

# Interpreting Past Forested Environments

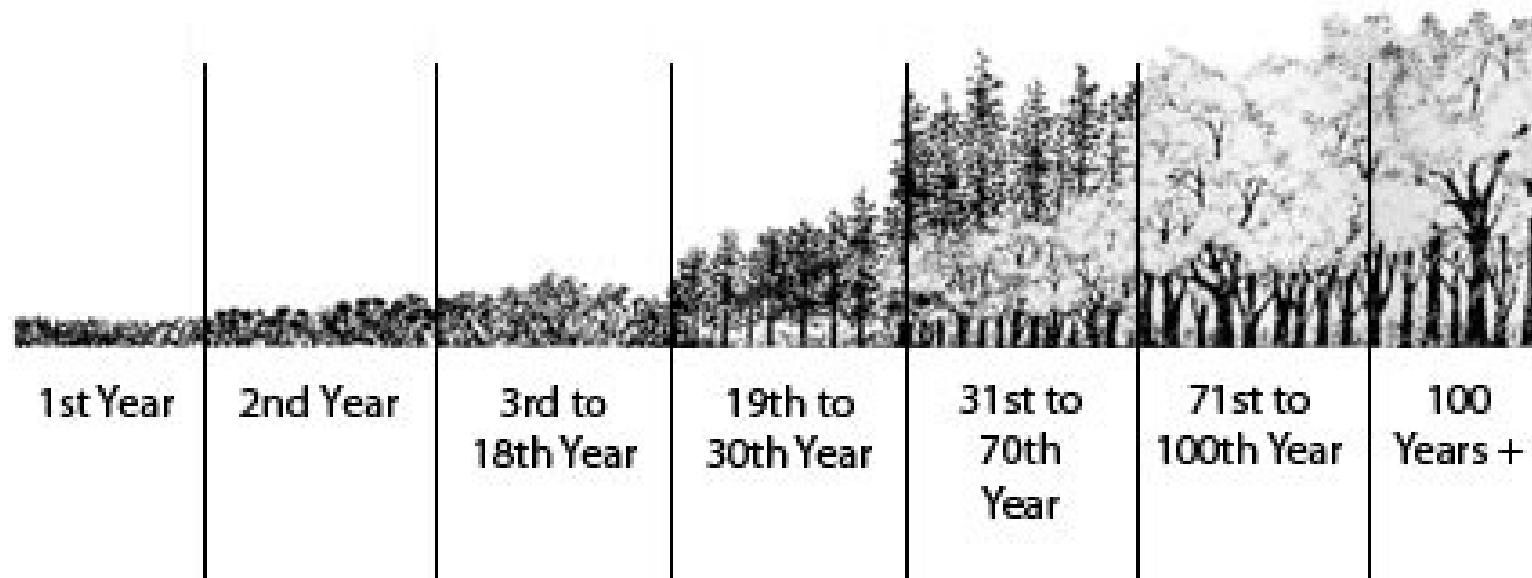
Daniel Druckenbrod, Professor  
Rider University, Lawrenceville, NJ



## **1817 Description of Monticello landscape**

“Having an introduction to Mr. Jefferson I ascended his little mountain, on a fine morning, which gave the situation its due effect. The whole of the sides and base are covered with forest, through which roads have been cut circularly so that the winding may be shortened at pleasure: the summit is an open lawn, near to the south side of which the house is built, with its garden just descending the brow... I walked with him round his grounds, to visit his pet trees and improvements of various kinds...” (Thomas Jefferson’s Garden Book)

# Forest succession



<https://dukeforest.duke.edu/forest-environment/forest-succession/>

## Using tree rings to reconstruct forest history



## Tree growth conceptual model

$$R_t \approx A_t + C_t + D_t + E_t$$

$R_t$  = ring width (growth increment)

$A_t$  = age or size related trend

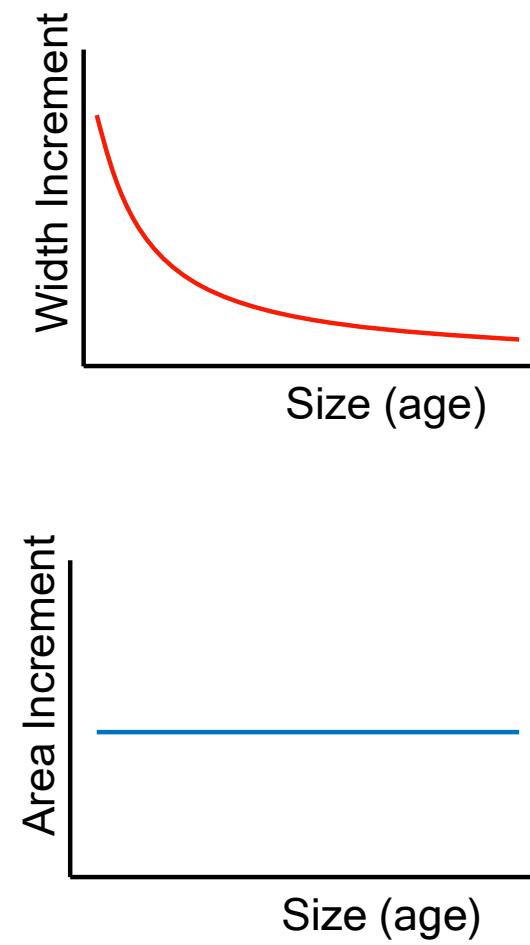
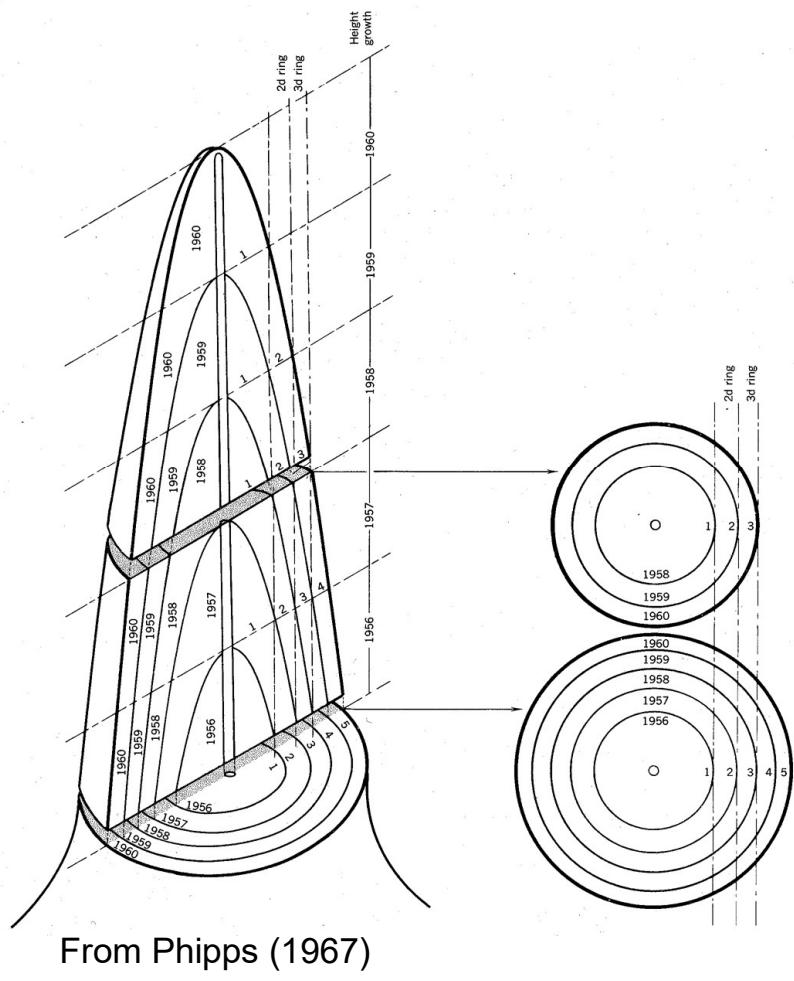
$C_t$  = climate signal

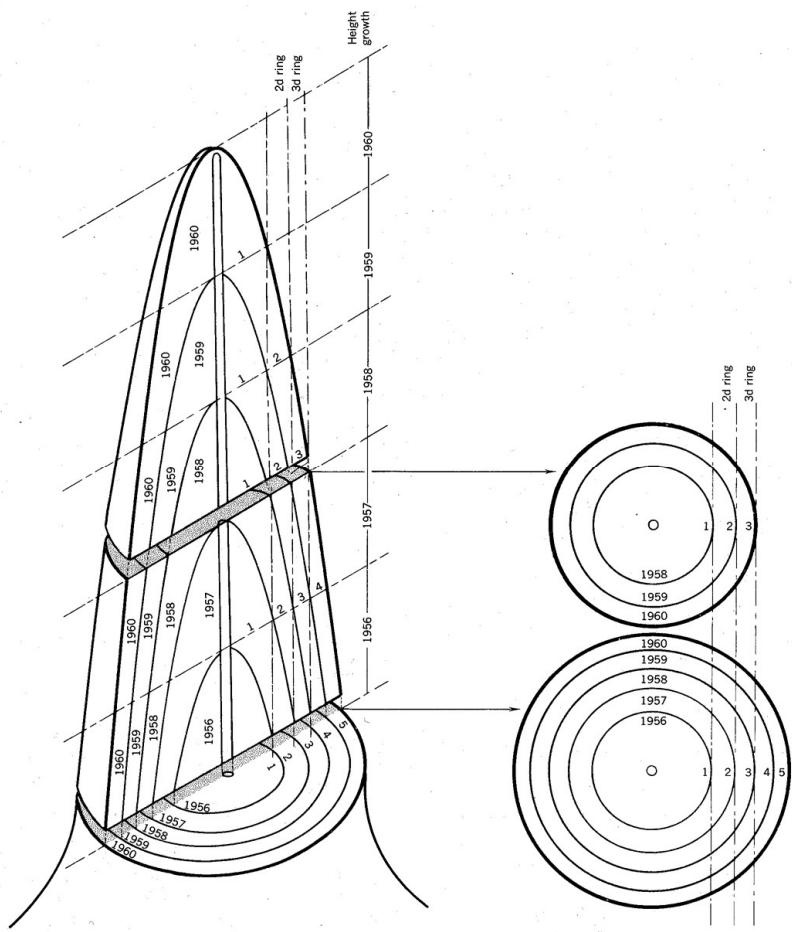
$D_t$  = canopy disturbance signal

$E_t$  = error term

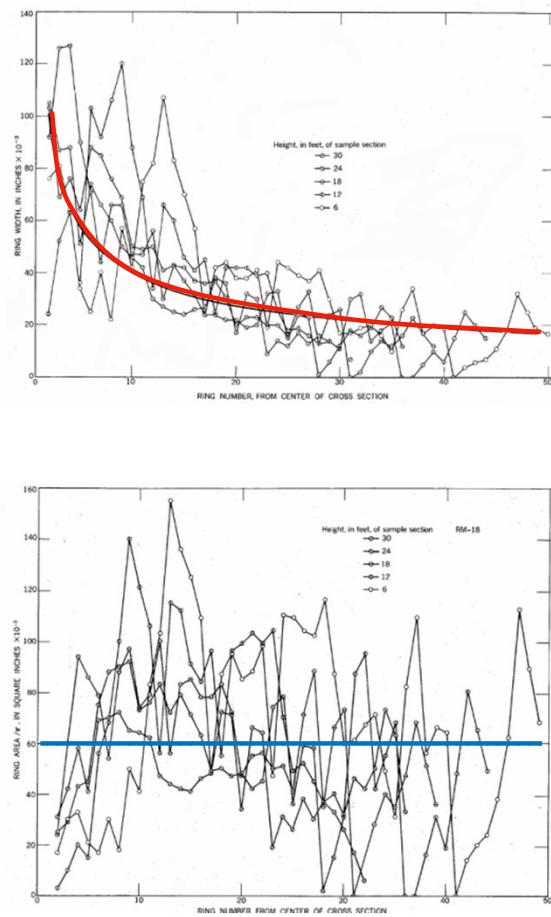
Graybill (1982) and Cook (1985)

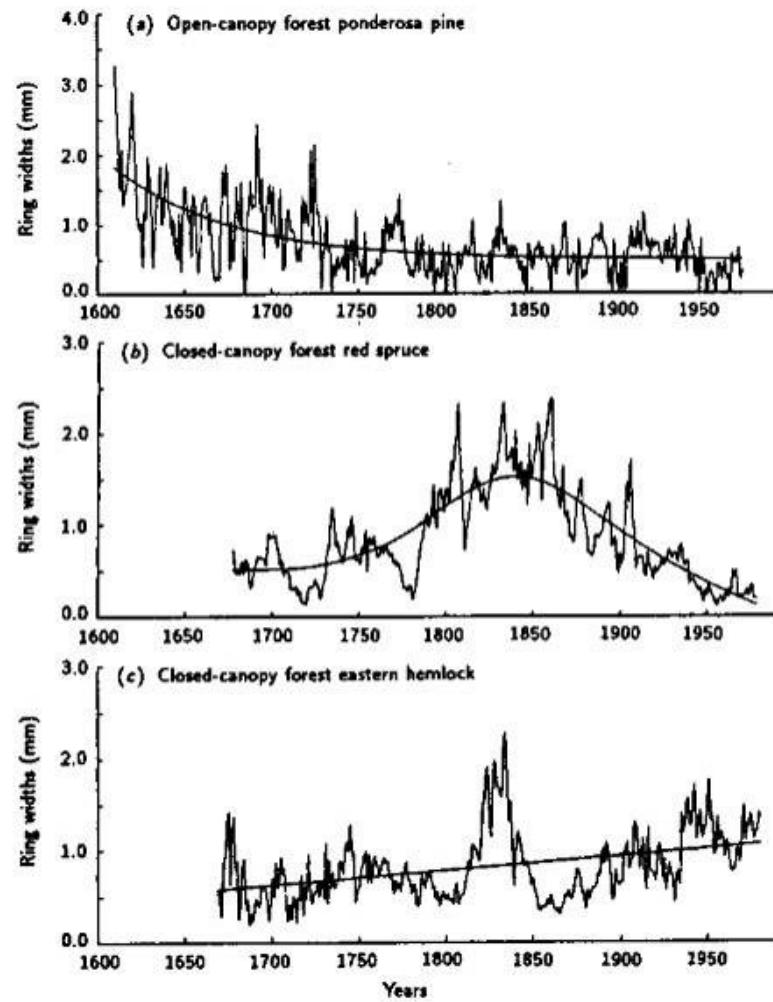




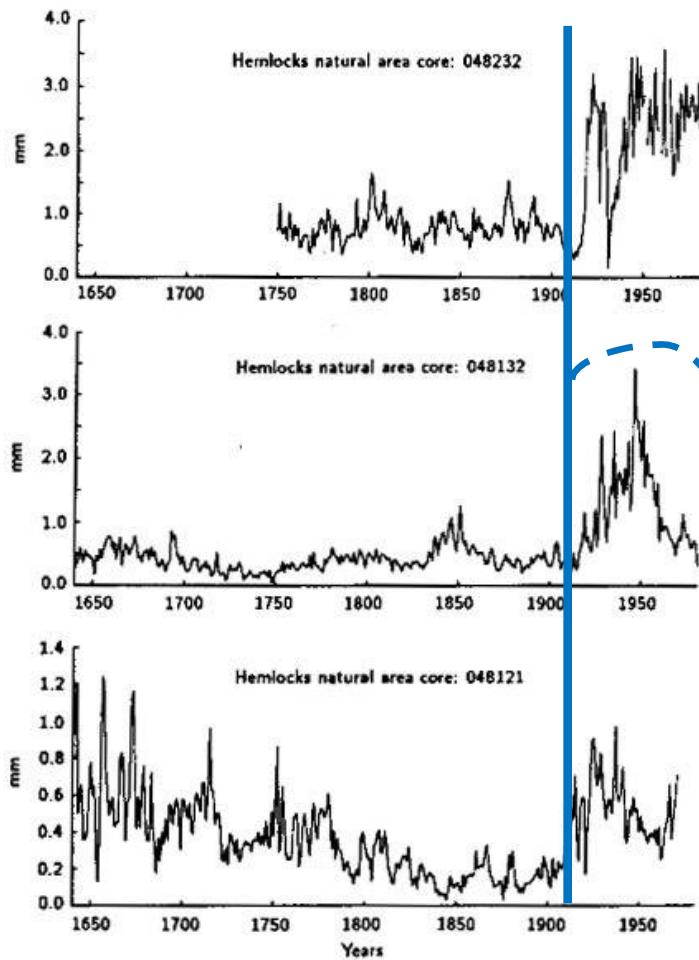


From Phipps (1967)





From Cook (1986)



synchronized  
release from  
suppression

From Cook (1986) and Zack Pratt Museum

PRESERVATION NJ

# Dating Historical Structures

## ■ John Rogers House, Mercer County Park

### John Rogers House

Year Listed: **1996**

City: **West Windsor**

Status: **Endangered**

County: **Mercer**

#### DESCRIPTION:

Perhaps the oldest building in West Windsor Township, the Rogers House (1761) is a distinctive regional example of the pattern-brick houses most commonly found in southern New Jersey. This Mercer County example proves the broad influence of the English Quakers who were some of the state's earliest settlers.

Vacant for more than fifteen years at the time of the list, the house is owned by Mercer County and remains standing because of its sturdy original construction.

#### UPDATE:

- County still letting it deteriorate
- preparing to cover the roof with a tarp



# Dating Historical Structures

- John Rogers House, Mercer County Park

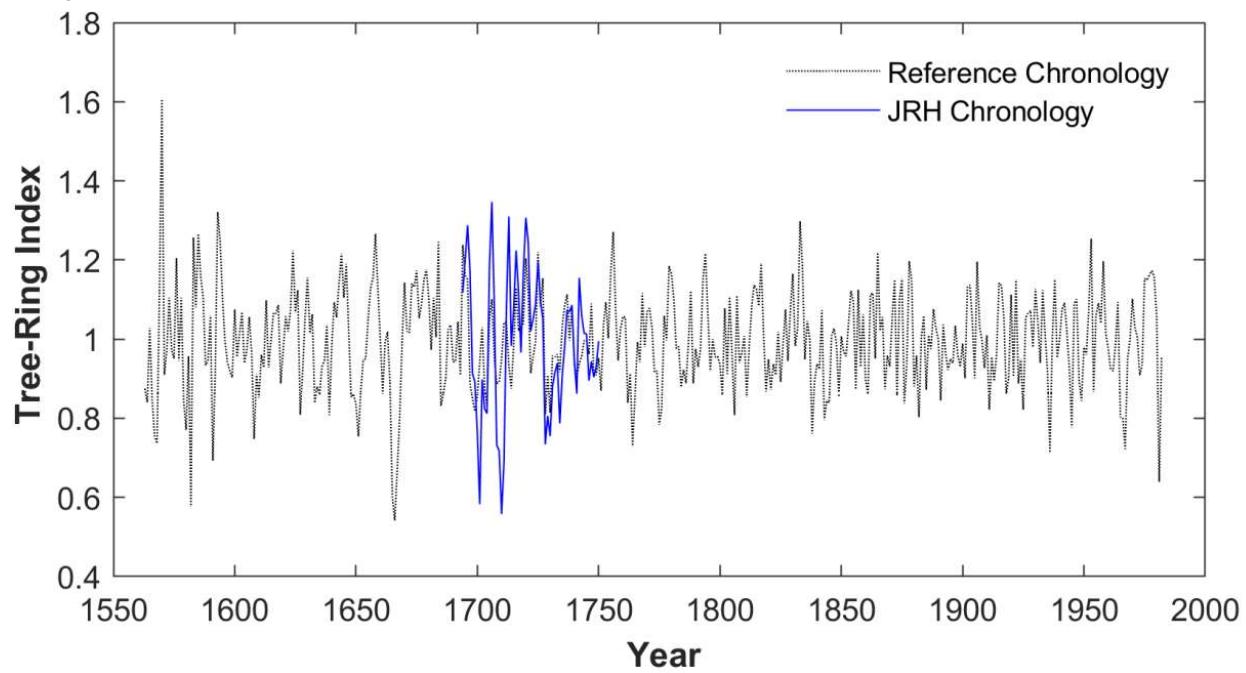


© nj.com



# Dating Historical Structures

- John Rogers House, Mercer County Park
- Crossdating with reference chronology (because not every house has its year inscribed in the bricks!)



## Dating Historical Structures

- Back in Virginia...



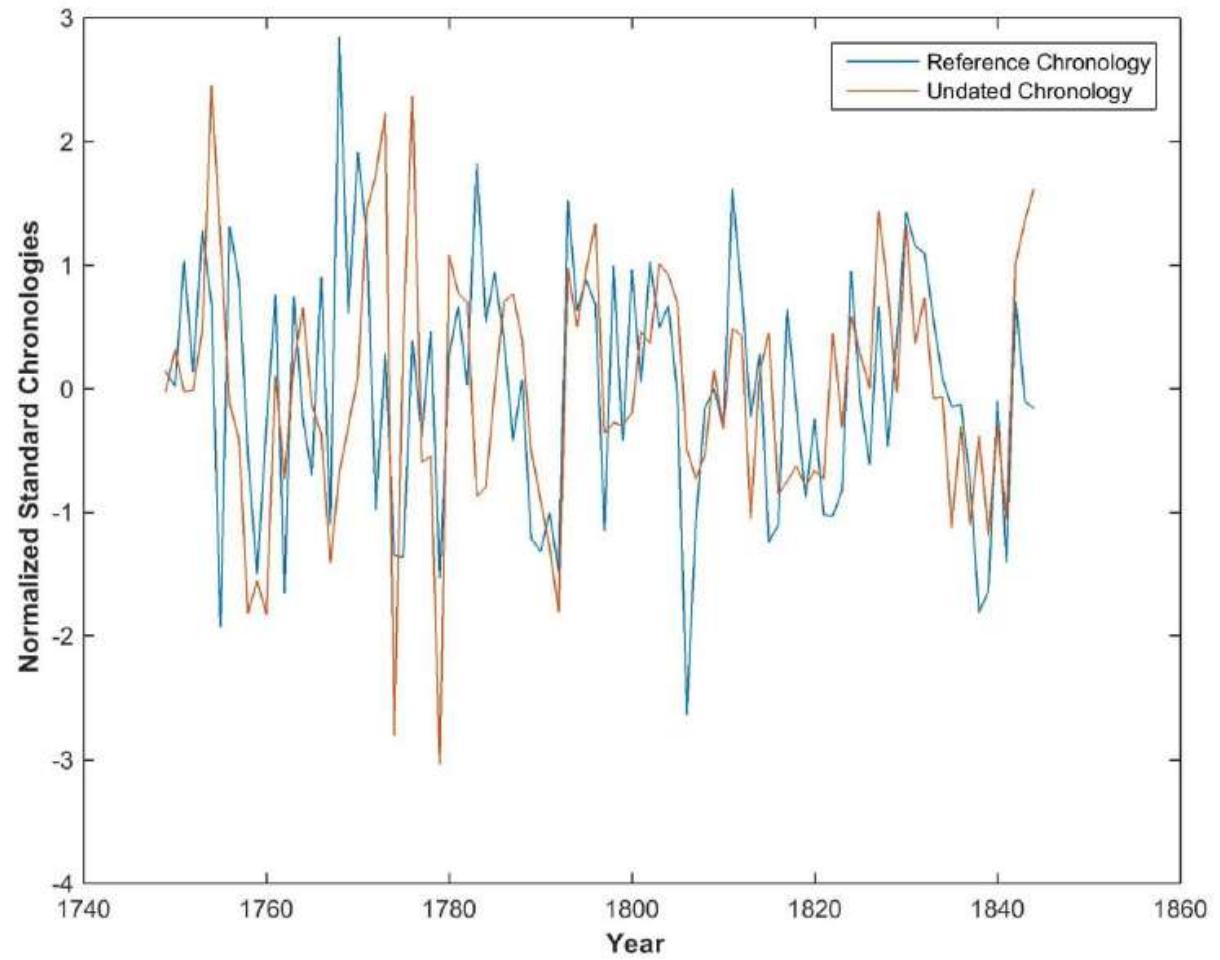
**Farm House Photograph**

The exterior photograph (ca. 1900) shows the changes to roof, walls and portico completed after 1846.

Source: Thomas Jefferson's Poplar Forest Collection

# Dating Historical Structures

- Crossdating Hutter wood samples



## Severe weather events recorded by trees

- Jefferson 1774 letter excerpt:

a frost which destroyed almost every thing. it killed the wheat, rye, corn, many tobacco plants, and even large saplings. the leaves of the trees were entirely killed. all the shoots of vines. at Monticello near half the fruit of every kind was killed; and before this no instance had ever occurred of any fruit killed here by the frost. in all other places in the neighborhood the destruction of fruit was total. this frost was general & equally destructive thro the whole country and the neighboring colonies

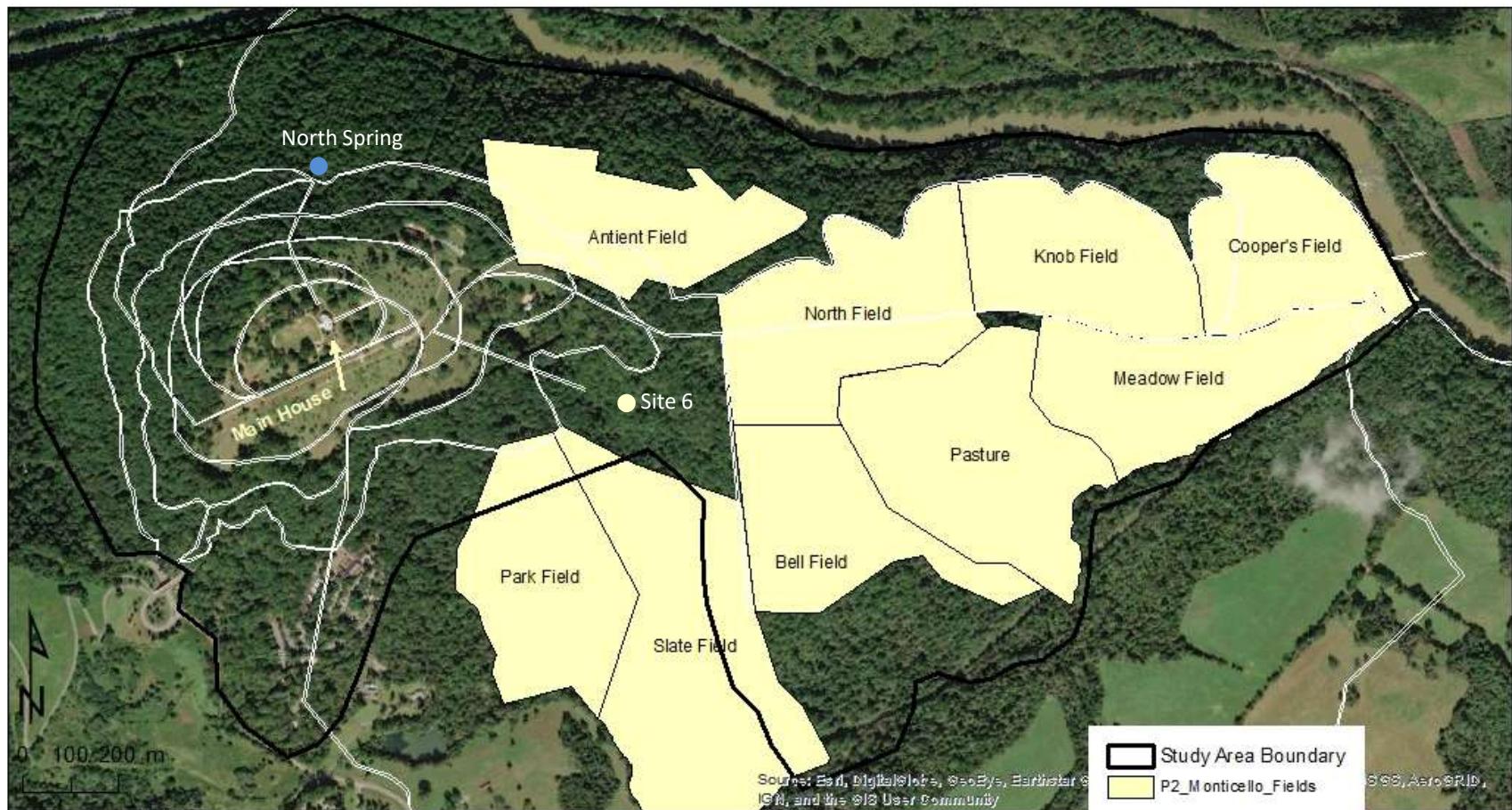


Sample HUT03

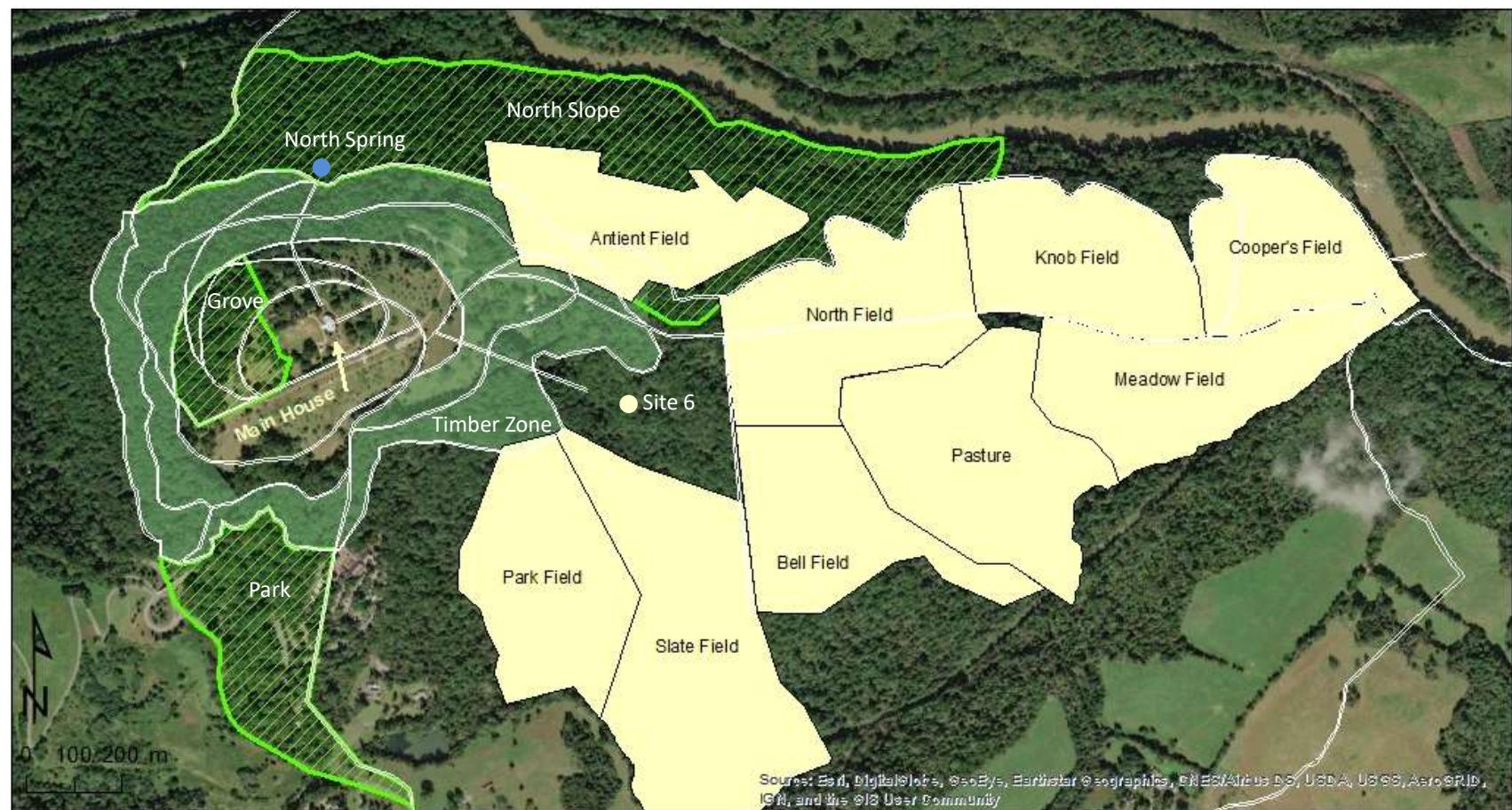
## Monticello with current aerial photograph



# Jefferson's roads and fields with current aerial photograph



# Jefferson-era landscape with current aerial photograph



Pine



Oak



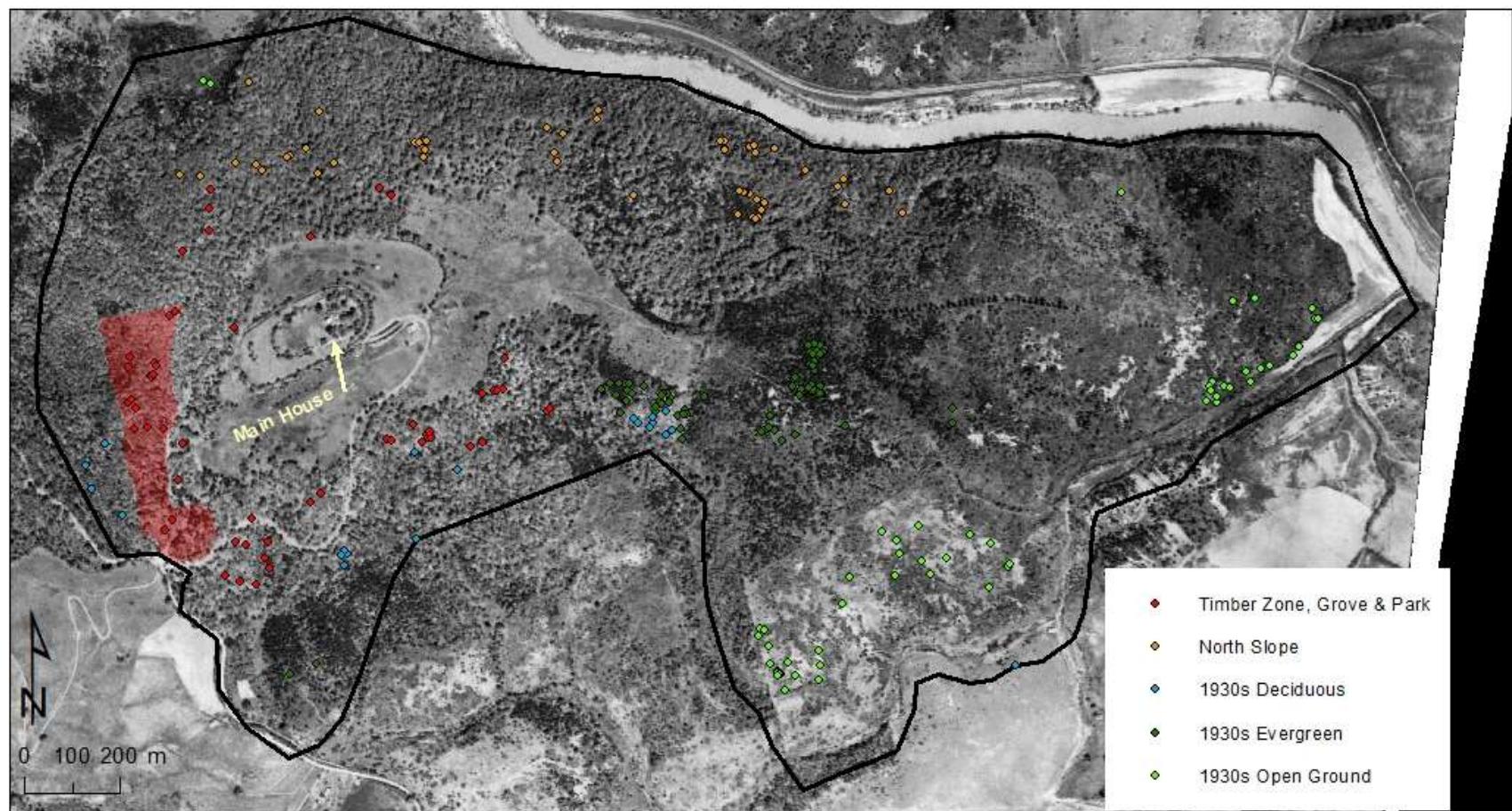
## Monticello with 1937 aerial photograph



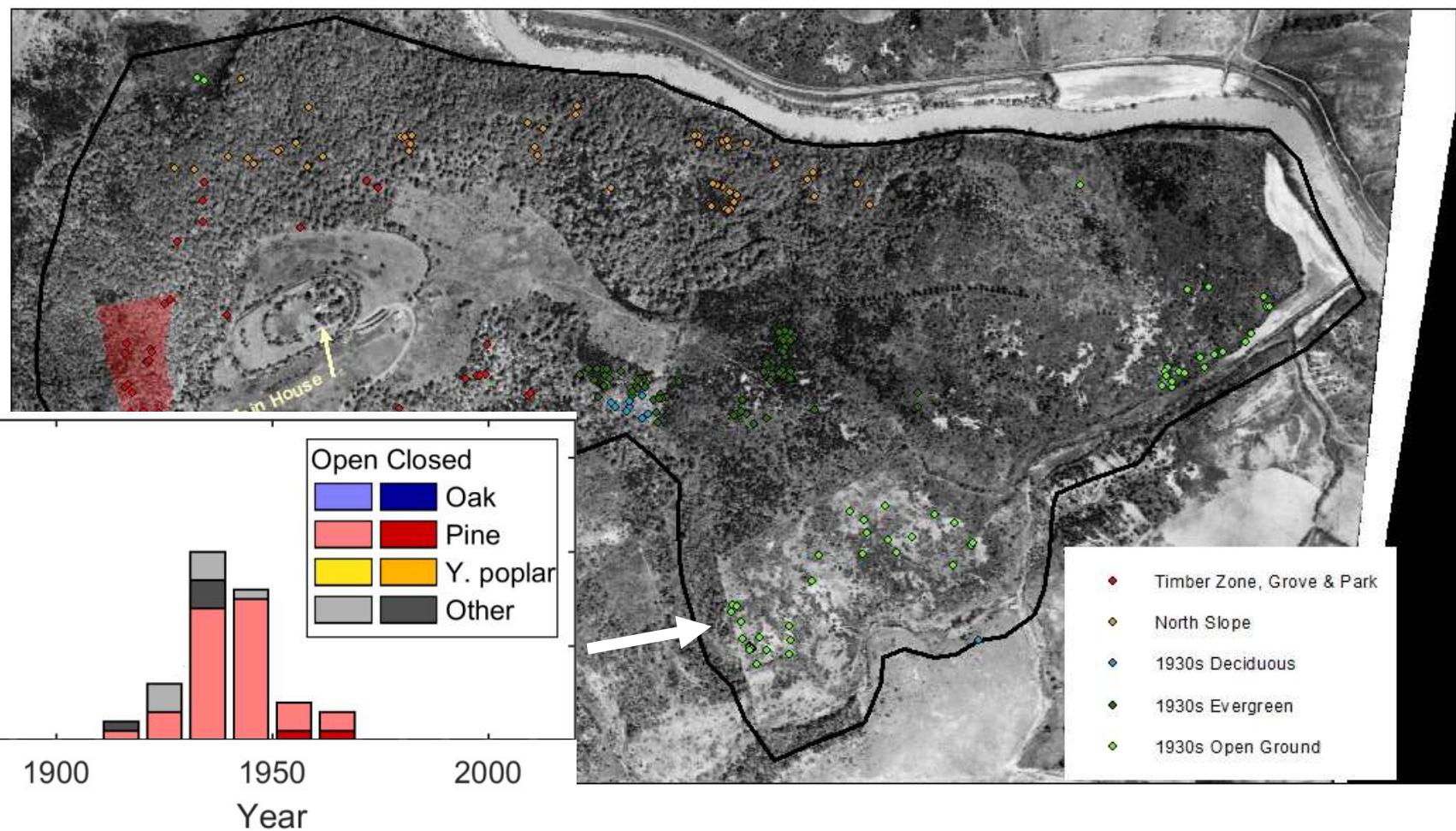
Monticello  
oblique aerial  
photograph circa  
1930



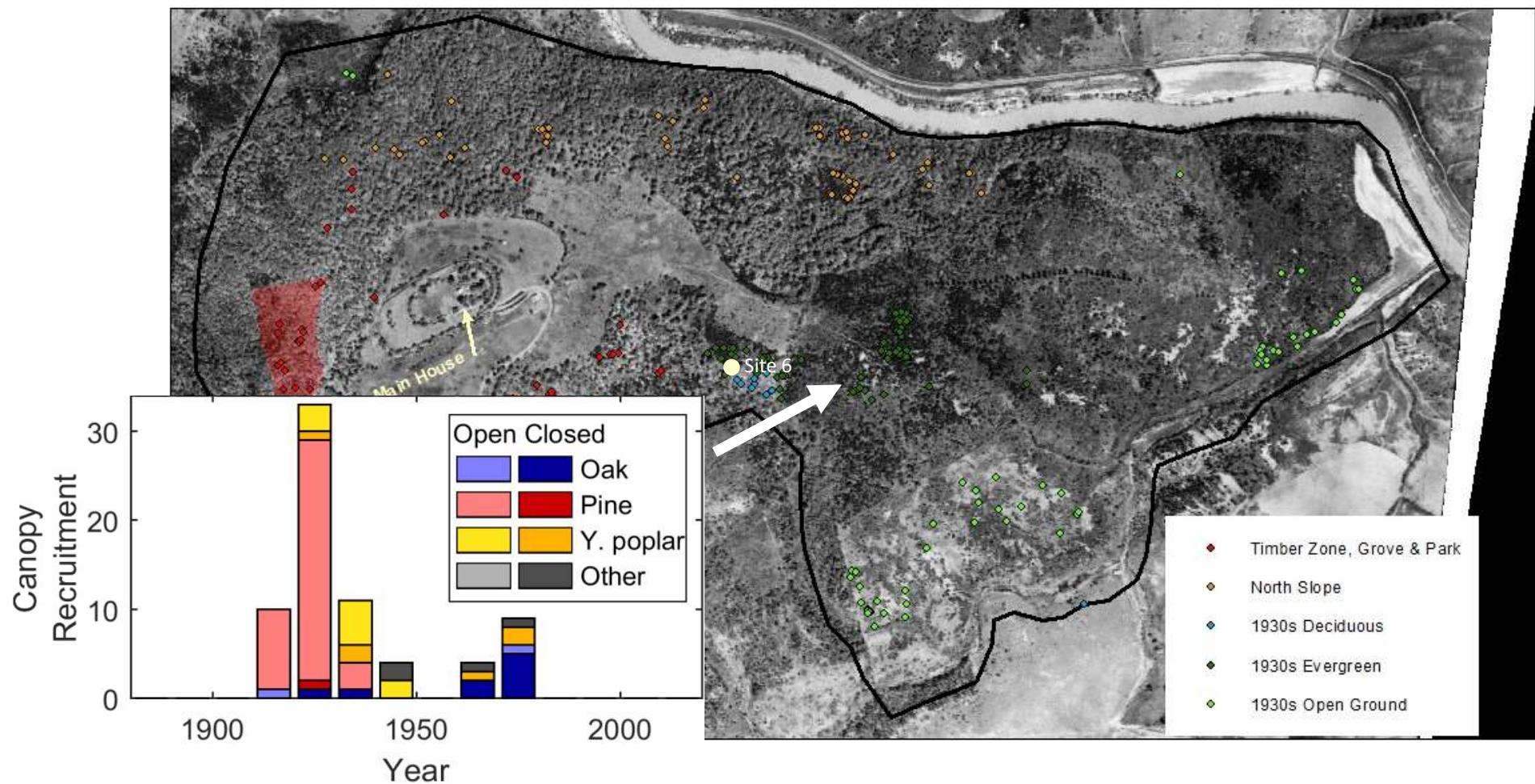
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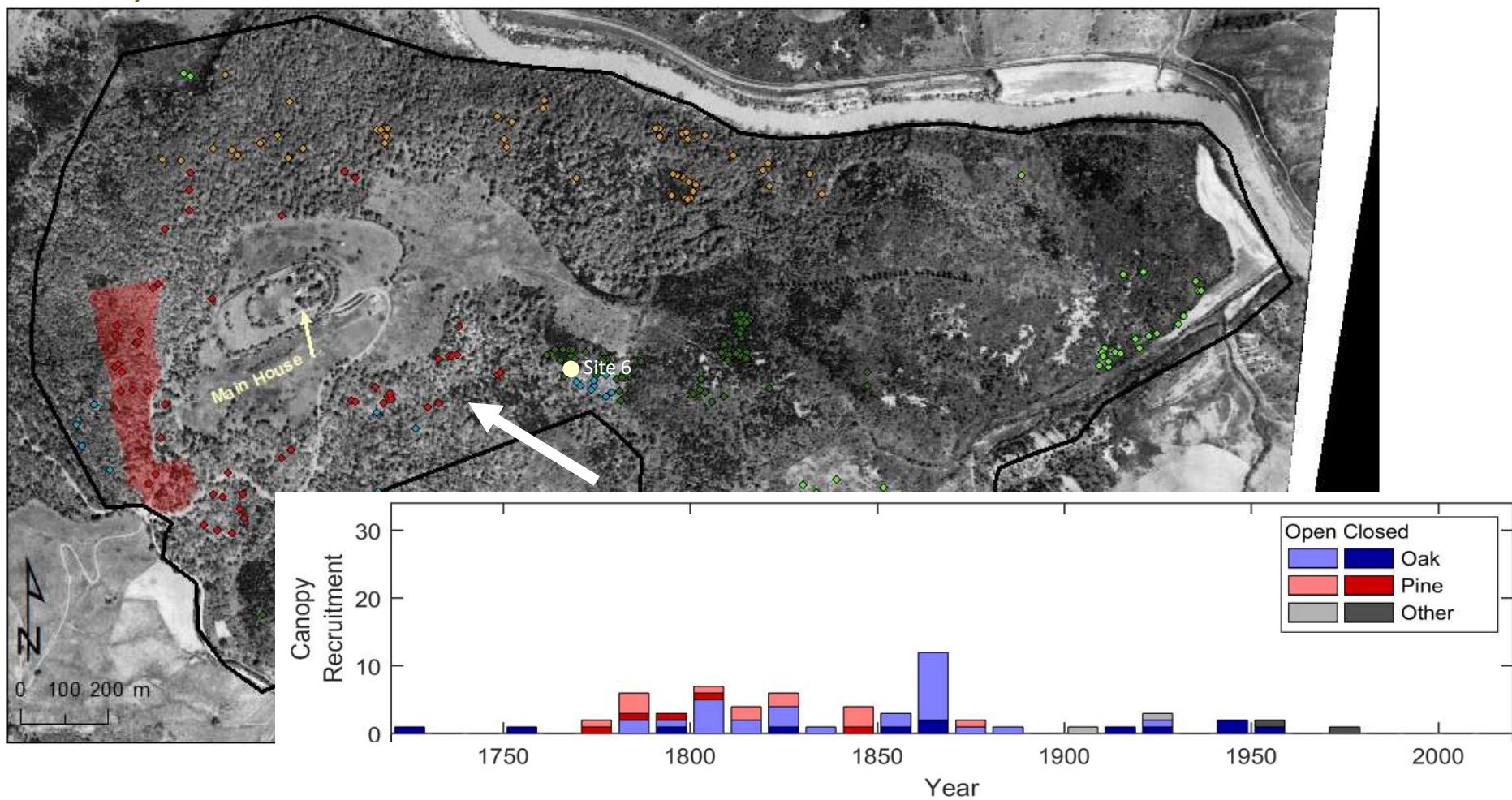
## Monticello with 1937 aerial photograph with trees on open ground



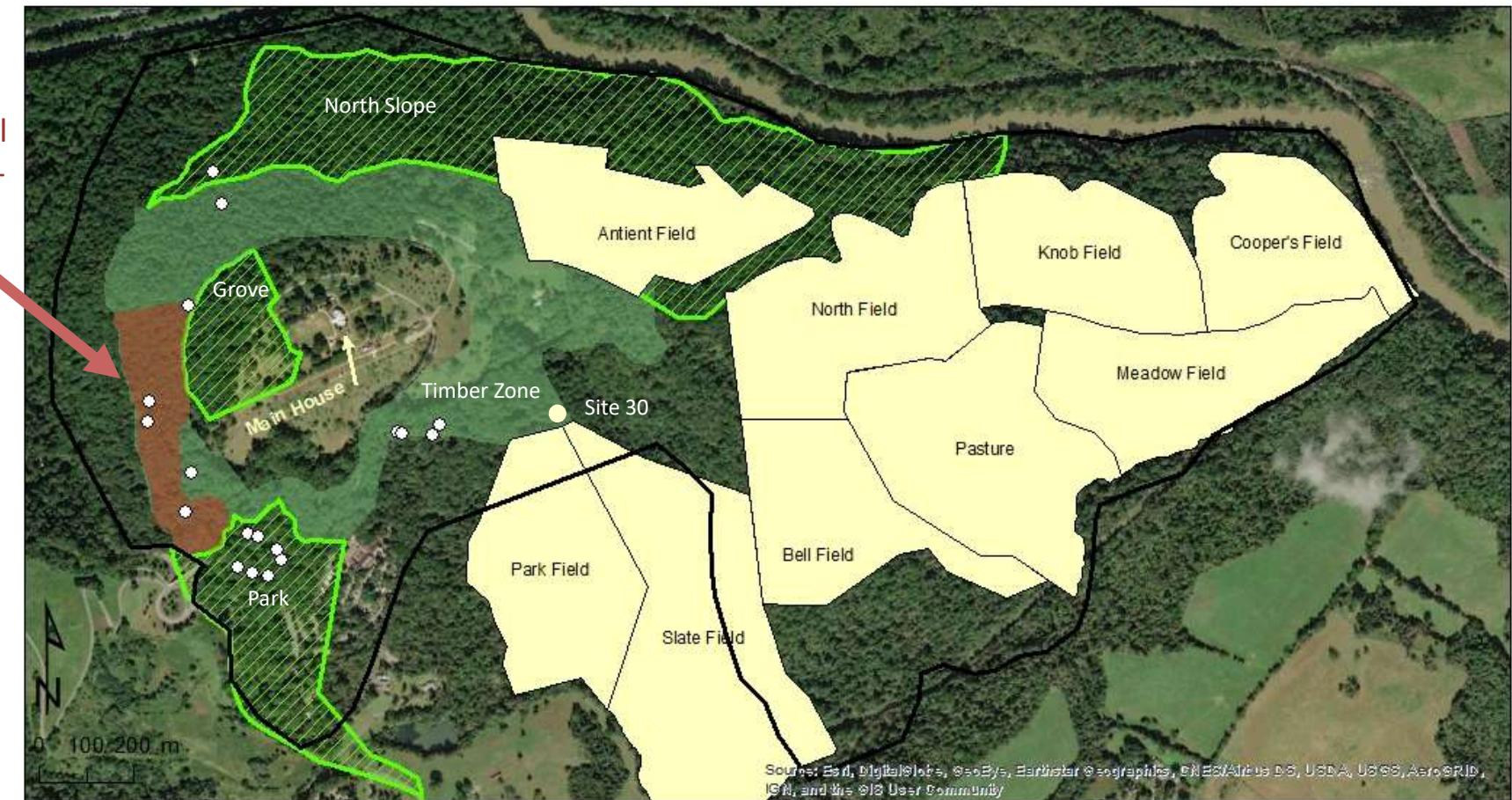
# Monticello with 1937 aerial photograph with trees on evergreen cover



## Monticello with 1937 aerial photograph with trees in Timber Zone, Grove, and Park



## Monticello with Jefferson-era trees and landscape on current aerial



## Draft letter to William Hamilton, Woodlands, Philadelphia

- July, 1806

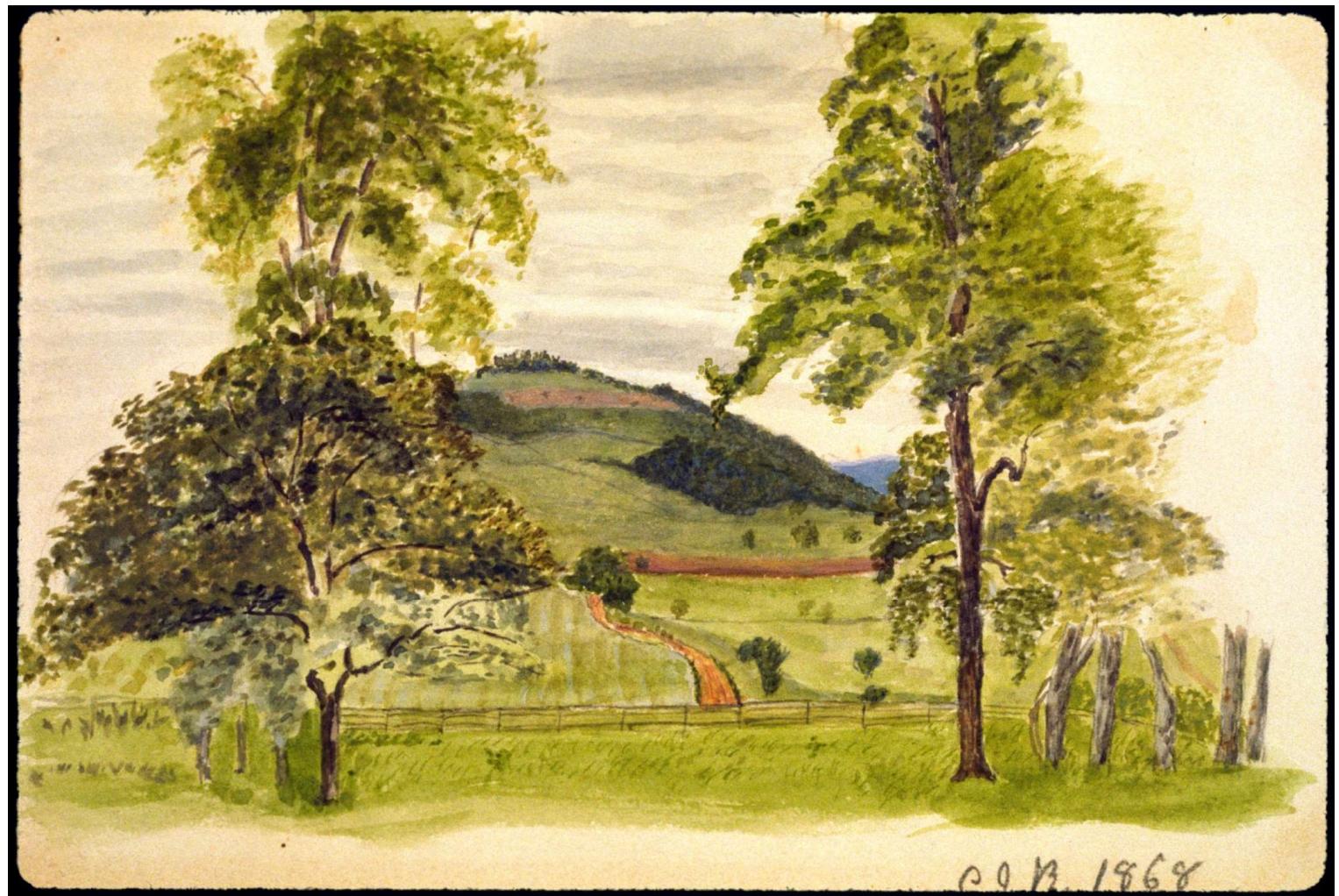
the grounds which I destine to improve in the style of the English gardens... are in a form very difficult to be managed. they compose the Northern quadrant of a mountain for about 2/3 of it's height, & then spread for the upper third over it's whole crown. they contain about 300. acres... they are chiefly still in their native woods, which are majestic, and very generally a close undergrowth, which I have not suffered to be touched, knowing how much easier it is to cut away, than to fill up. the upper third is chiefly open, but to the South is covered with a dense thicket of [Scotch broom].

(Garden Book p322-4. Letter held by Library of Congress.)

## Monticello with current aerial photograph



Circa 1868 painting of Monticello showing agricultural fields



## What can tree-rings tell us about the lives of all people at Monticello?

- Few documentary data from enslaved and Native people

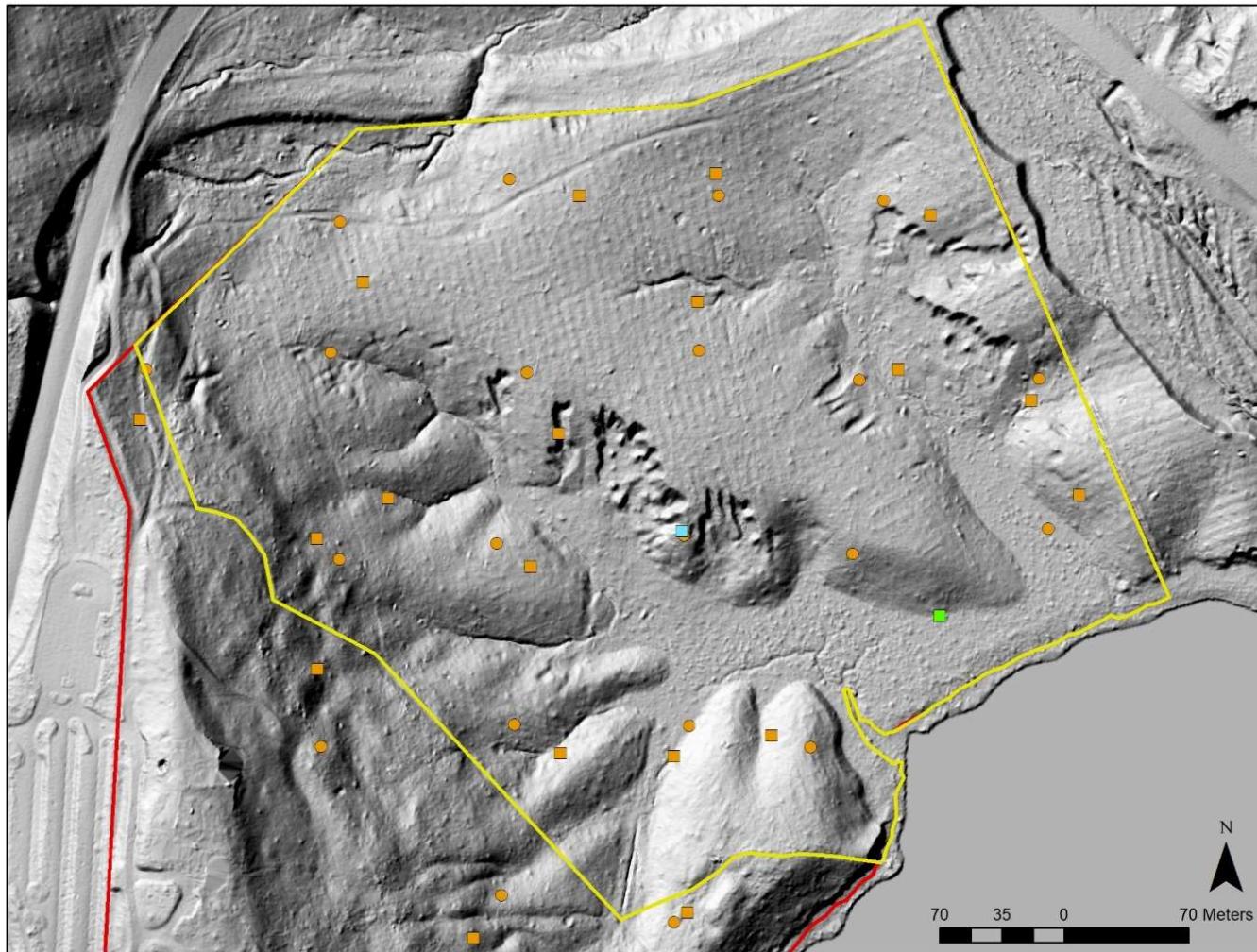
“Mr. Jefferson had a large park at Monticello: built in a sort of a flat on the side of the mountain...”

Isaac Jefferson

- Environmental data provide context for the lives of all people during colonial era and earlier. These data document past land use that may otherwise be forgotten and the legacies of past human land use

# Evidence of past plantation agriculture at Mount Vernon

- LIDAR



# Reference chronologies in North America

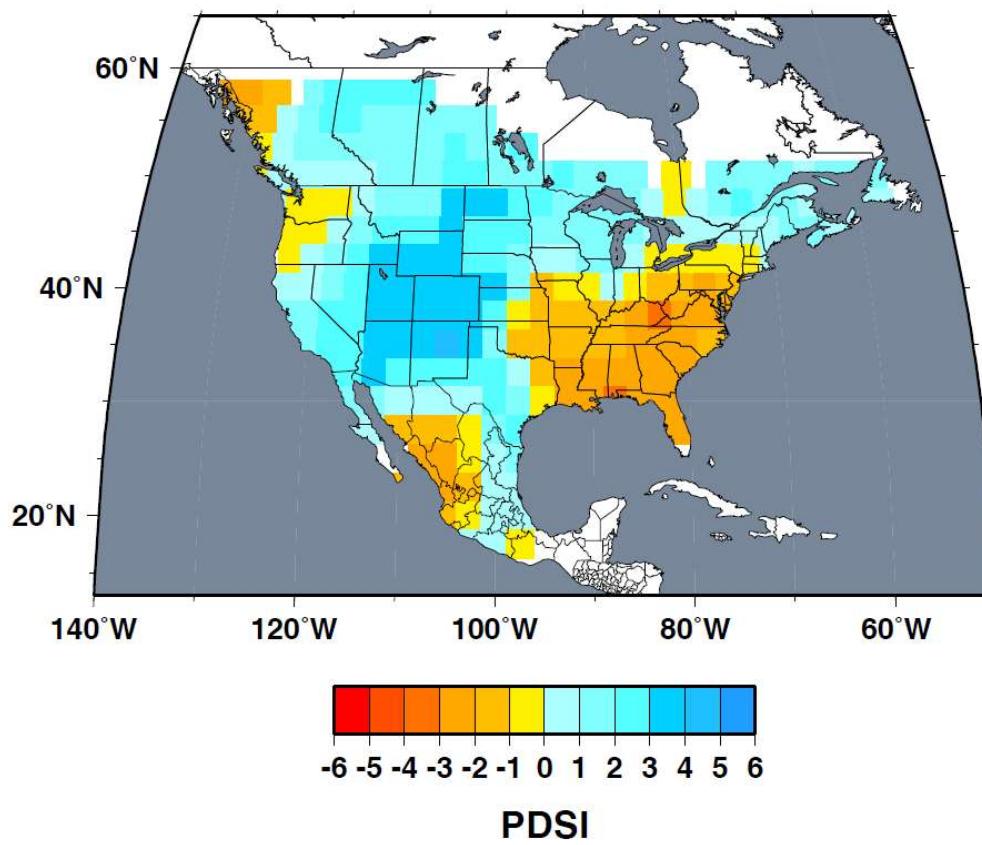


# Drought Atlases – climate over space and time

- Ed Cook

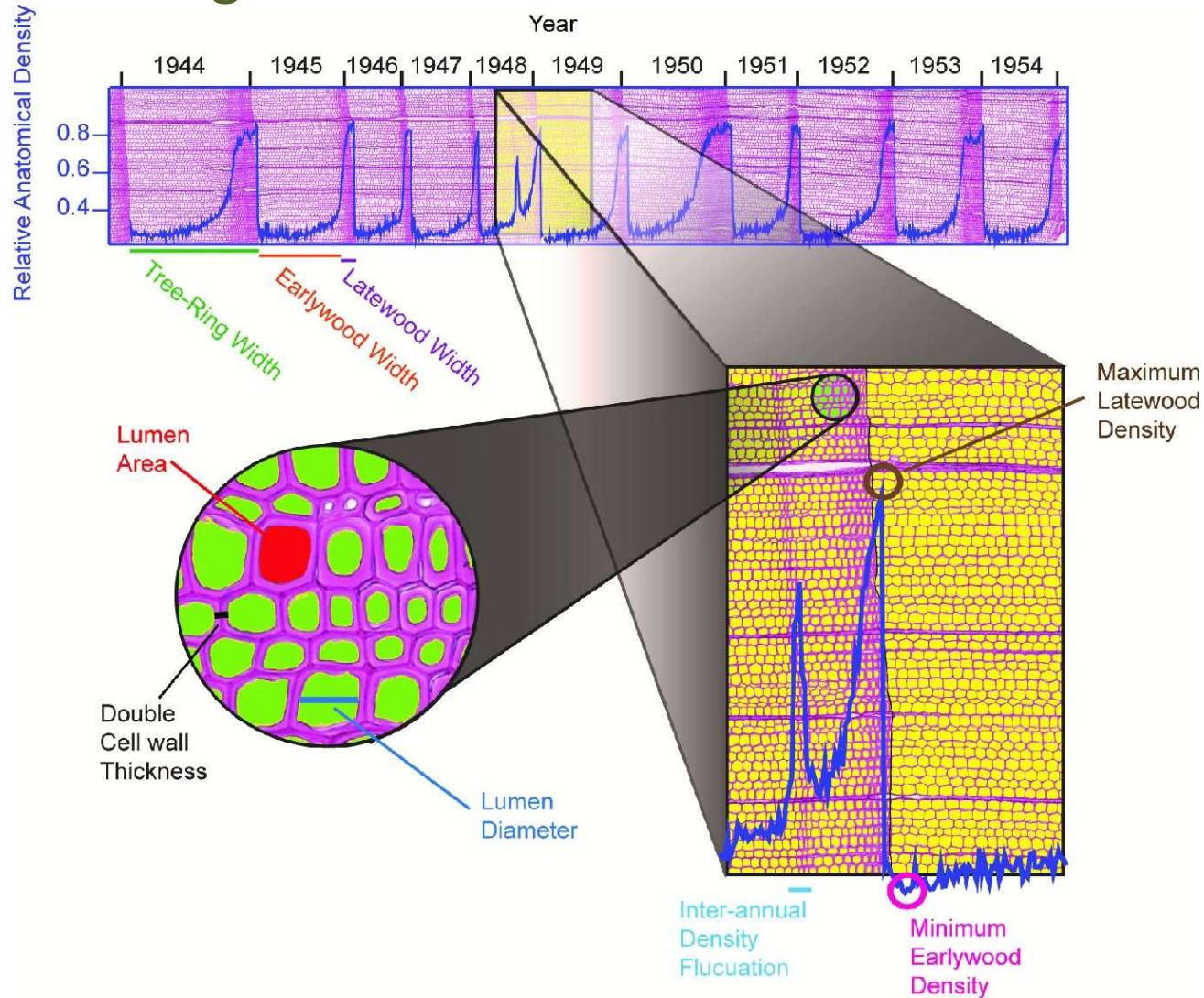
## TREE-RING RECONSTRUCTED DROUGHT

1491



## Other climate proxies from tree-rings

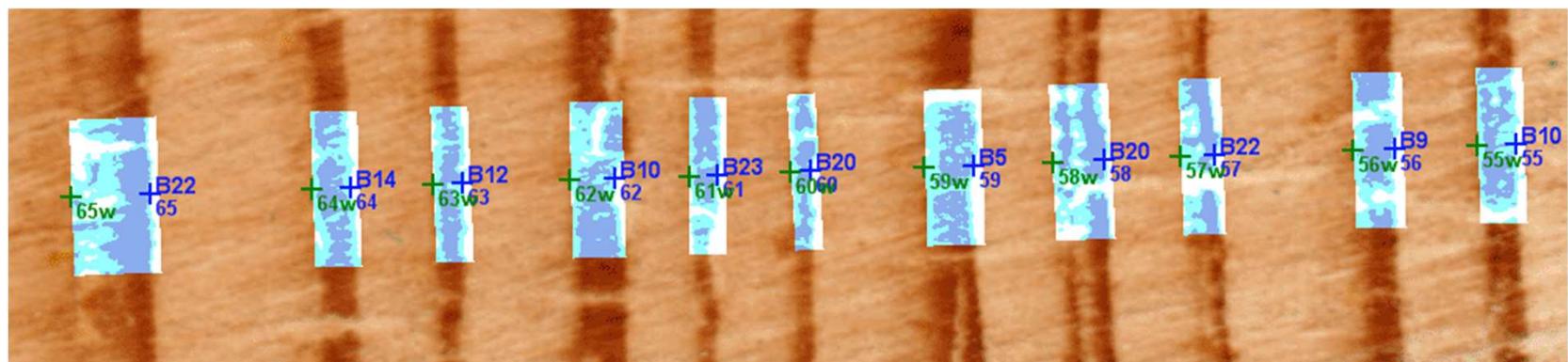
- Latewood density
- Quantitative wood anatomy



Frank et al. 2022. Dendrochronology:  
Fundamentals and Innovations

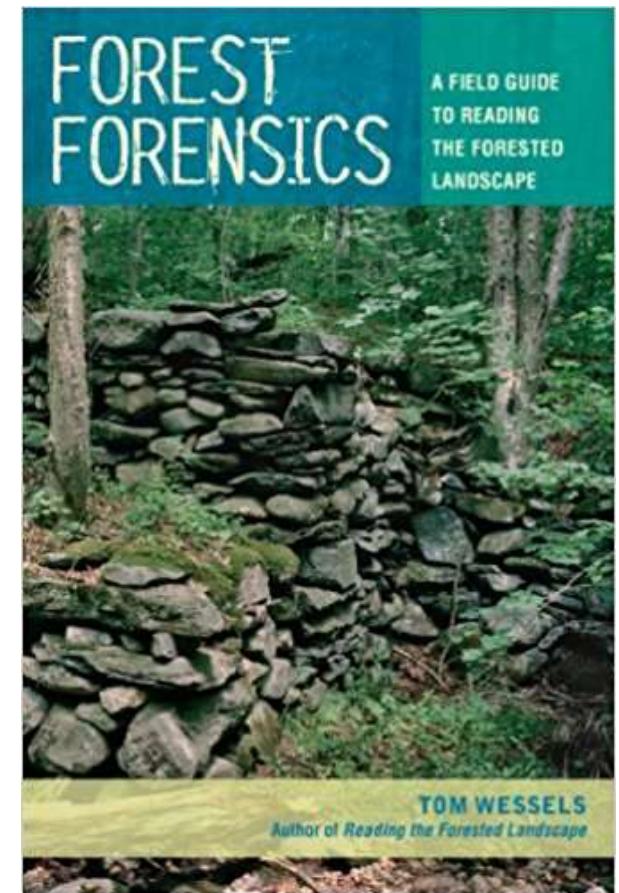
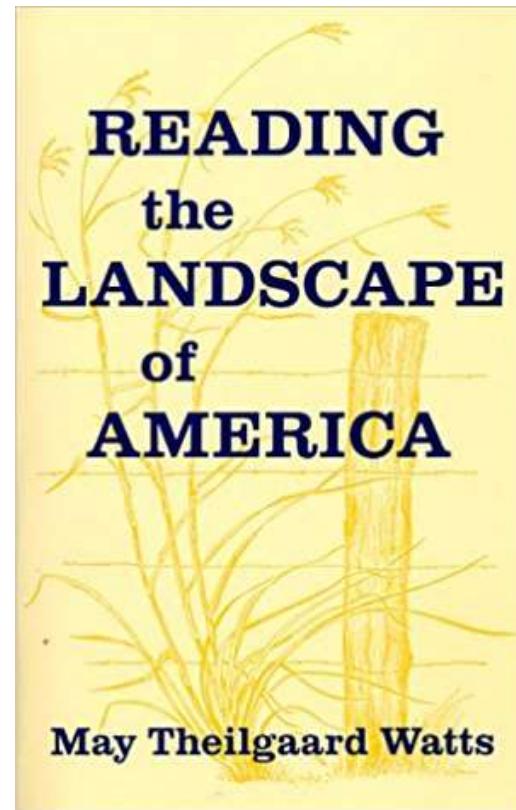
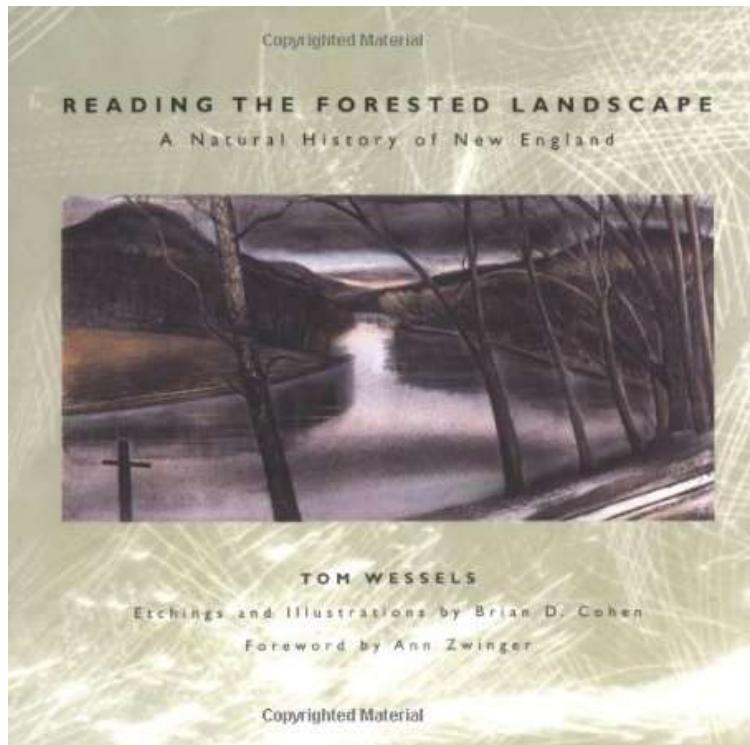
## Other climate proxies from tree-rings

- Latewood density
- Quantitative wood anatomy
- Blue-intensity reflectance



CooRecorder  
[www.cybis.se](http://www.cybis.se)

# Resources for interpreting forest environments



## Resources for interpreting forest environments

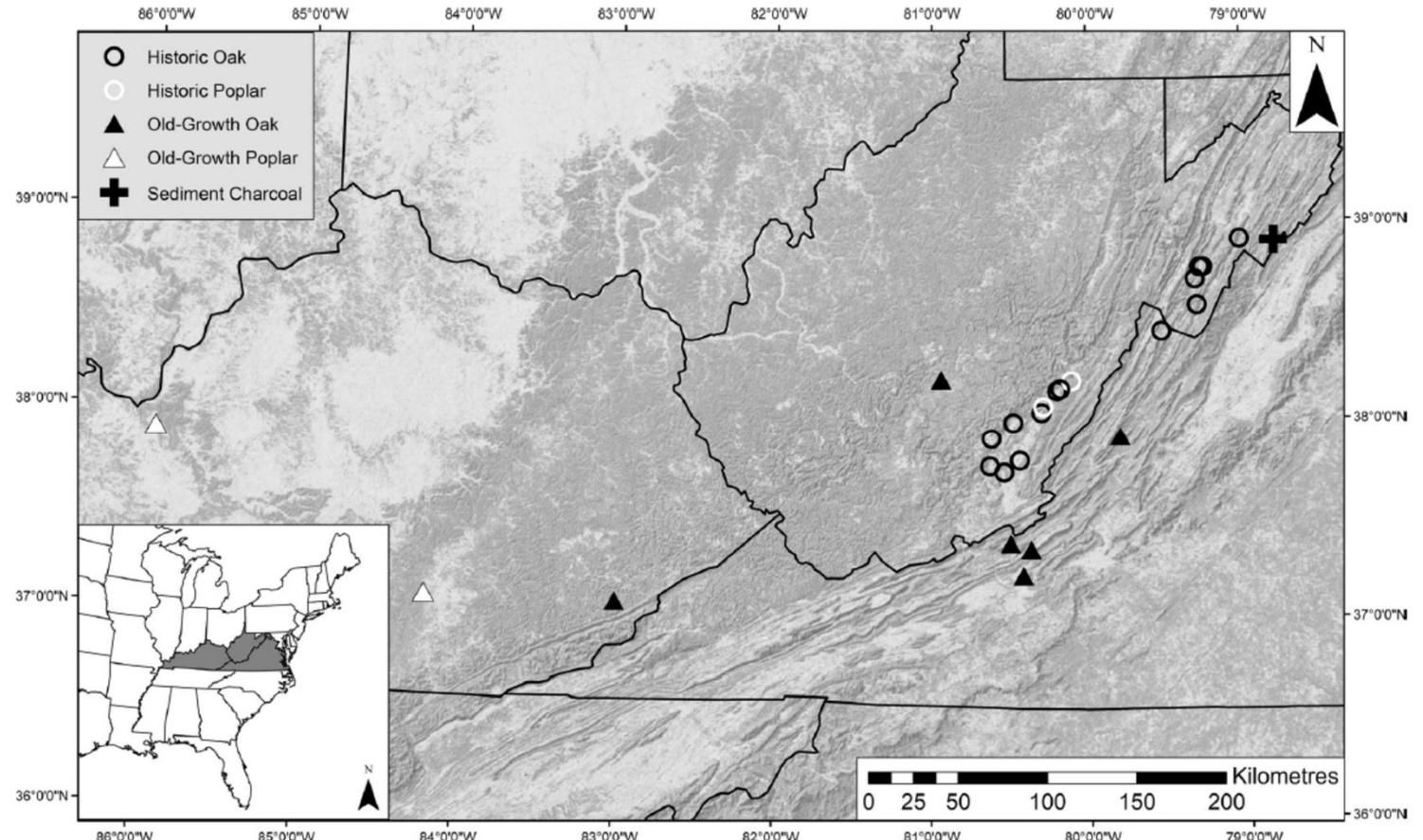


## Acknowledgements

- Edward Cook, Michael Mann, and Camille Wells with initial tree-ring sampling
- William Beiswanger, Peter Hatch, Hank Shugart, and Neil Pederson for scientific and historical advice
- Monticello Archaeology Field School, Longwood University, and Rider University students assisted with field or lab work, particularly Allison Ingram, Cindy Brinkler, Jason Dallas, Heather Sluzar, Joseph Snider, and Rachel Young.
- Thomas Jefferson Foundation and Rider University for their support of research at Monticello

# Evidence of past Native American agriculture in the Appalachians?

- Kristen de Graauw and Amy Hessl (2022). *J. of Biogeography*



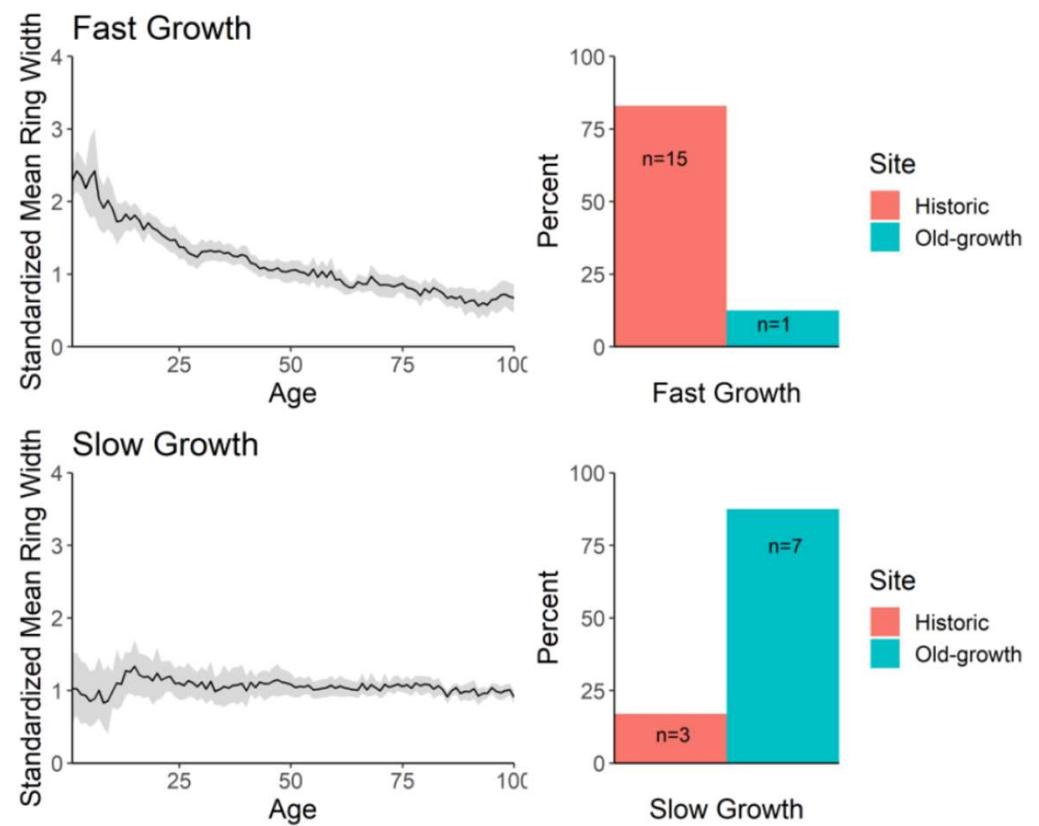
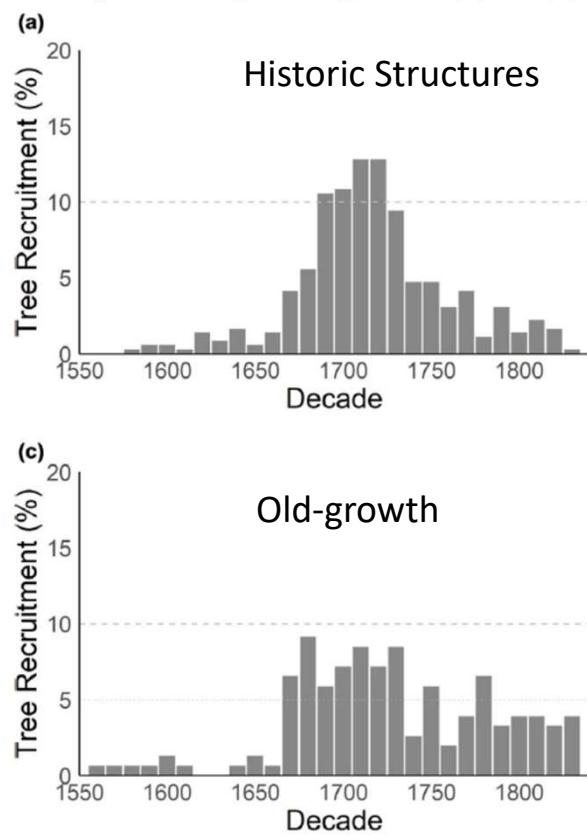
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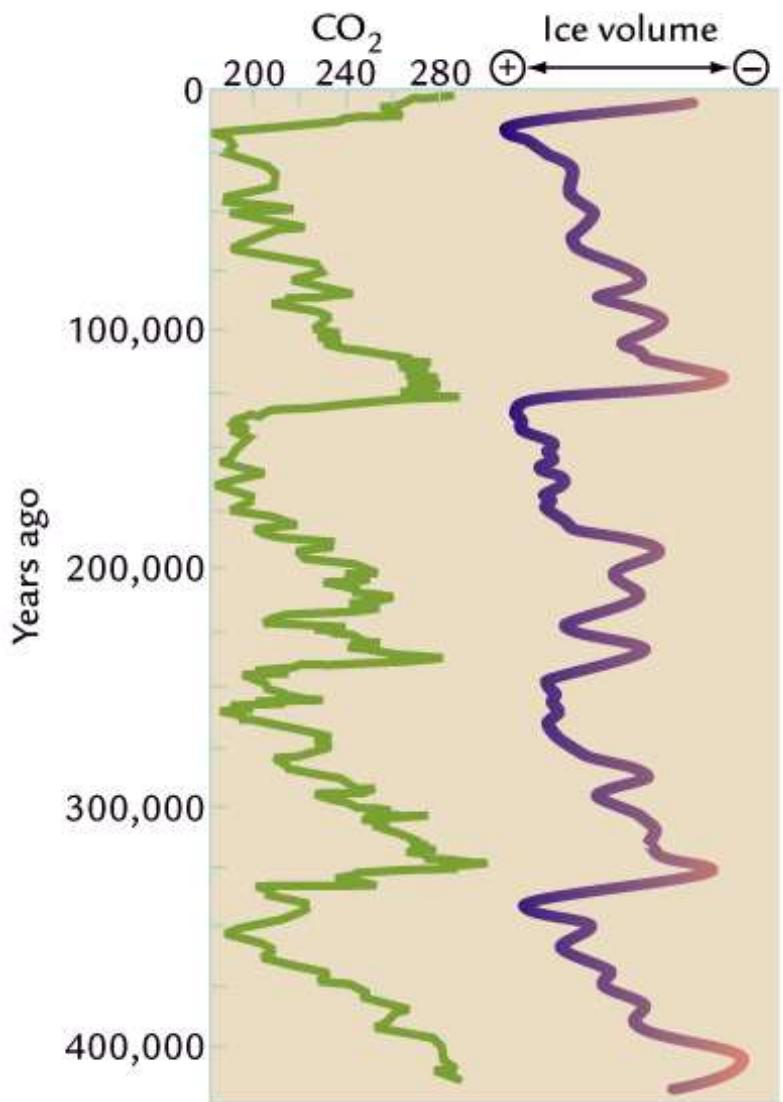
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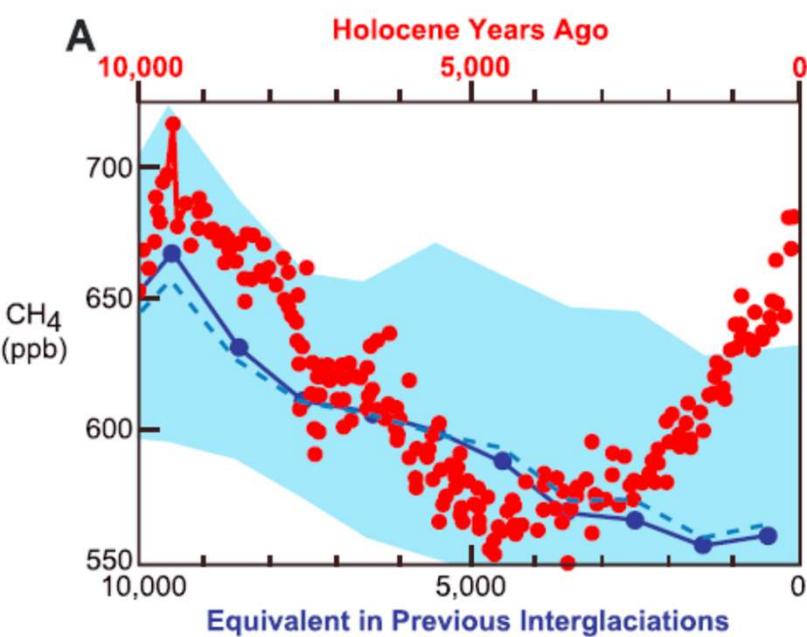
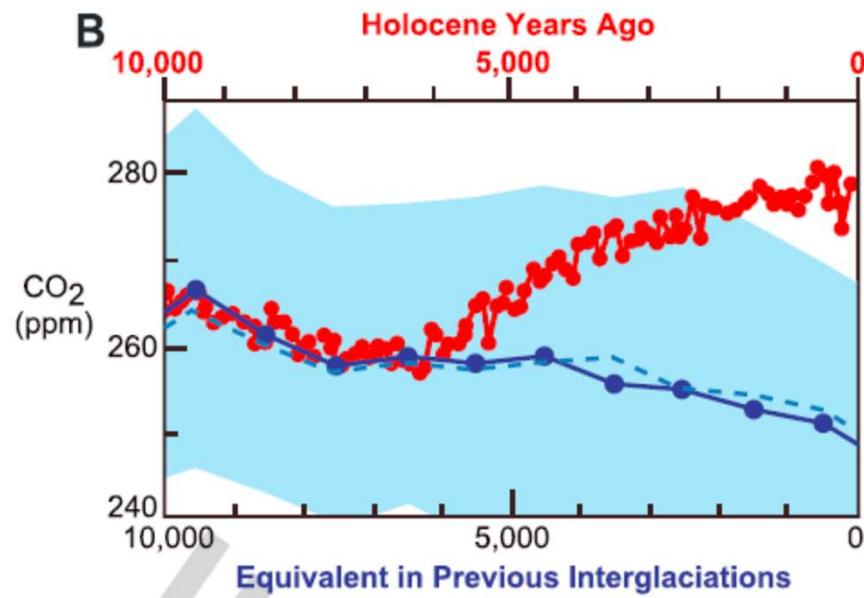
## Past Land Use and Climate Change

- Ruddiman et al. (2016) *Reviews of Geophysics*



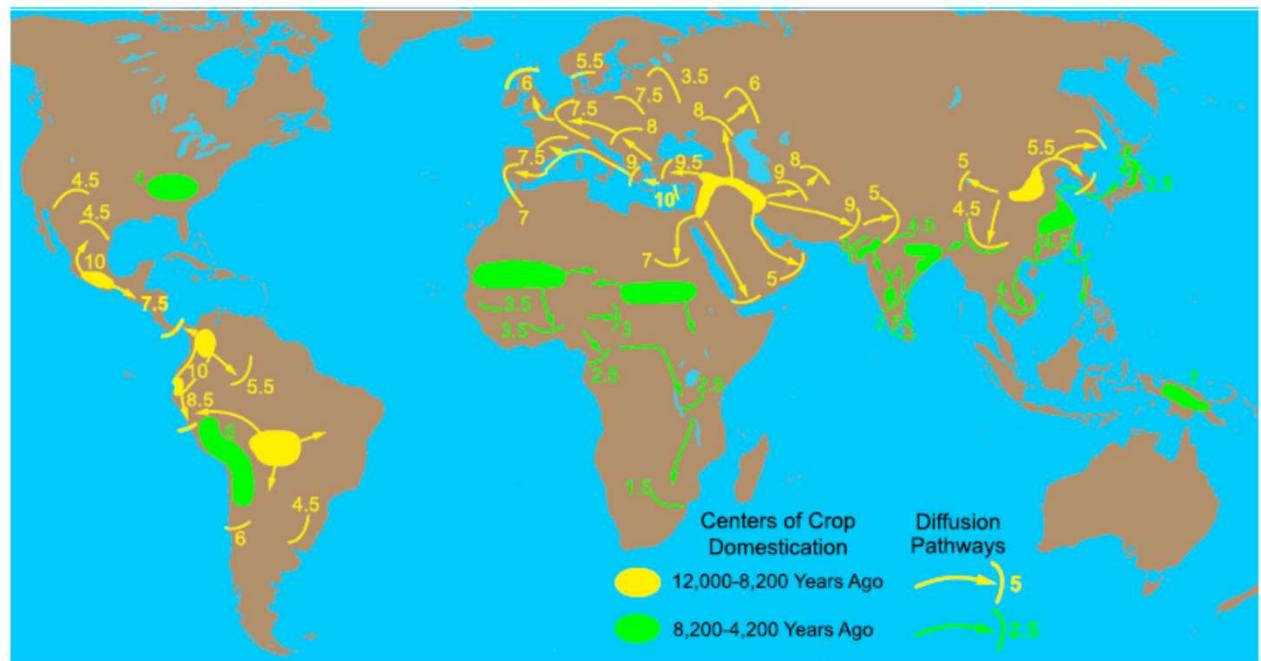
# Early Human Impacts on Climate Change?

- Ruddiman et al. (2016) *Reviews of Geophysics*



# Early Human Impacts on Climate Change?

- Ruddiman et al. (2016) *Reviews of Geophysics*
  - Multiple origins of agriculture and Early Anthropogenic Hypothesis



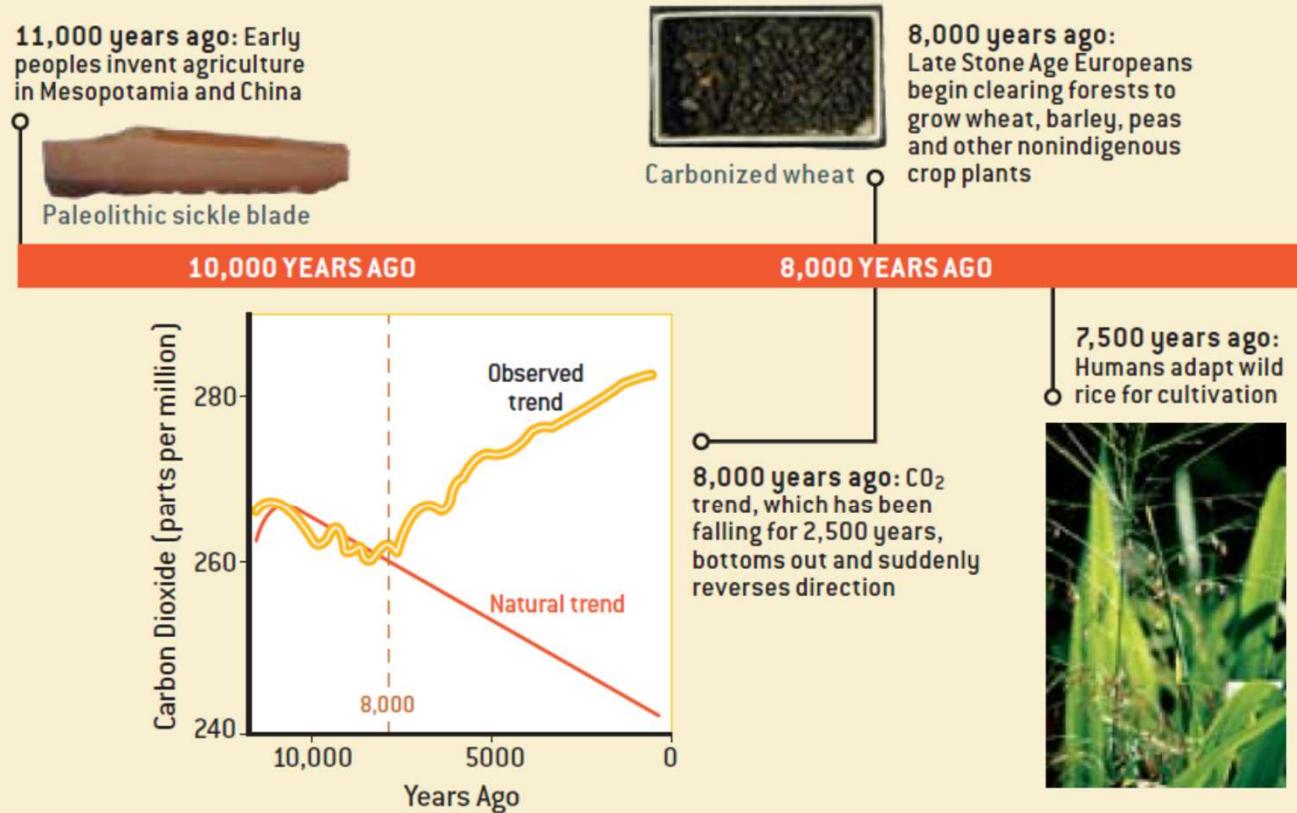
**Figure 6.** The spread of agricultural crops. Domesticated crops originated during the early Holocene from 12,000 to 8200 years ago and in the middle Holocene from 8200 to 4200 years ago [Fuller et al., 2014; Larson et al., 2014]. Numbers along dispersion pathways represent ages in thousands of years.

# Early Human Impacts on Climate Change?

- Ruddiman (2005) *American Scientist*: Early Anthropogenic Hypothesis

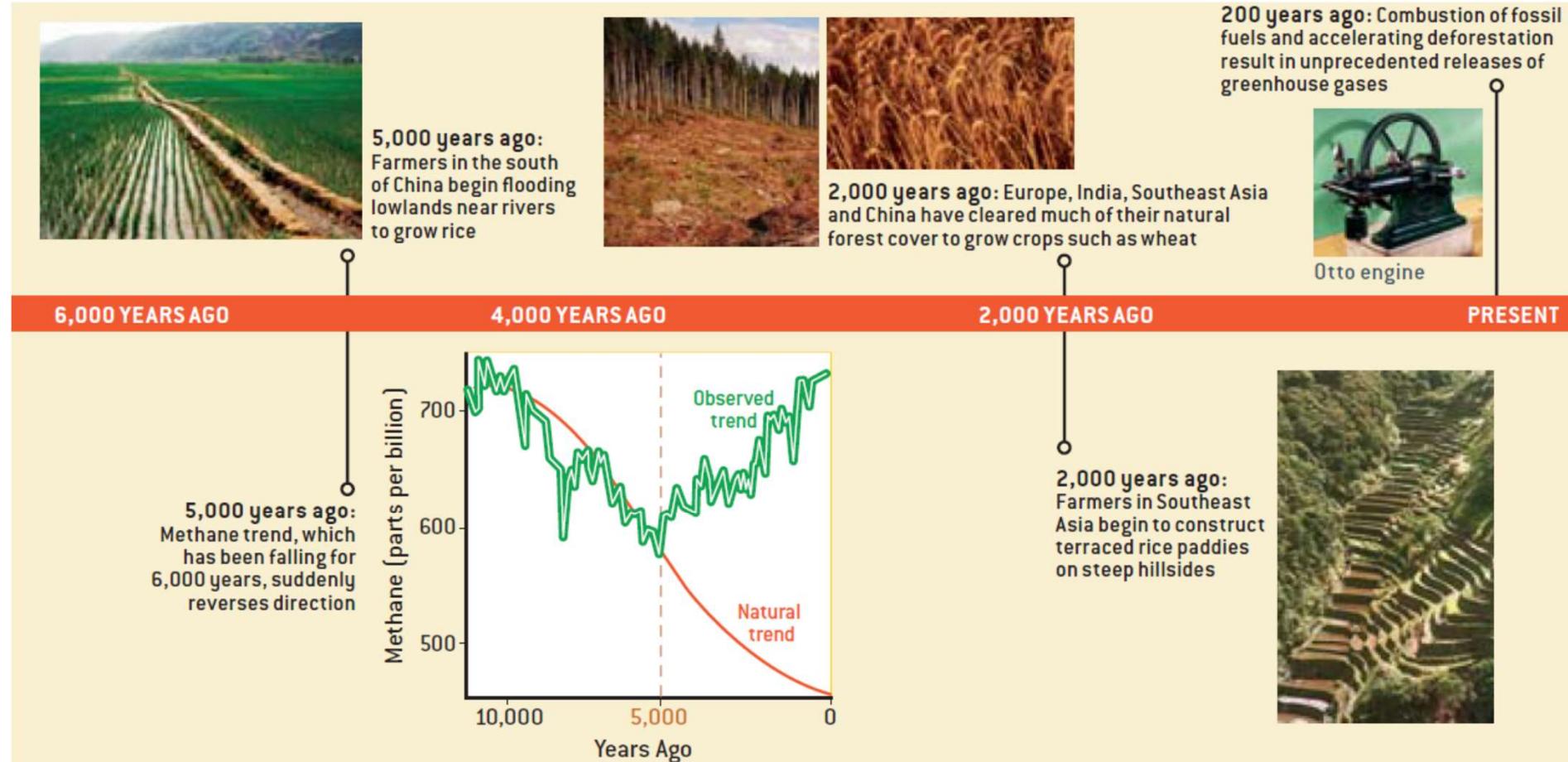
## Human Activities and Greenhouse Gases

Our human ancestors invented agriculture about 11,000 years ago—around the same time that atmospheric concentrations of methane and CO<sub>2</sub> peaked in the wake of the last ice age. Had the gas trends subsequently mimicked older interglacial intervals, as expected, they would have fallen right up through the start of the industrial era. Instead the declining trends of both gases reversed direction several thousand years ago and have risen steadily ever since. The timing of key agricultural innovations—namely, deforestation and rice irrigation—may explain these surprising reversals. —W.F.R.



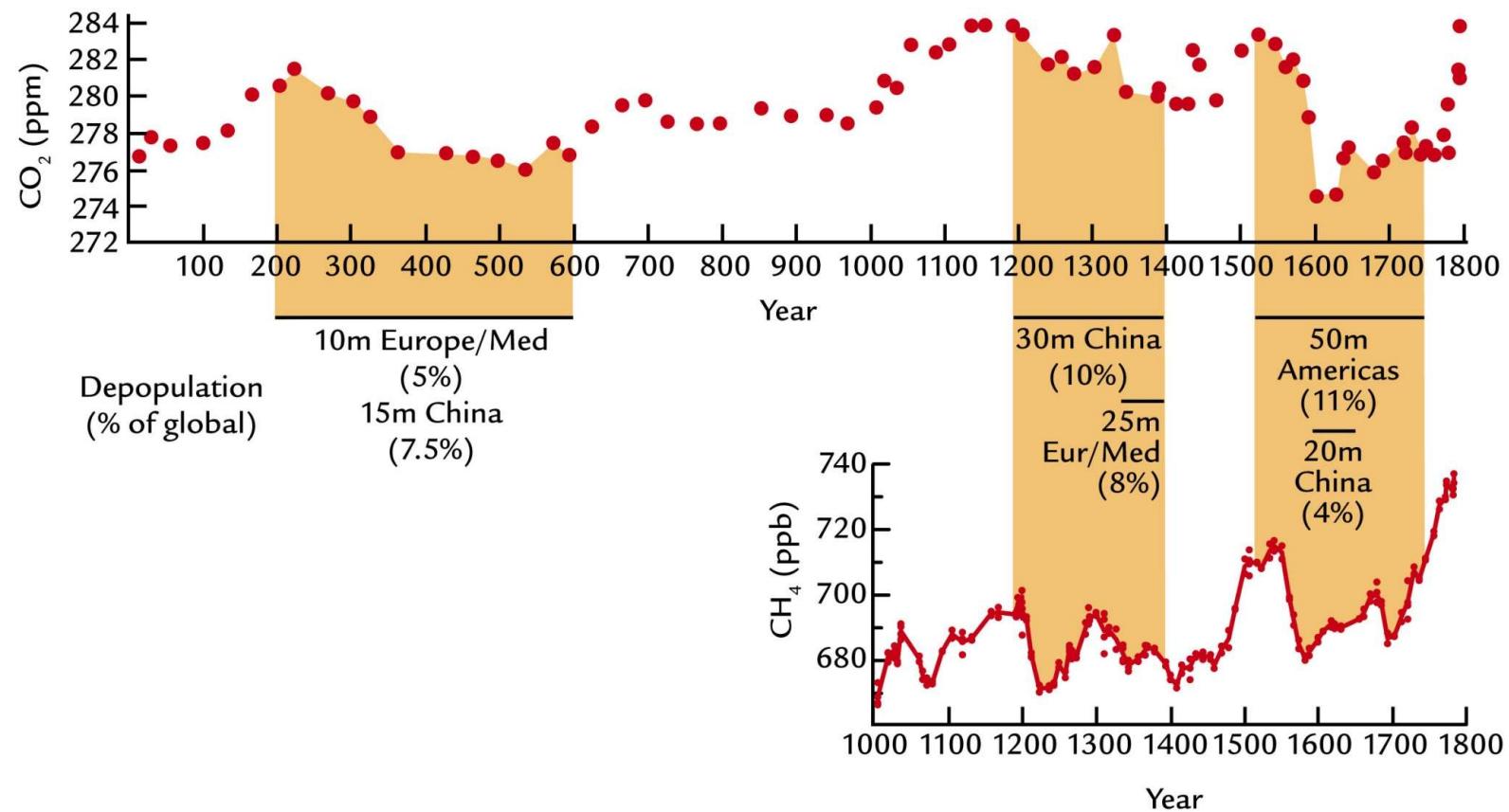
# Early Human Impacts on Climate Change?

- Ruddiman (2005) *American Scientist*: Early Anthropogenic Hypothesis



# Early Human Impacts on Climate Change?

- Disease?

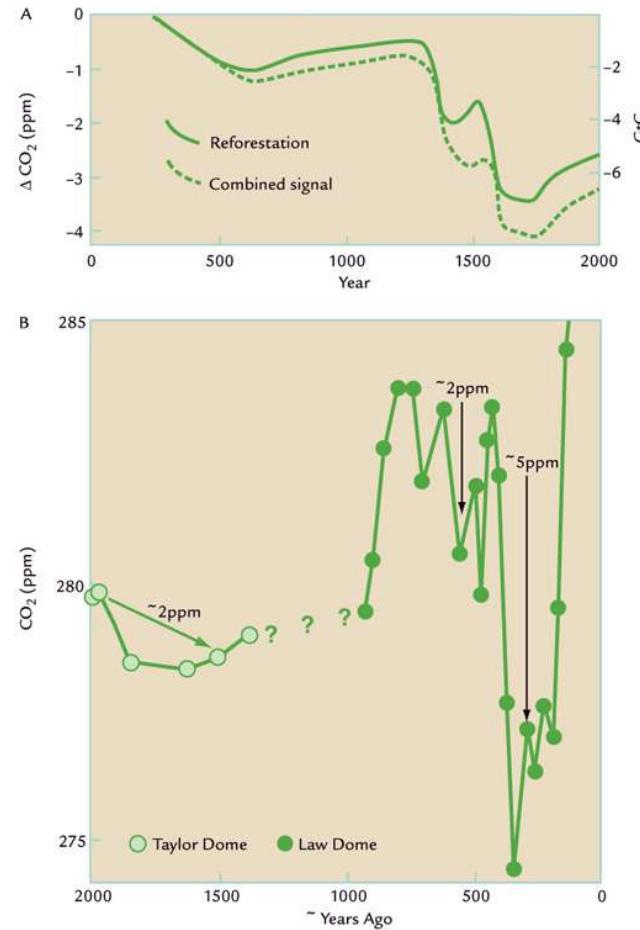


# Early Human Impacts on Climate Change?

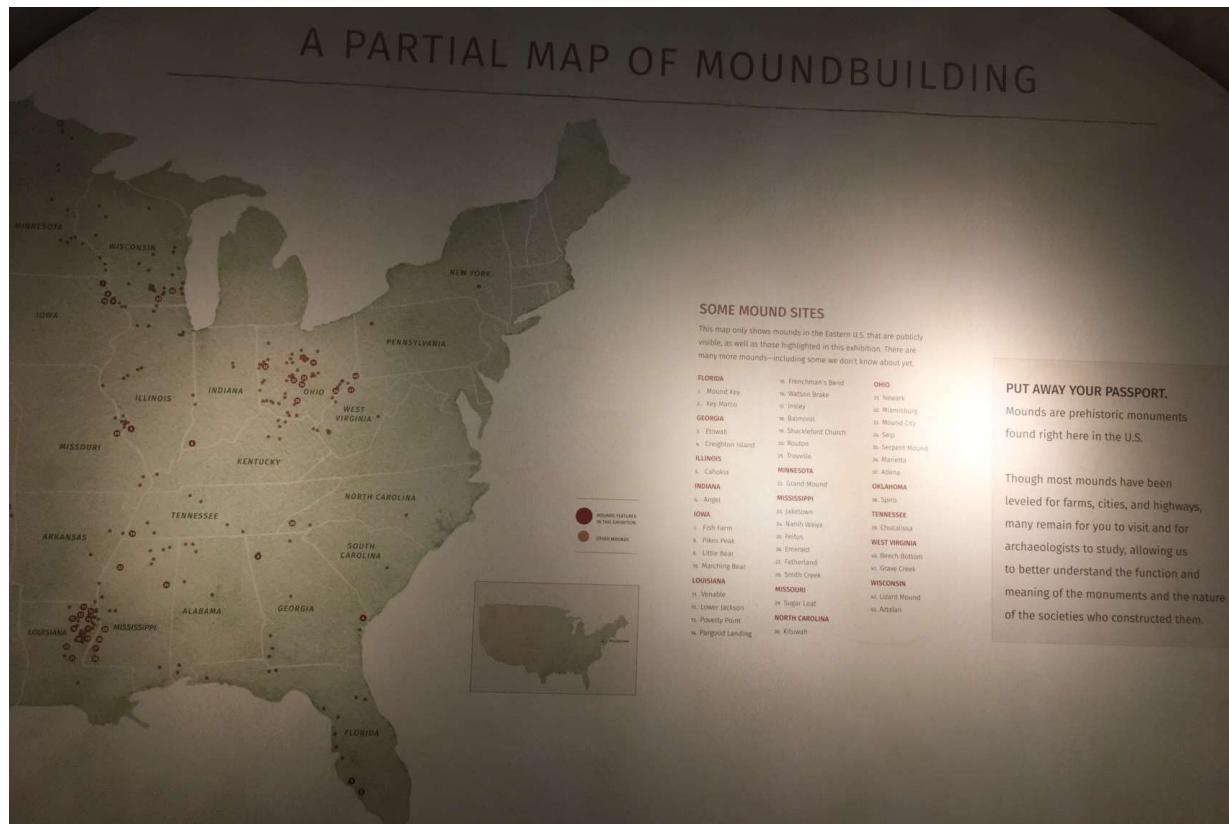
- Cause of Little Ice Age?



Hernán Cortés  
invasion route  
into Mexico



# Early Human Impacts on Climate Change?



# Penn Museum

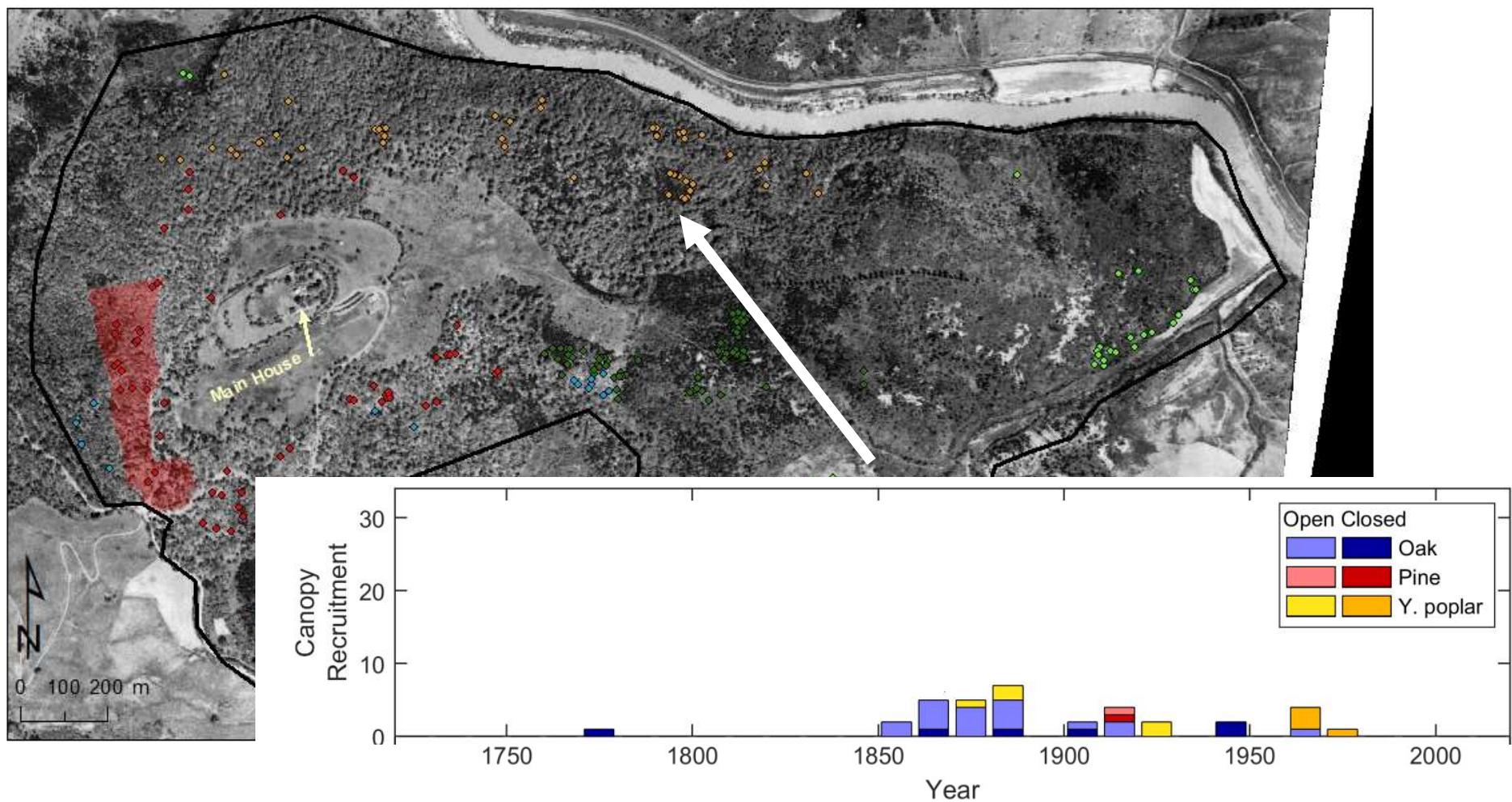
## Further Reading

- Druckenbrod, Daniel L., Fraser D. Neiman, David L. Richardson, and Derek Wheeler. "Land-Use Legacies in Forests at Jefferson's Monticello Plantation." *Journal of Vegetation Science* 29, no. 2 (2018): 307–16. <https://doi.org/10.1111/jvs.12599>
- Druckenbrod, Daniel L., and Nicole Chakowski. "Dendrochronological Dating of Two Tulip Poplars on the West Lawn of Monticello." *Tree-Ring Research* 70, no. 1 (January 1, 2014): 41–48. <https://doi.org/10.3959/1536-1098-70.1.41>
- Cook, E.R., and L.A. Kairiukstis, eds. *Methods of Dendrochronology*. Netherlands: International Institute for Applied Systems Analysis, 1990.

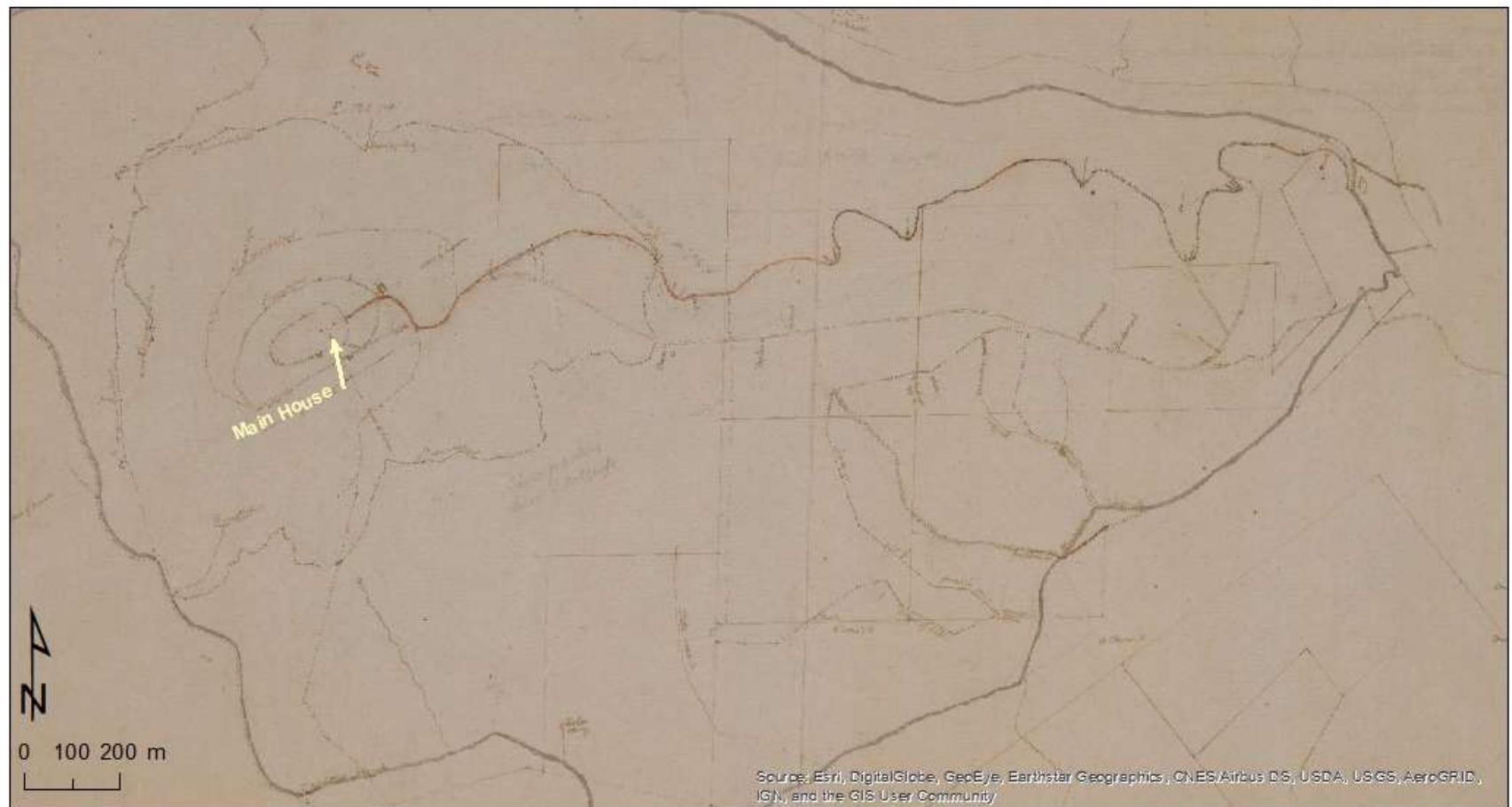


## Extra slides

## Monticello with 1937 aerial photograph with trees on north slope



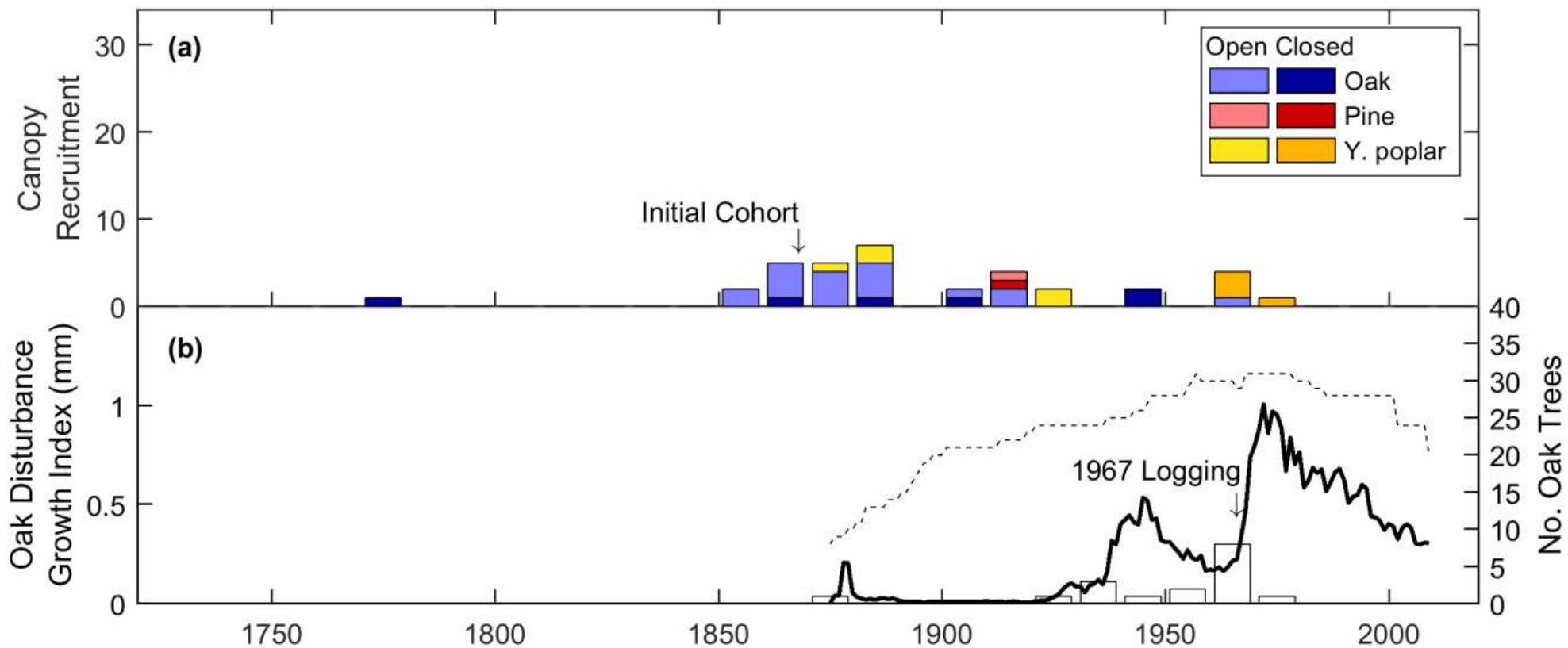
# Monticello survey by Thomas Jefferson



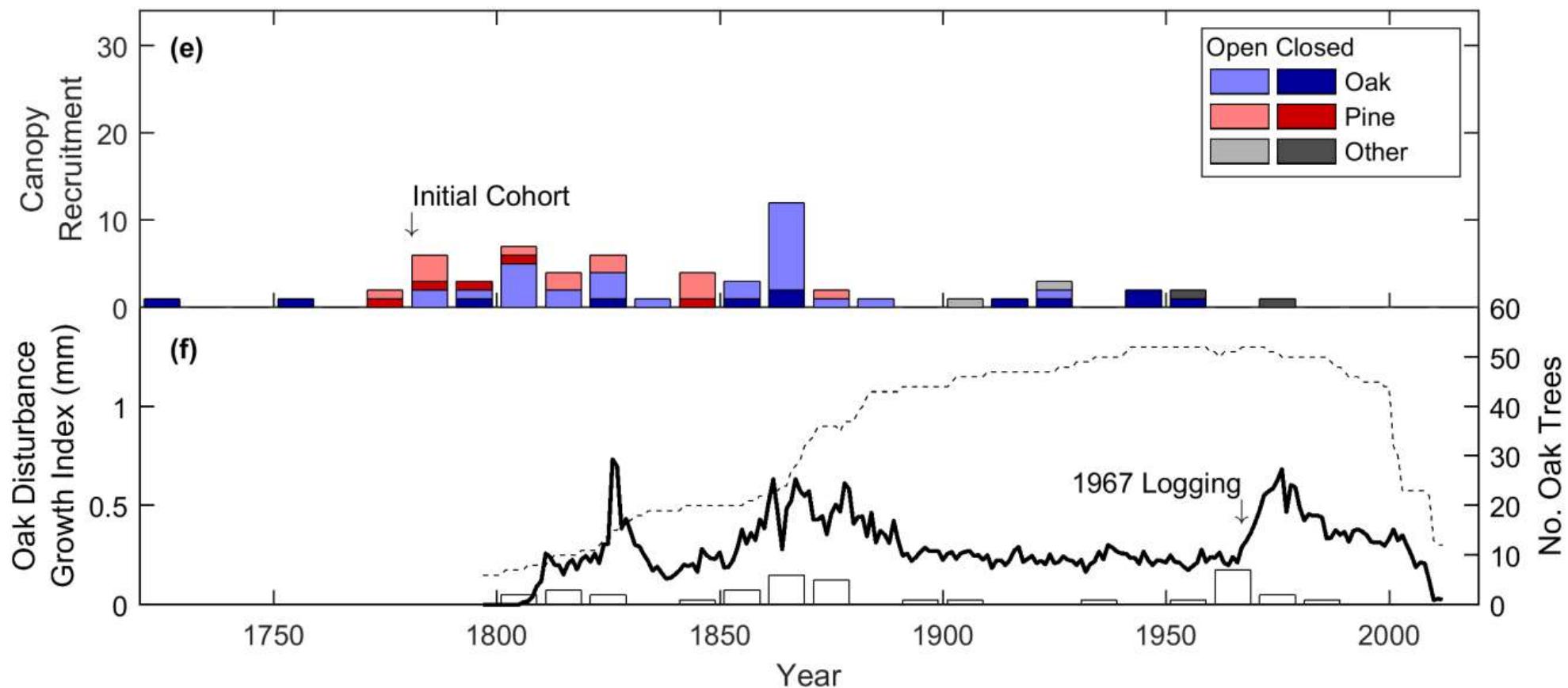
## Timber zone note (ca. 1790s)



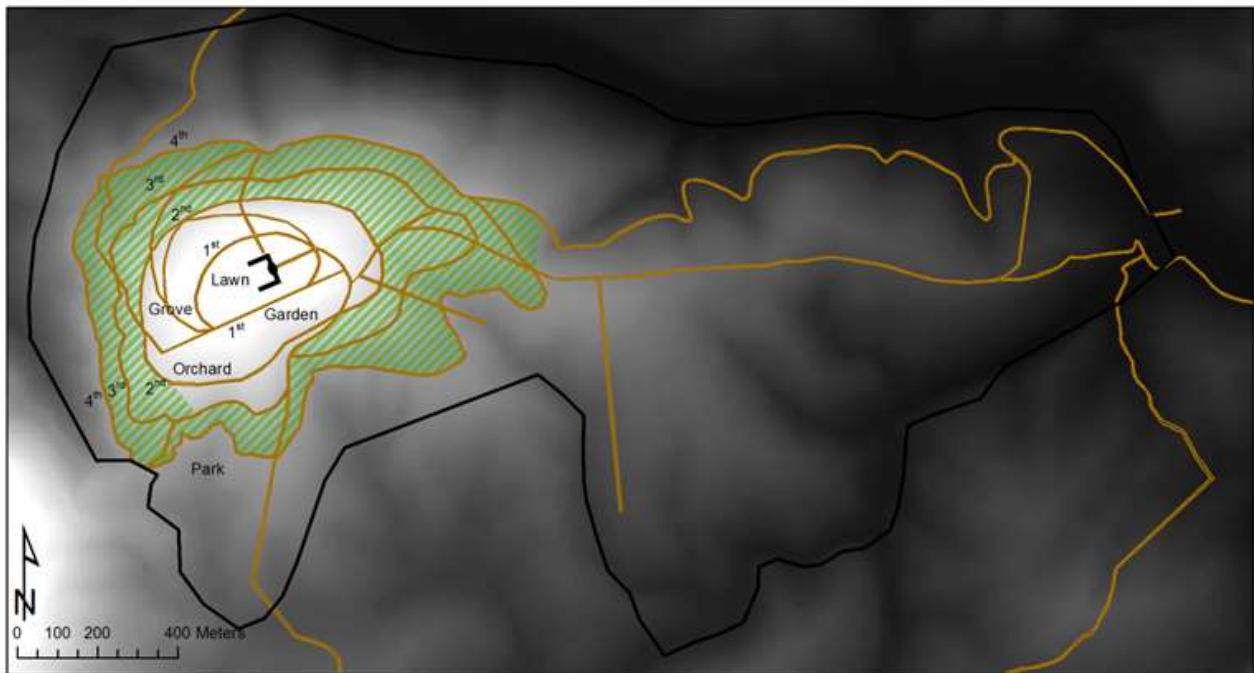
# Forest history of north slope



# Timber zone, Grove, & Park



# Forest cover through time

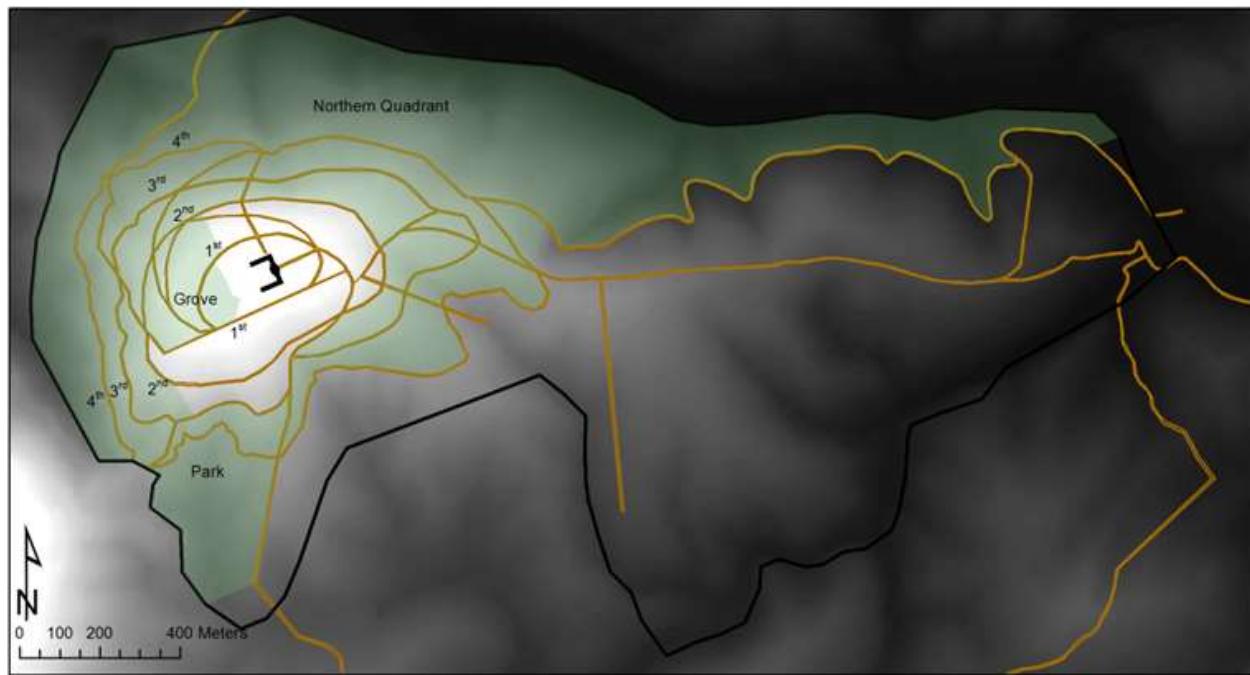


**Figure A2.** Ornamental land use showing timber zone in green cross-hatching as interpreted by Jefferson documents.

Trim up their bodies as high as the constitution & form of the tree will bear, but so as that their tops shall still unite & [yield] dense shade. A wood, so open below, will have nearly the appearance of open grounds.

(Garden Book p322-4)

# Forest cover through time



**Figure A3.** Document-Based Reconstruction of Forest Cover at Monticello circa 1826

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