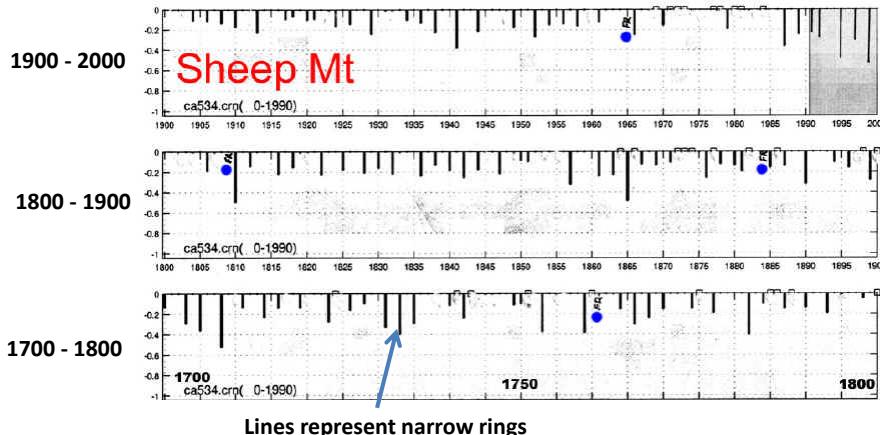Skeleton plot master is created for a site

Skeleton plot master: a plot of narrow rings for a site (group of trees)
→ The plot shows the narrow rings with calendar years

Each section is one century, and the oldest section is on the bottom

Lines represent narrow rings

What is a site?

A group of trees that are sampled at a location
        → (i.e. a hillslope, mountain-top).

Sites are usually named after geographic location
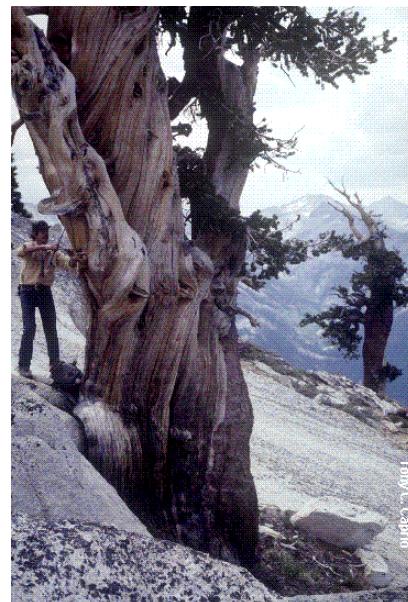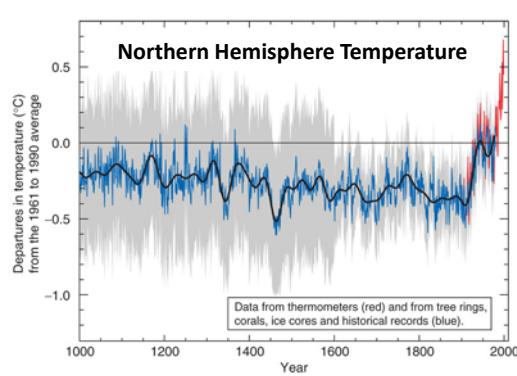   → (i.e. Mt. Lemmon or Sheep Mountain)

Site Selection

We search for locations where the trees are <u>sensitive</u> to an environmental variable

i.e. temperature or precipitation

→ A steep hillslope

. . . A lot of work happens between sampling trees and developing a temperature reconstruction . . .

Northern Hemisphere Temperature

Data from thermometers (red) and from tree rings, corals, ice cores and historical records (blue).

Bristlecone Pine Project
(Both the AT HOME and Group Assignments):

Goal: Imagine you are a climate scientist:

Learn about the steps of:

 (1) data collection (2) site comparison and (3) hypothesis testing
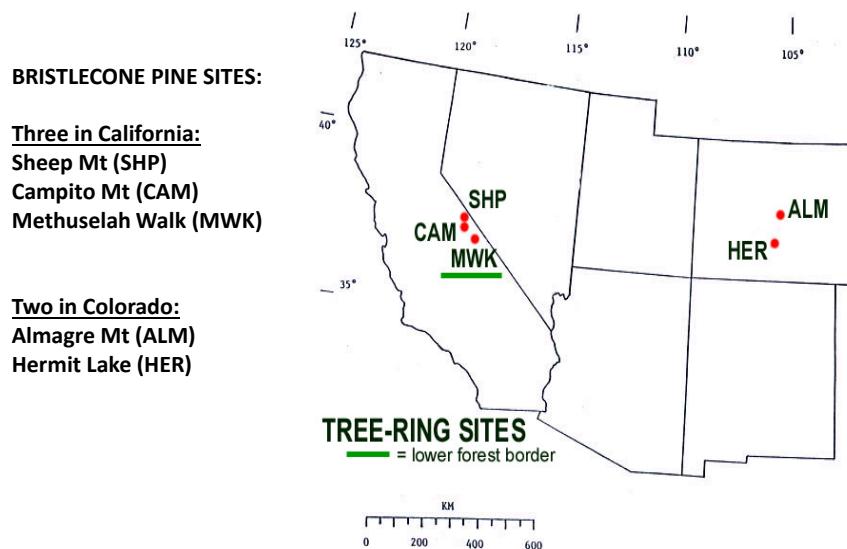
The AT HOME assignment involves data collection

This is the equivalent of doing field work:
→ *going to the mountains and collecting samples*

We collect information about each site:

Site photos, elevation, rock type, forest type

In this assignment, we are going to learn about five Bristlecone pine sites:

BRISTLECONE PINE SITES:

Three in California:
Sheep Mt (SHP)
Campito Mt (CAM)
Methuselah Walk (MWK)

Two in Colorado:
Almagre Mt (ALM)
Hermit Lake (HER)

TREE-RING SITES
= lower forest border

Part 1 of the AT HOME Assignment:

Answer questions based on the following lecture slides

Part 2 of the AT HOME Assignment:

Fill in a data table using information from three websites:

(copy and paste the web address into a browser)

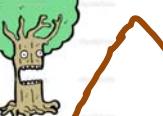http://www.ltrr.arizona.edu/kkh/natsgc/5-site_photos.htm

http://www.ltrr.arizona.edu/kkh/natsgc/skeleton_plots.htm

http://www.ltrr.arizona.edu/kkh/natsgc/indices.htm

Moisture-sensitive vs. Temperature sensitive tree growth

Temperature-sensitive:

At higher elevation, growth is *limited* by cold temperature
Usually enough moisture (lots of snow), but trees need warm temperatures in the summer in order to grow

Warm summers (longer growing season) = wide rings
Cold summers (shorter growing season) = narrow rings

Moisture-sensitive:

At lower elevations, trees are limited by precipitation

Usually warm enough, but dry years (lack of rainfall) will limit growth
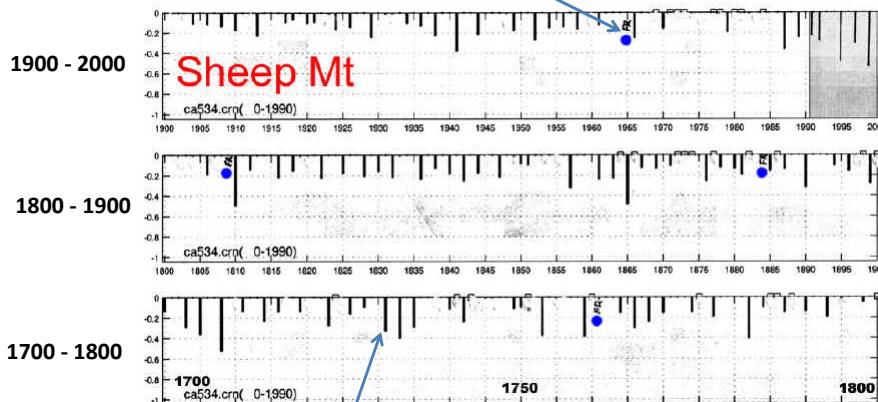
Wet winters (more rain/snow) = wide rings
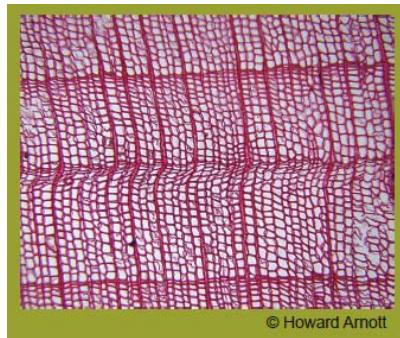Dry winters (less rain/snow) = narrow rings

a mountain

Skeleton plot master is a plot of narrow rings (vertical lines) for a site
This skeleton plot master also includes blue dots

→ blue dots = frost rings (fr)

1900 - 2000   **Sheep Mt**

1800 - 1900

1700 - 1800

Vertical lines = Narrow rings, which are <u>plotted with calendar years</u>

Frost Rings:

A frost ring is a row of damaged cells in the middle of a tree ring
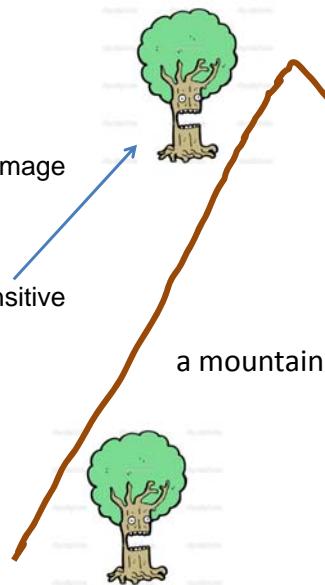

© Howard Arnott

How do frost rings form?

→ At high elevation, in certain years it can get very cold for a period of a few days to weeks

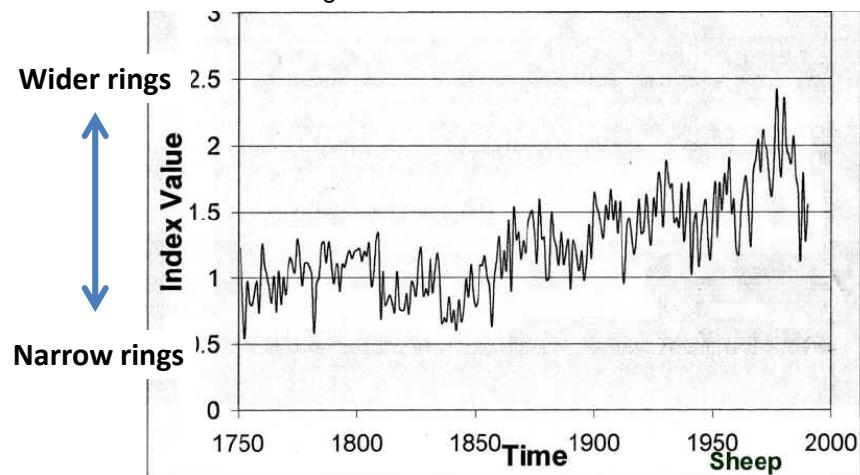These very cold temperatures cause the cell damage in the trees

This is more likely to happen for temperature-sensitive trees growing at high elevation

a mountain

Ring-width index plot:

A time-series plot showing the departure of growth compared to average growth for the whole record.

The line at 1.0 = the average for the whole record.

Wider rings

Narrow rings

Index Value

2.5
2
1.5
1
.5
0

1750   1800   1850 Time 1900   1950   2000
Sheep

Data Collection Table:

In order to fill out the site data table . . .

Copy and paste the website address into a web browser:

http://www.ltrr.arizona.edu/kkh/natsgc/5-site_photos.htm

http://www.ltrr.arizona.edu/kkh/natsgc/skeleton_plots.htm

http://www.ltrr.arizona.edu/kkh/natsgc/indices.htm

Questions?

Short video on Bristlecone pines on Wednesday