Fire History of western Maryland and Surrounding Areas

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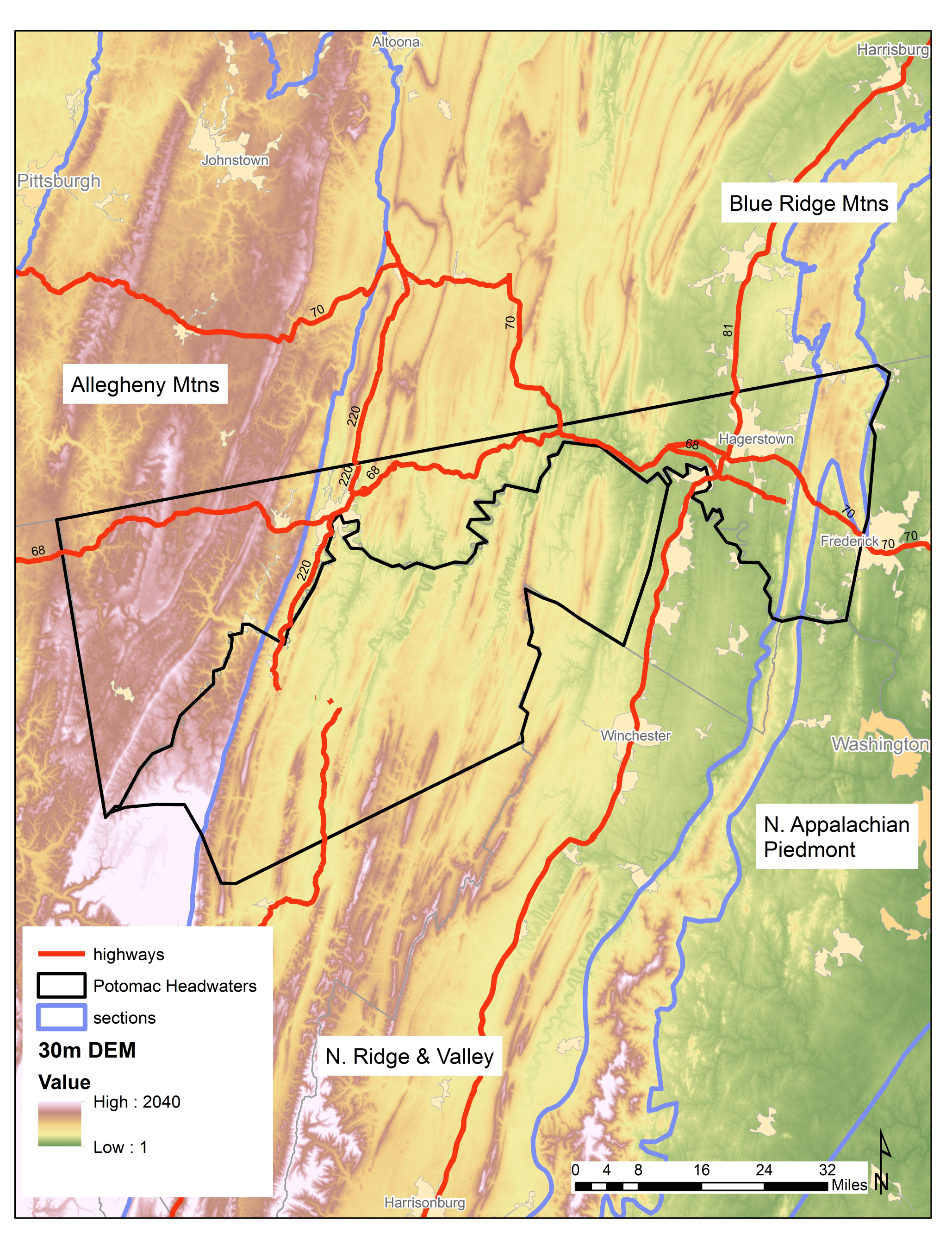
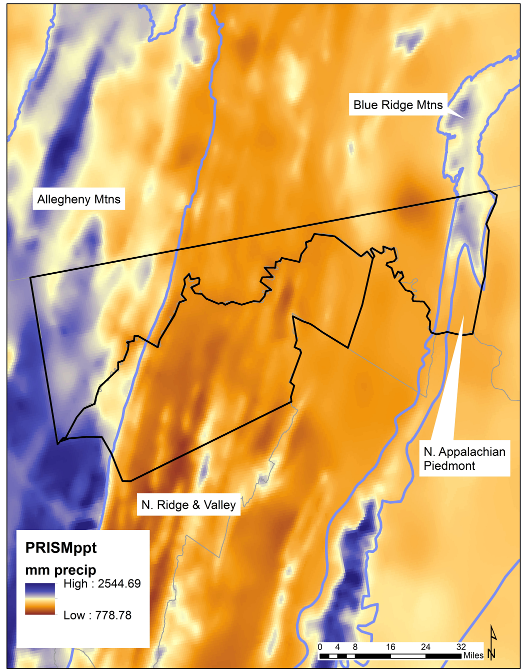
Ecological context sections

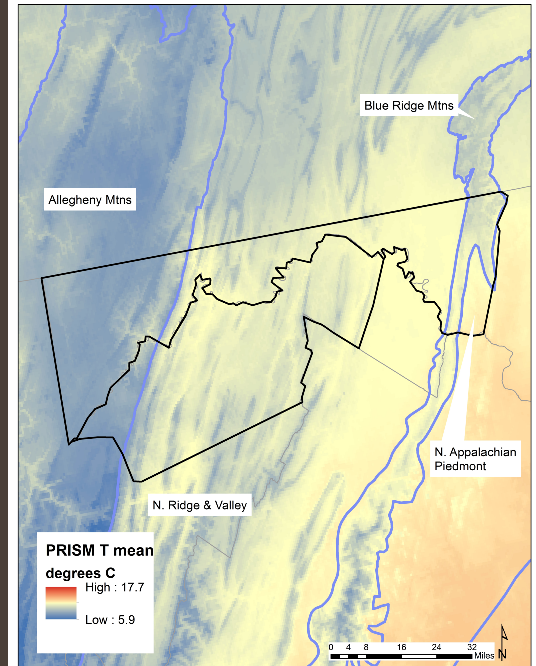


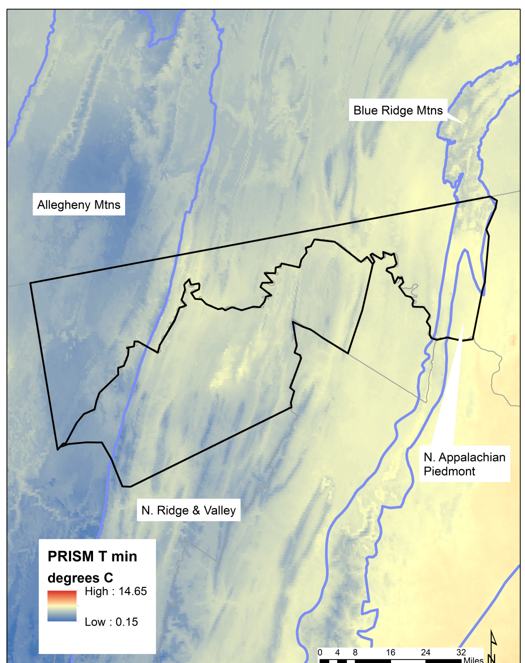
Allegheny Mtns M221B – dissected plateau, bedrock shale, siltstone, sandstone, carbonates

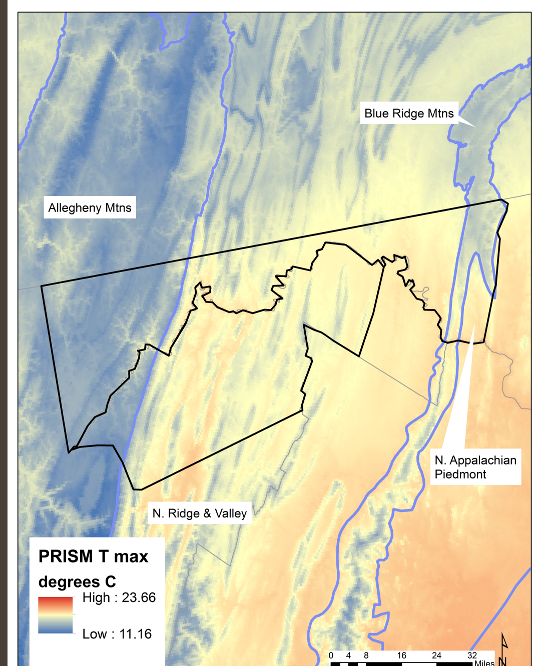
N. Ridge & Valley M221A – broad, shallow, NE-SW valleys, valley bedrock carbonates, ridges capped with sandstone

30-year climate normals









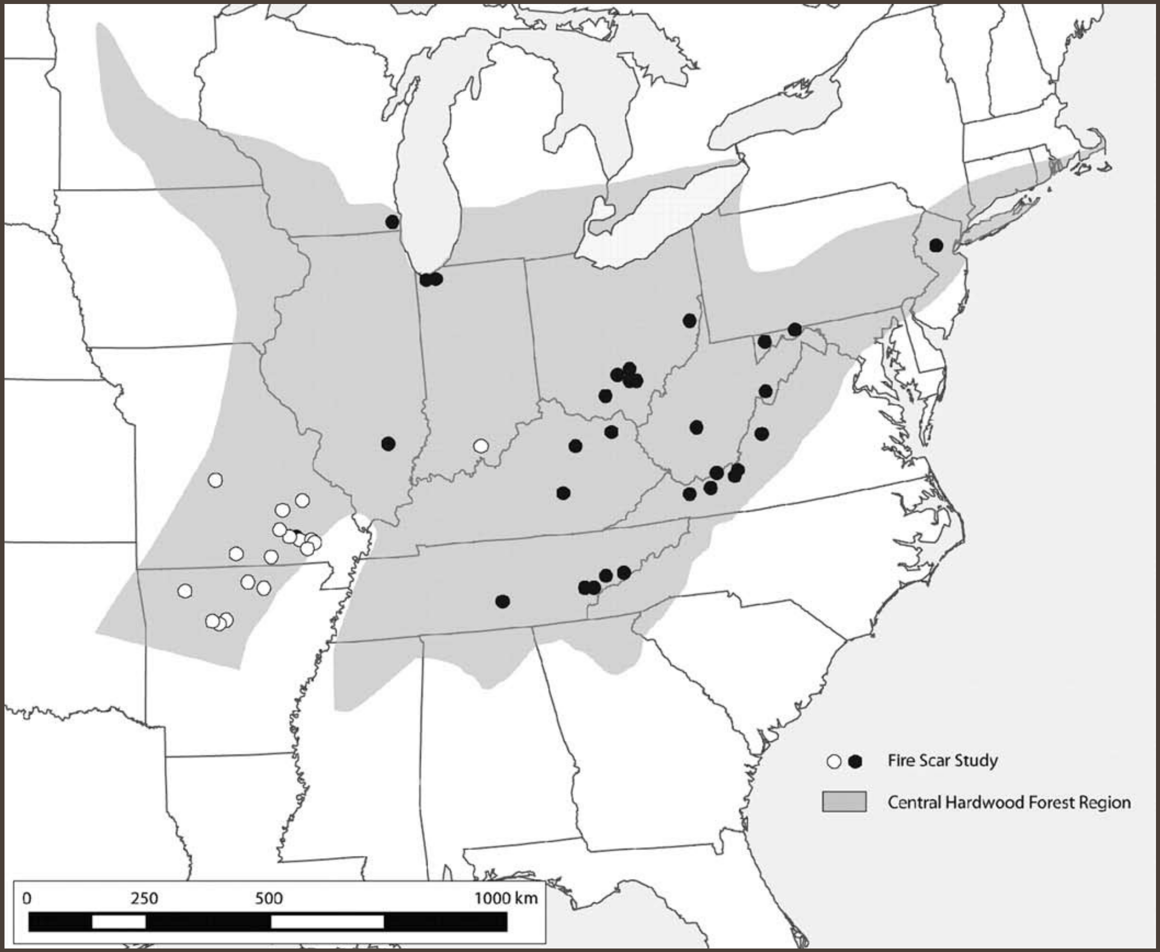
Methods to determine fire history

- Early European settler's accounts
- Soil/bog charcoal
- Tree ring scars
- Inferred through species ecology

- Keeping in mind
  - History of European settlement and land clearing
  - Old growth patches remaining may not be representative
  - Patchy paleo record (pollen, charcoal, cave sediments)

Regional fire history

(Hart and Buchanan 2012)



Some regional findings

- Sediment charcoal
  - Central and S. Appalachians - ↑ in charcoal with ↑ in oak-hickory
  - ↑ in amounts related to human population ↑
  - Hard to get dates
  - May be biased toward high intensity fires
- Soil charcoal
  - S. Appalachian highlands – fire frequency ↑ 4,000 YPB and again 1,000 YBP
  - Fine spatial scale
  - Depth ≠ age
- Fire scars in tree rings
  - WV (Maxwell and Hicks 2010) – 1898-2005, 5 yrs MFI
  - WV (Schuler and McClain 2003) – 1846-2002, 18 yrs MFI
  - VA (Aldrich and others 2010) – 1704-2003, 5-17 yrs MFI
  - Mainly dormant season fires
  - Some surface fires may be missing
  - Some stand replacing fires may be missing

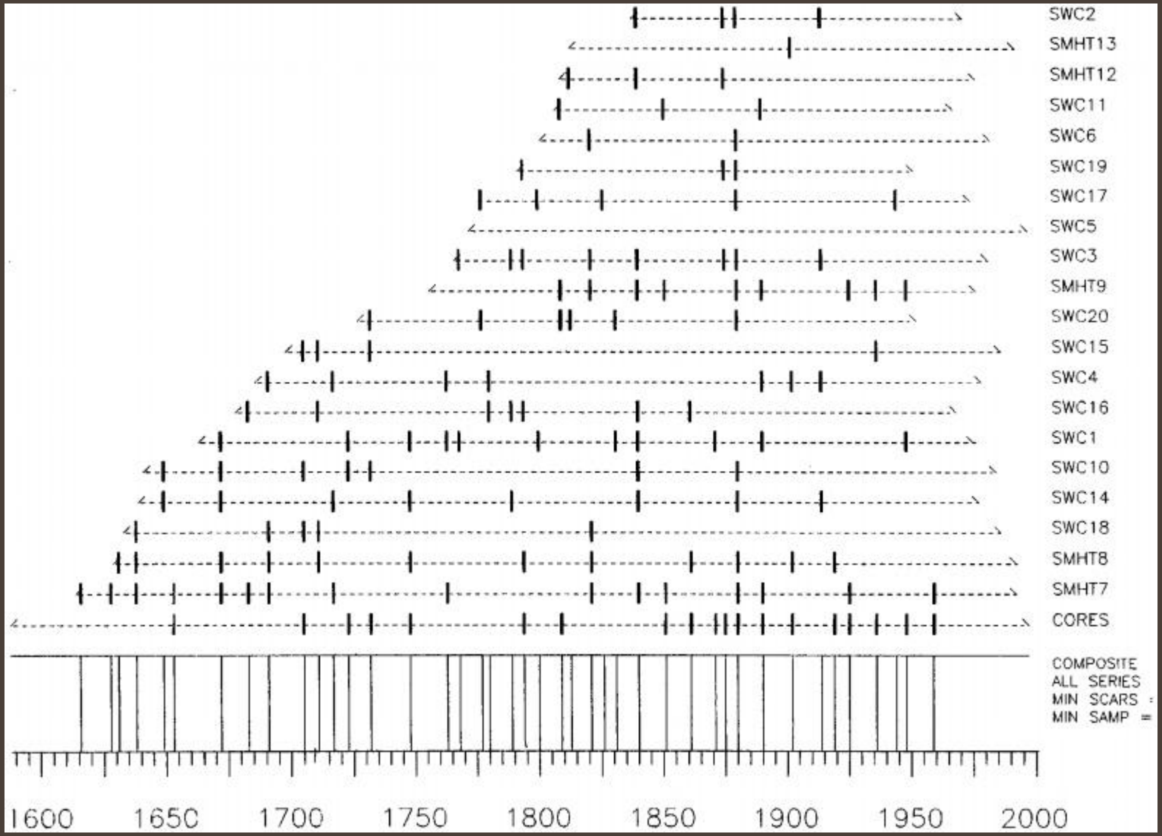
Within/near the FLN

- Fire scars in tree rings
  - MD Savage Mountain (Shumway and others 2001)
    - 1616-1992
    - MFI of 8 yrs (Weibull dist.)
    - Pre-European settlement fires smaller
    - Post-European settlement intensity ↑
    - Evidence of Native American site use downslope of study
    - Oaks recruit with fires
    - Black birch and red maple ↑ during fire suppression (1930 on)

Savage Mtn MD

from Shumway and others 2001

Fig. 2. Fire scar records obtained for 20 cross sections cut from the shelterwood cut area (SWC) and the felled hazard trees on the
Savage Mountain hiking trail (SMHT) and for combined cores (labeled as Cores) obtained in the South Savage (SS) and Coleman Hollow
(CH) stands.



PA – Tuscarora Mountains

- PA – Tuscarora Mountains (Marschall and others 2016)
  - Pitch pine live trees and remnants
  - 1663-2013 and 1644-2013
  - Frequent yet variable fire history
  - MFI of 5.1 and 5.7 yrs
  - Mainly during dormant season

Pines in PA

from Marschall and others 2016

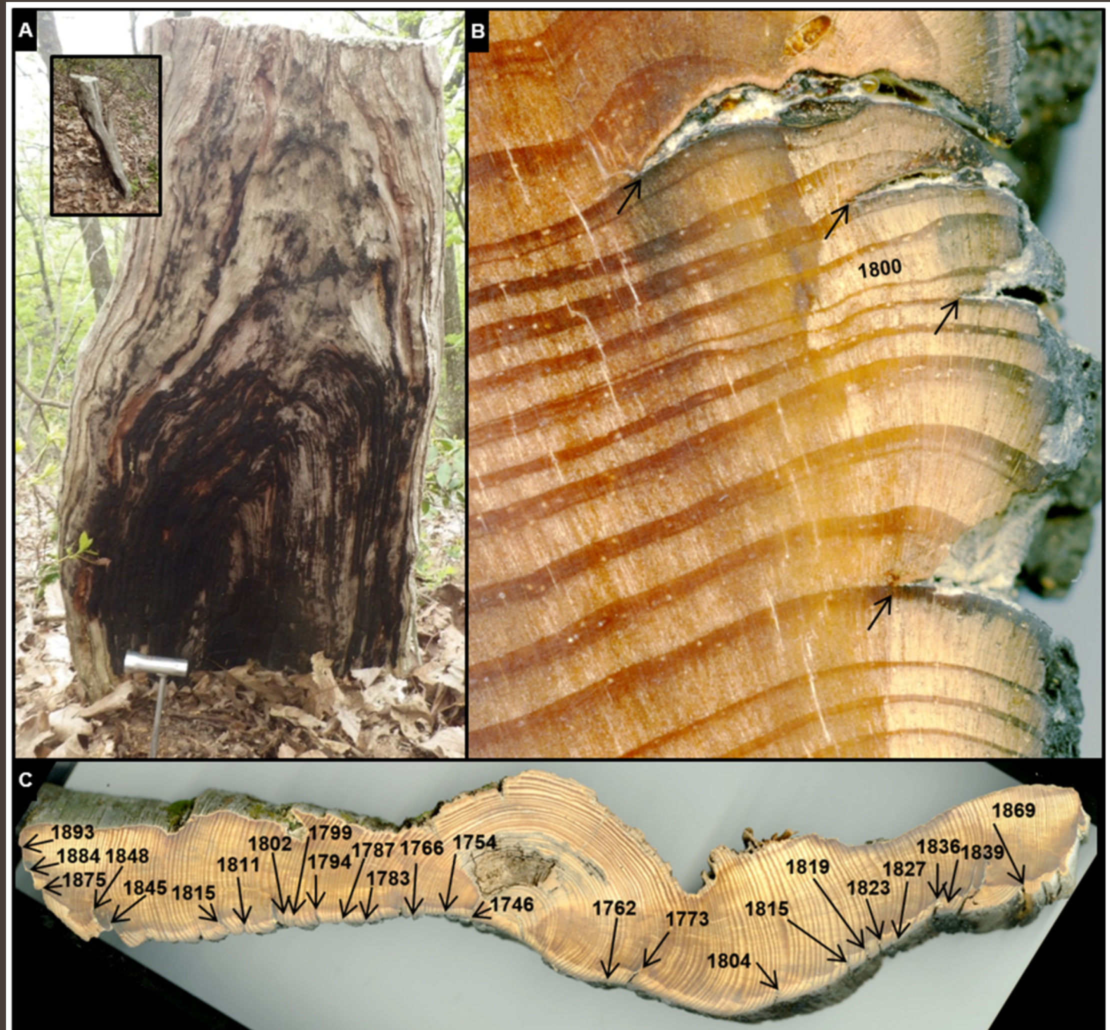


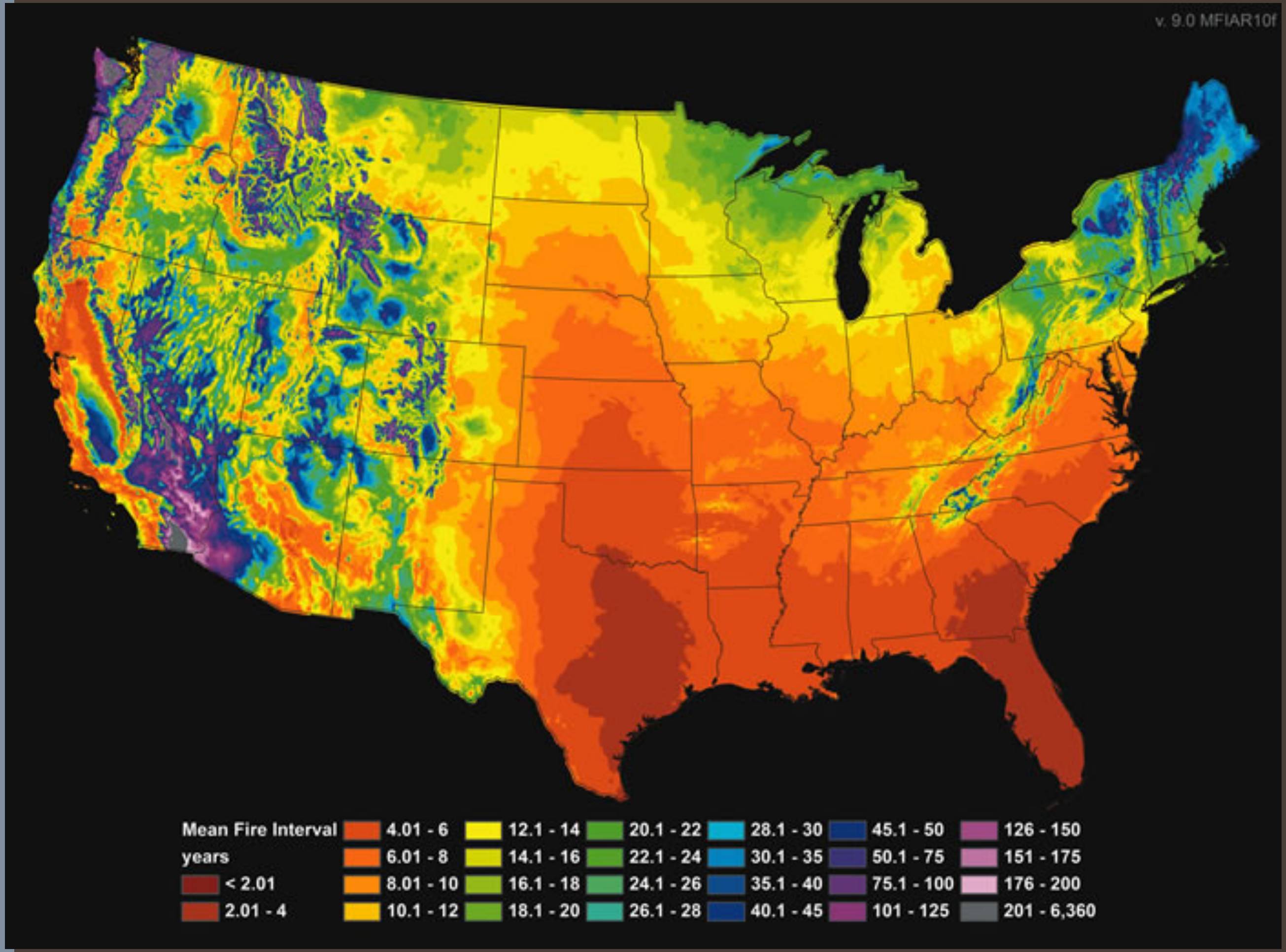
Figure 2. (A) Fire-scarred pitch pine (*Pinus rigida*) stump (sample no. 107032) with charcoal, inset shows side view. (B,C) Cross-sectional views of rings and fire scars from this sample, arrows denote fire-scar years. This tree had 27 fire scars during the time period of 1734–1898, with most scars occurring in the dormant season tree-ring position.

Other methods

- Fire as a chemical reaction
- Inferring from species ecology

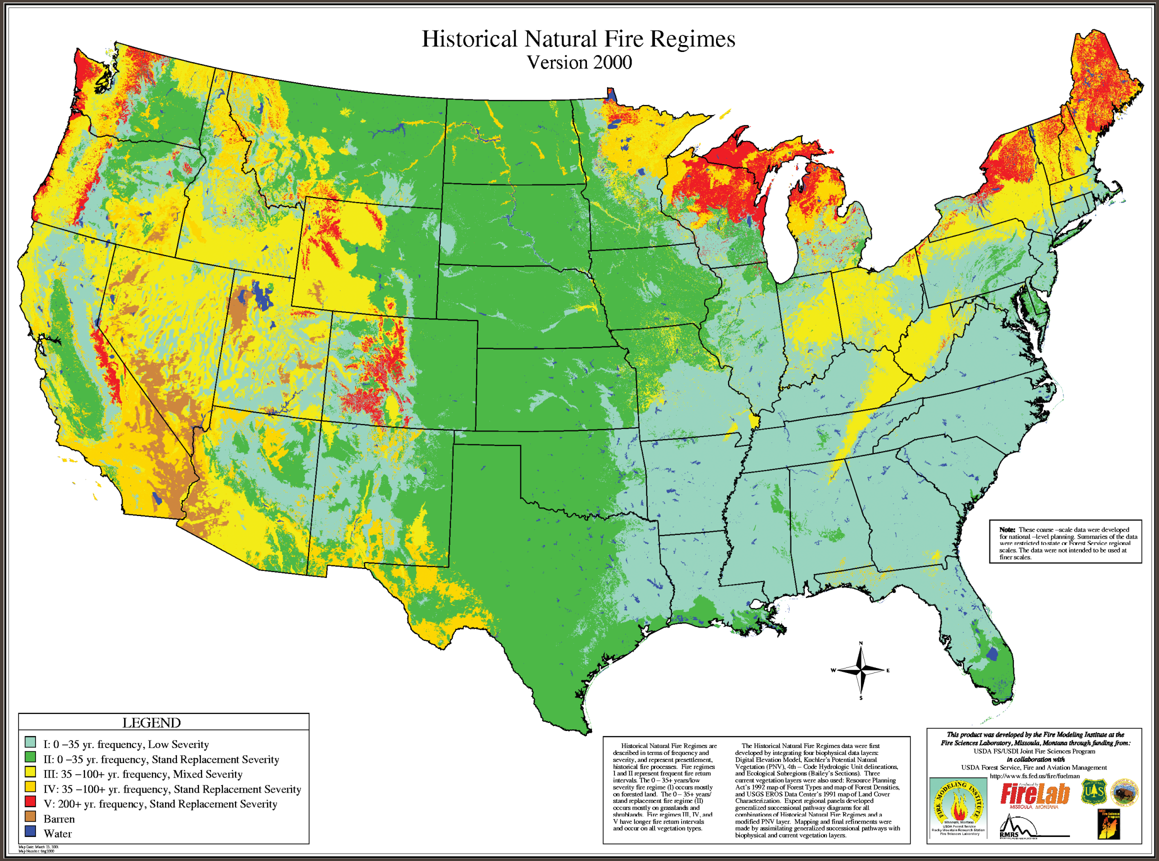
Historic fire return interval based on chemistry

(Guyette and others 2012)



Historic fire regimes based on PNV and climate

(Schmidt and others 2002)



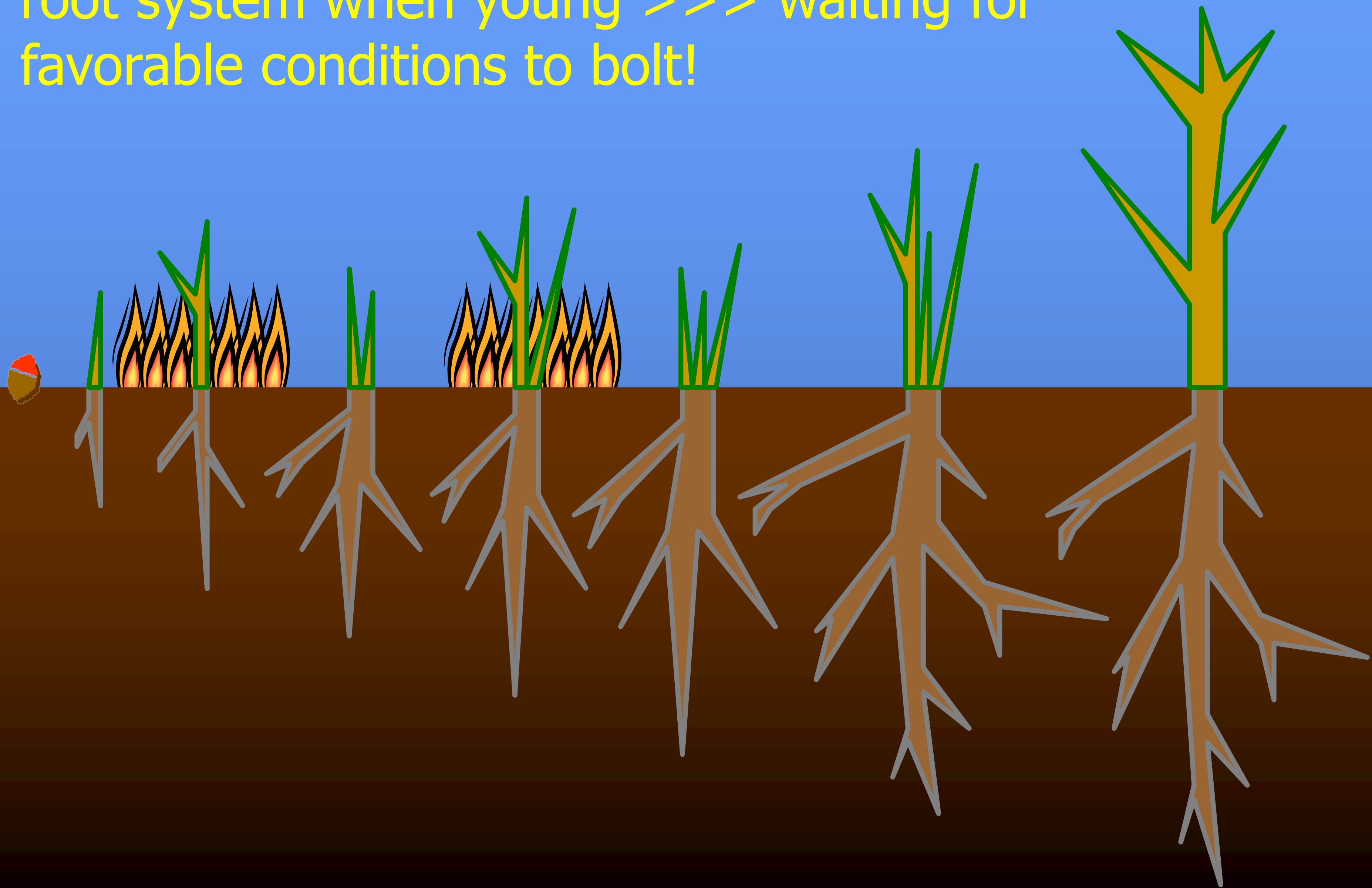
Fire as global herbivore
(Bond and Keeley 2005)

- Fire and consumer control of ecosystems
  - Climate potential vs actual with disturbance and consumers
- Fire and consumer control of species composition
  - Fire as predator and the changes when predator is removed
- **Fire as evolutionary agent**
  - Benefit to flammability?
  - Connection between flammable morphology and fire-stimulated recruitment (Pines)
  - Remember it's a disturbance regime, not one fire
- Fire and the origin of biomes
  - Flammable ecosystems pre-date humans

Oak is a fire- and drought-tolerant genus that possesses various adaptations …

- Thick bark (fire protection)
- Able compartmentalizer (fire injury)
- Aggressive sprouter (fire-based reproductive strategy)
- Opportunistic: responds favorably to disturbance
- Fuel characteristics (fire promotion)
- Water efficient (drought resistance)
  - tap roots exploit deep H_2O sources
  - osmotic adjustment: extract H_2O from dry soils
  - xeromorphic leaves minimizes H_2O loss

Oak Survival Strategy: heavy investment in root system when young >>> waiting for favorable conditions to bolt!



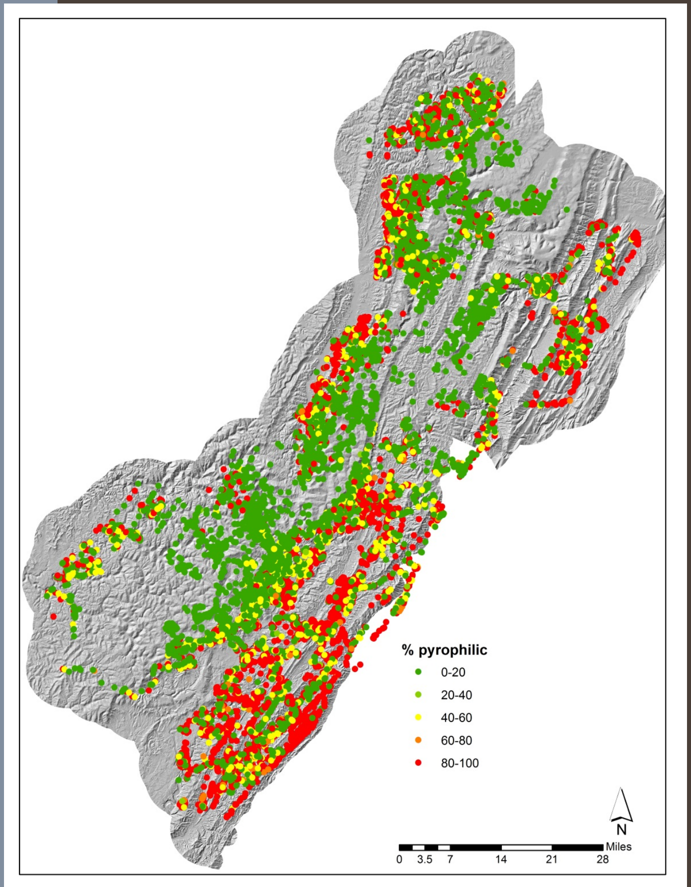
"I don't know the scientific explanation, but fire made it good"
- Homer J. Simpson

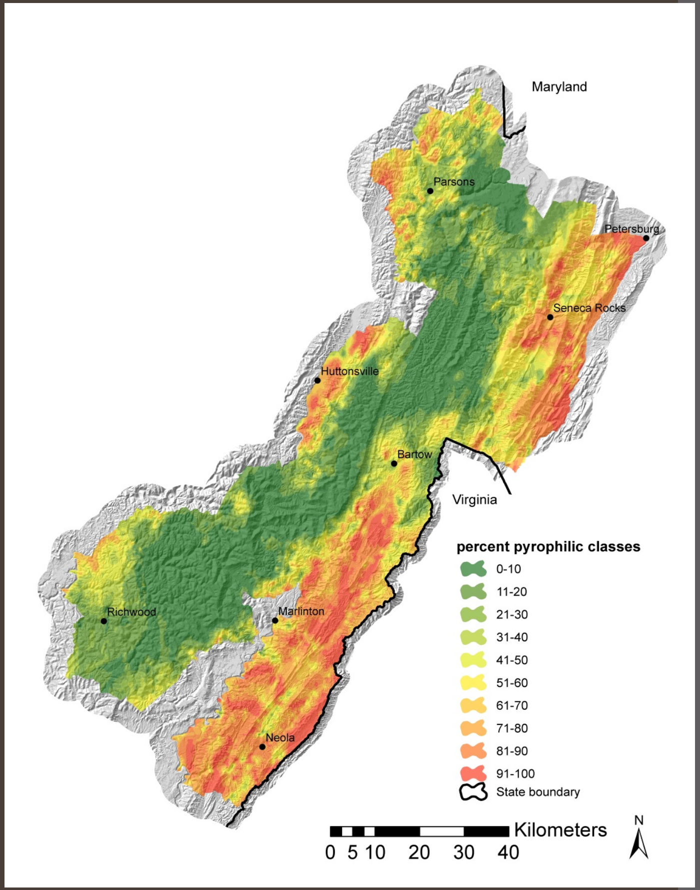
Using witness trees as ecological data

Witness-tree categorization

Pyrophilic		Pyrophobic	
Traits: Thick bark, sprouters, xerophytic, fire-encouraging leaves, early seral		Traits: Thin bark, shallow roots, mesophytic, fire-discouraging leaves, late seral	
Carya	Hickory	Abies	Balsam fir, fir, balsam
Castanea	Chestnut	Acer	Maple
Cornus	Dogwood	Betula	Birch
Juniperus	Red cedar, cedar	Carpinus/Ostrya	Hornbeam, ironwood
Nyssa	Blackgum, gum	Fagus	American beech
Pinus	Pine	Fraxinus	Ash
Populus	Aspen, cottonwood	Juglans	Butternut, walnut
Quercus	Oak	Liriodendron	Yellow-poplar, tulip tree
Robinia	Locust	Magnolia	Magnolia, cucumber
Sassafras	Sassafras	Picea	Red spruce, spruce, yew pine
		Plantanus	Sycamore
		Prunus	Black or wild cherry
		Salix	Willow
		Taxus	Yew
		Tilia	Basswood, white lynn, lin
		Tsuga	Hemlock, hemlock-spruce
		Ulmus	Elm

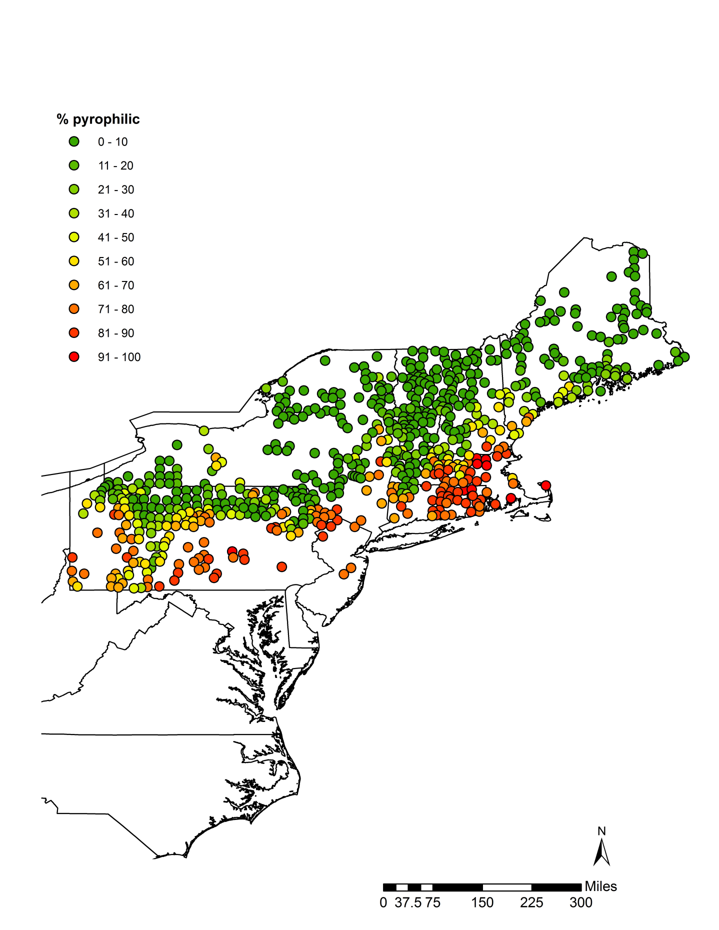
Calculating pyrophilic % and interpolation

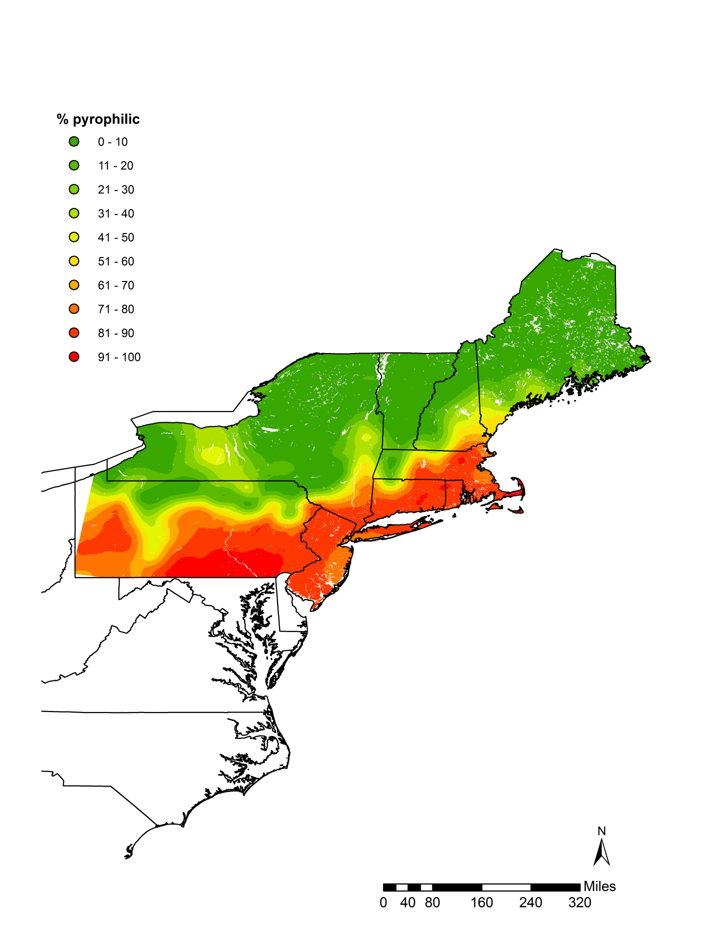




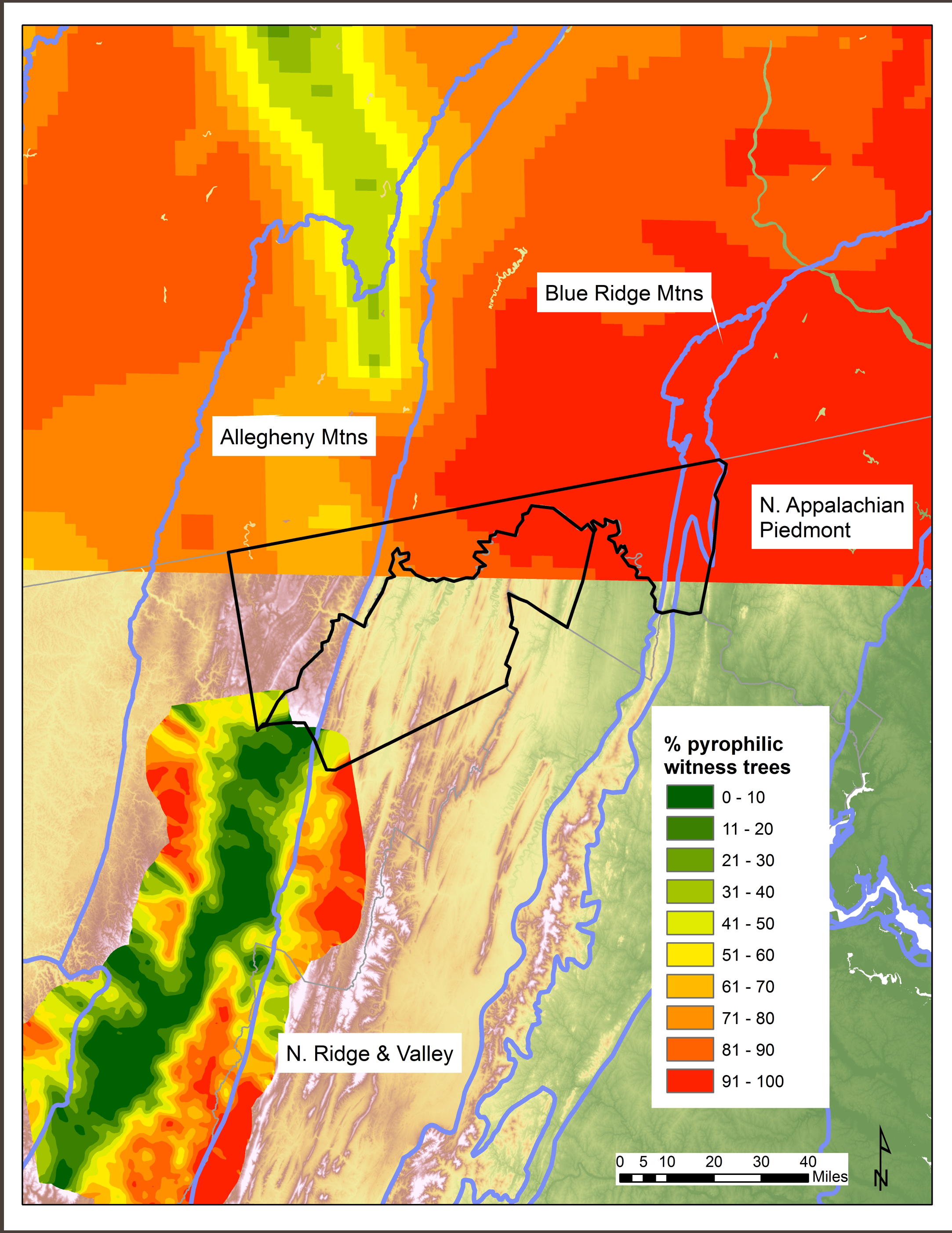
Town-level data for regional view

(100km2)





Connecting the dots



Bison & people

5 – old fields noted by Geo. Washington

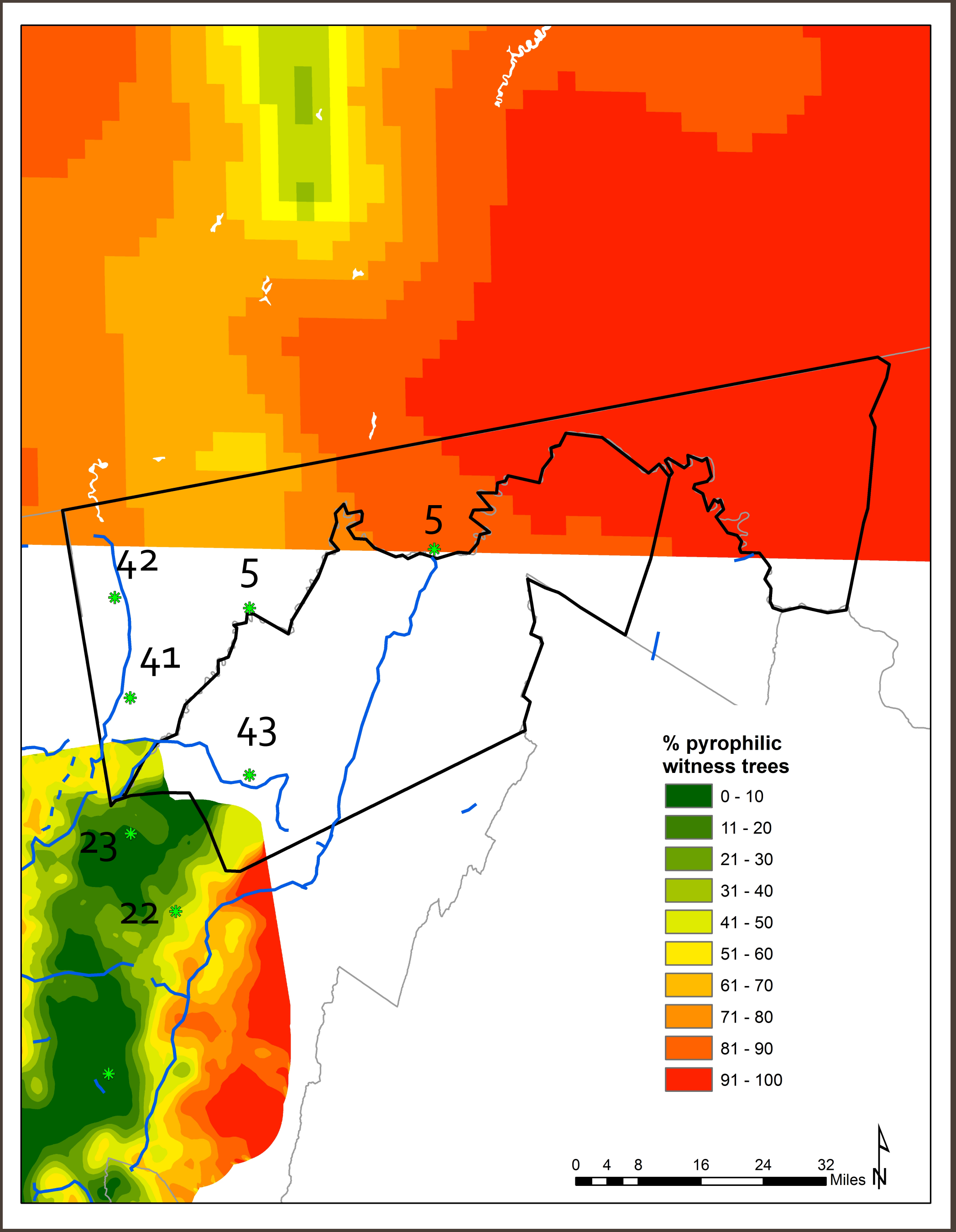
22 – elk killed on Red creek ~1840

23 – 3 elk killed near Davis ~1843

41 – Fort Ashby, 4 buffalo seen in 1794, 2 killed

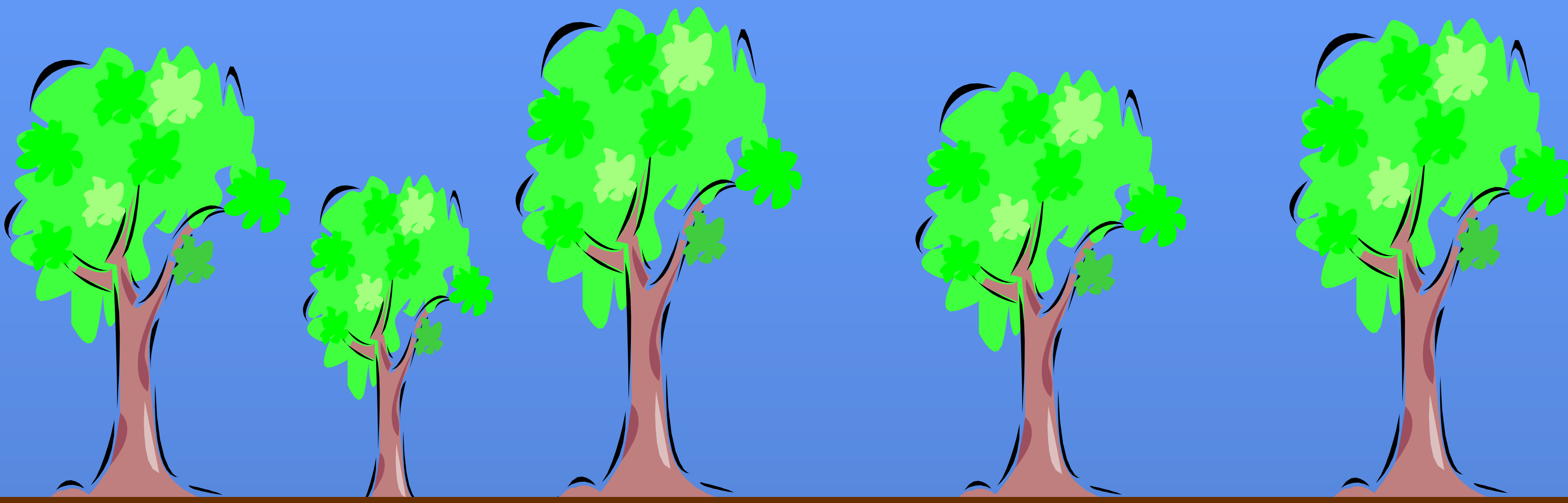
42 – herd of buffalo seen along Sang Run ~ 1796

43 – the McCullough Trail, used by Washington in 1784, called old buffalo trail

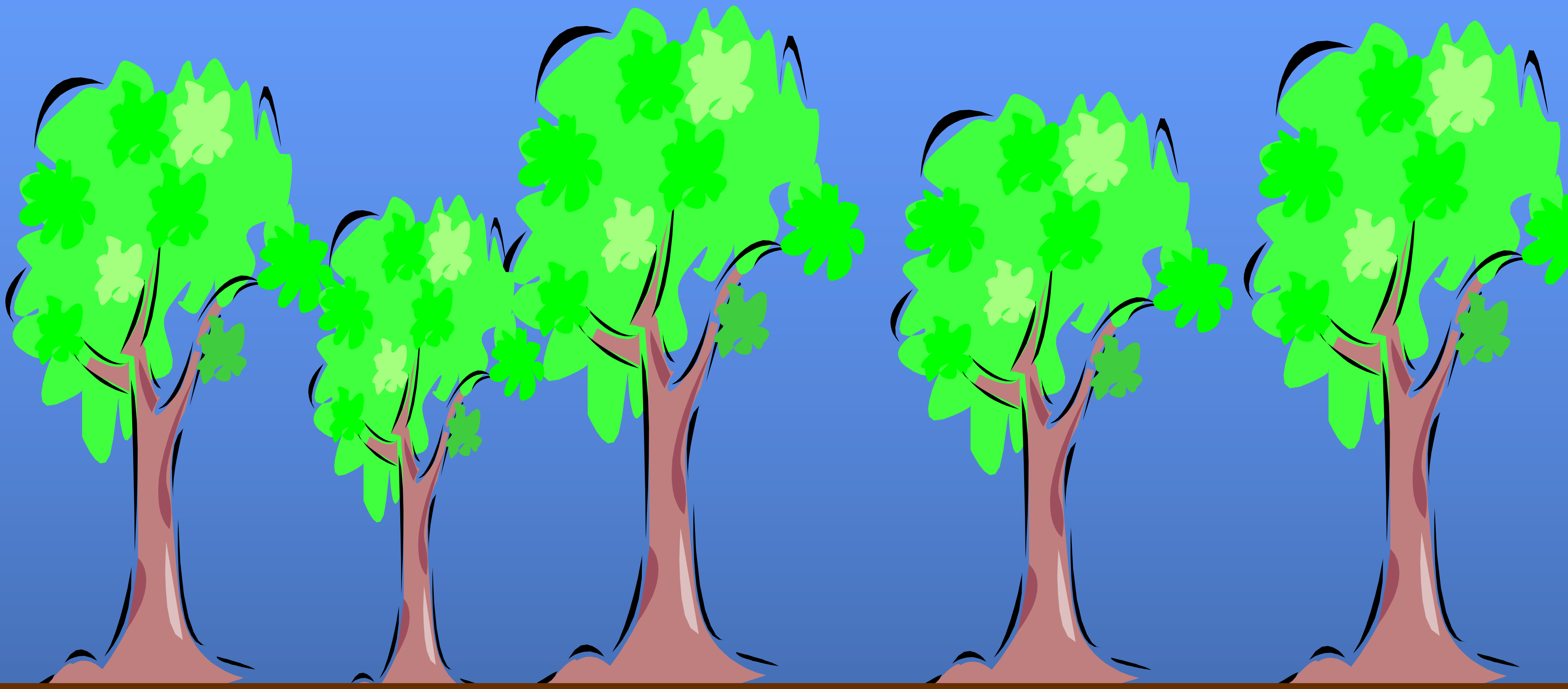


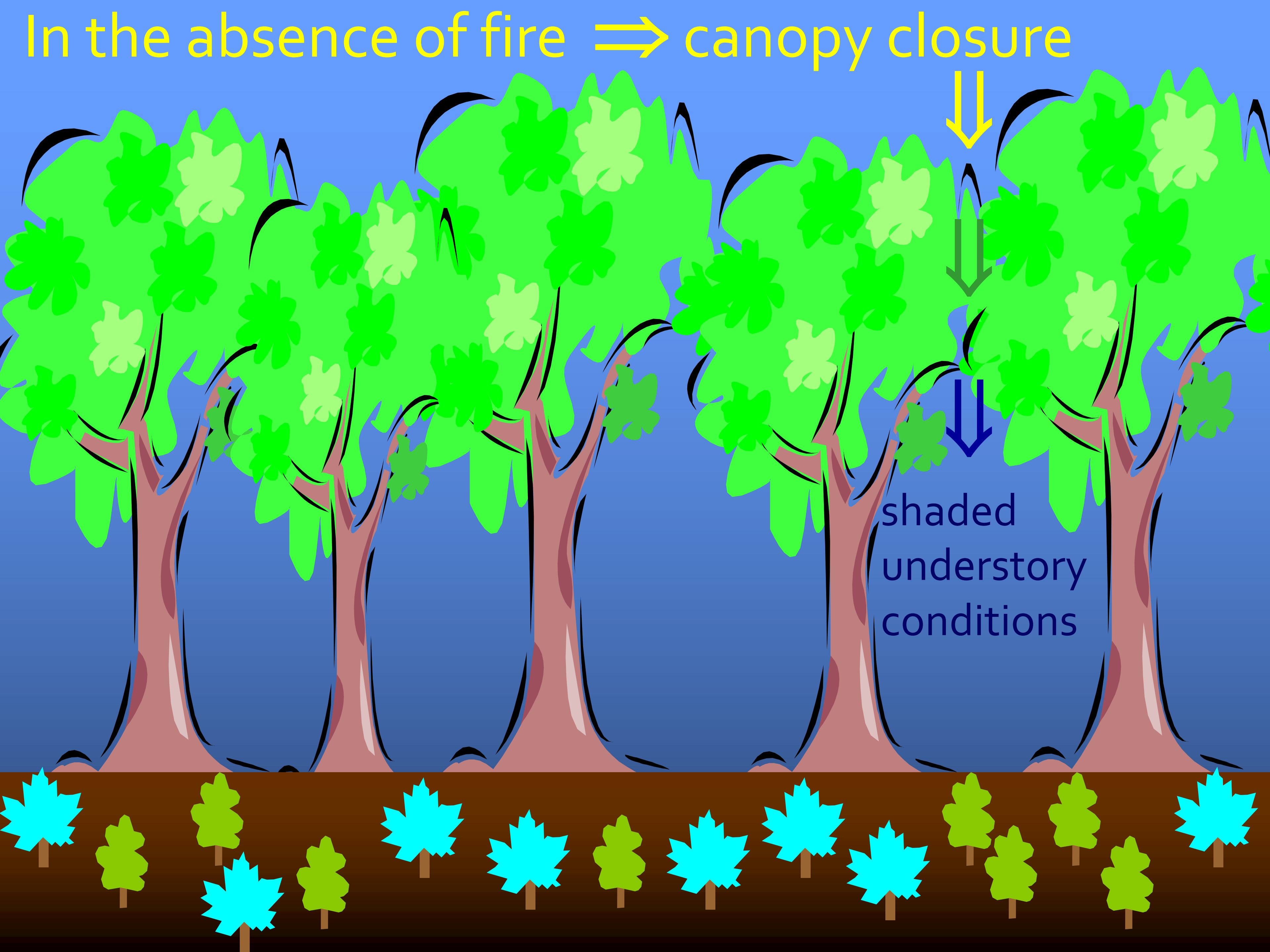
Smokey Bear effect

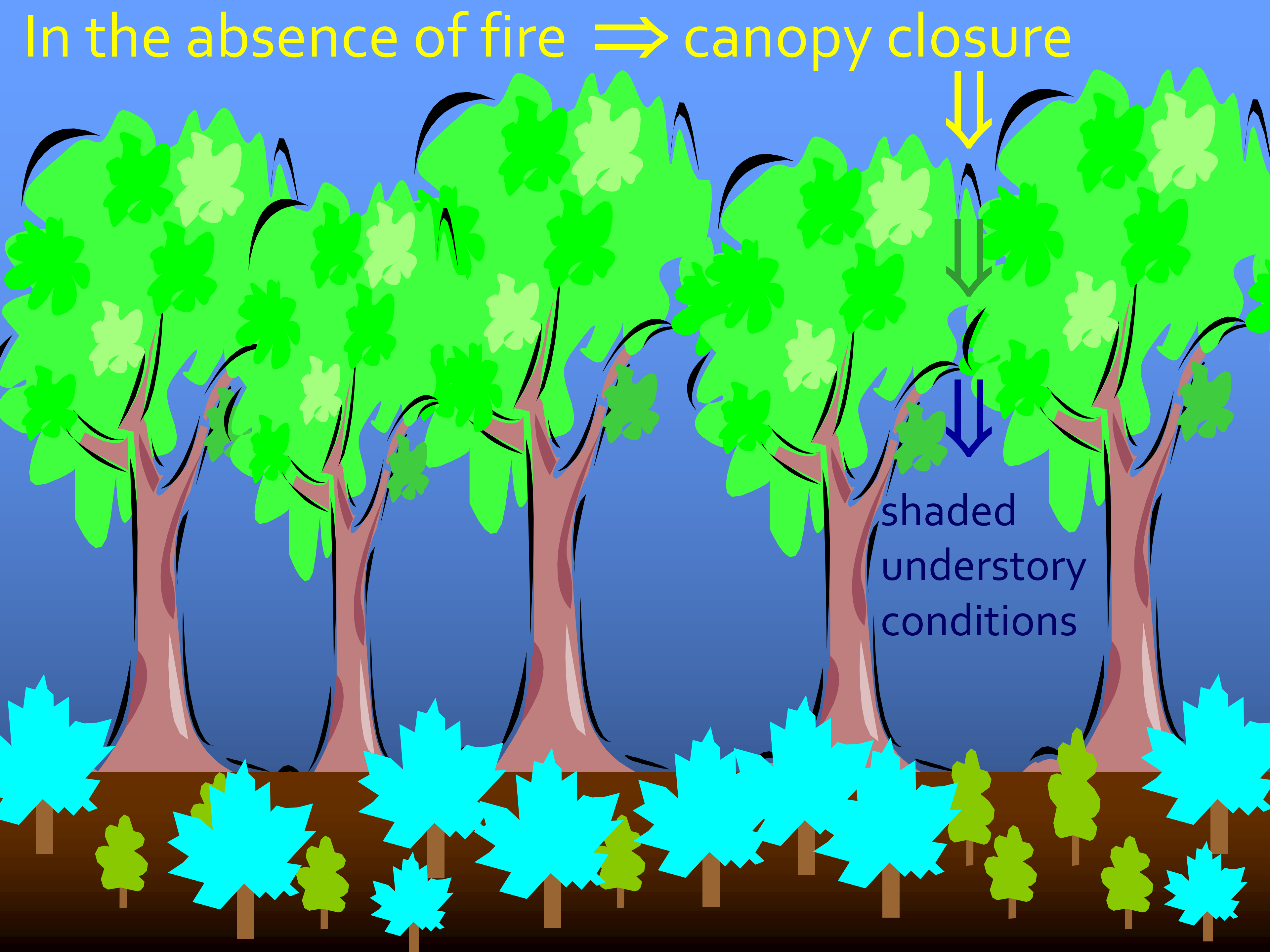
In the absence of fire



In the absence of fire ⇒




In the absence of fire ⇒ canopy closure
shaded understory conditions


In the absence of fire ⇒ canopy closure
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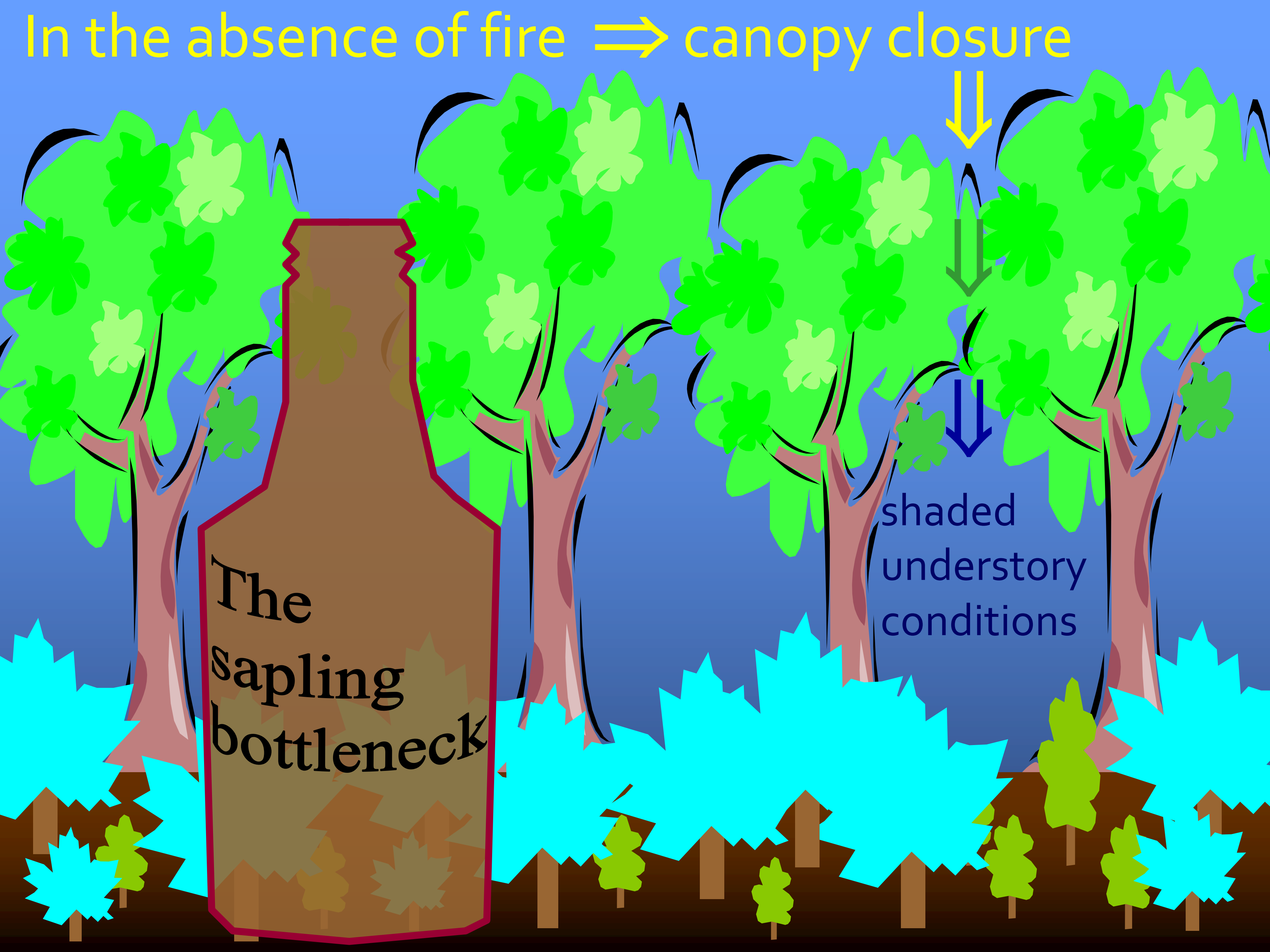
shaded understory conditions


In the absence of fire ⇒ canopy closure
shaded understory conditions
The sapling bottleneck

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The Demise of Fire and “Mesophication” of Forests in the Eastern United States

GREGORY J. NOWACKI AND MARC D. ABRAMS

A diverse array of fire-adapted plant communities once covered the eastern United States. European settlement greatly altered fire regimes, often increasing fire occurrence (e.g., in northern hardwoods) or substantially decreasing it (e.g., in tallgrass prairies). Notwithstanding these changes, fire suppression policies, beginning around the 1920s, greatly reduced fire throughout the East, with profound ecological consequences. Fire-maintained open lands converted to closed-canopy forests. As a result of shading, shade-tolerant, fire-sensitive plants began to replace heliophytic (sun-loving), fire-tolerant plants. A positive feedback cycle—which we term “mesophication”—ensued, whereby microenvironmental conditions (cool, damp, and shaded conditions; less flammable fuel beds) continually improve for shade-tolerant mesophytic species and deteriorate for shade-intolerant, fire-adapted species. Plant communities are undergoing rapid compositional and structural changes, some with no ecological antecedent. Stand-level species richness is declining, and will decline further, as numerous fire-adapted plants are replaced by a limited set of shade-tolerant, fire-sensitive species. As this process continues, the effort and cost required to restore fire-adapted ecosystems escalate rapidly.

Keywords: fire-adapted species, oak-pine, prescribed burning, forest floor, restoration

Fire was widespread and frequent throughout much of the eastern United States before European settlement (Pyne 1982, Abrams 1992). Widespread burning created a mismatch between the physiological limits set by climate and the actual expression of vegetation—a common phenomenon throughout the world (Bond et al. 2005). In the eastern United States, presettlement vegetation types were principally pyrogenic; that is, they formed systems assembling under and maintained by recurrent fire (Frost 1998, Wade et al. 2000). Prime examples include tallgrass prairies, aspen (*Populus*) parklands, oak (*Quercus*)-dominated central hardwoods, northern and southern “pineries,” and boreal spruce-fir (*Picea–Abies*) forests (Wright and Bailey 1982). In turn, an extensive array of eastern animal and plant species have adapted to and depend on fire, either directly (e.g., jack pine [*Pinus banksiana* Lamb.]) or through the use of fire-maintained habitat (e.g., Kirtland’s warbler [*Dendroica kirtlandii*]).

A diverse mix of vegetation and site conditions of the eastern United States supported a range of presettlement fire regimes, from intense stand-replacing burns on pine barrens to “asbestos-like” communities that rarely burned (e.g., northern hardwoods). However, most presettlement fire regimes produced low- to mixed-severity surface burns, which maintained the vast expanses of oak and pine forests that dominated much of the eastern United States, often in open “park-like” conditions (Wright and Bailey 1982, Frost 1998). Native Americans were the primary ignition source in many locations, given the moist and humid conditions of the East (Whitney 1994). Historical documents indicate that Native American ignitions far outnumbered natural causes (principally lightning) in most locations (Gleason 1913, DeVivo 1991). In this respect, humans were a “keystone species,” actively managing the environment with fire over millennia (Sauer 1975, Guyette et al. 2006). Nonetheless, within the fire-maintained landscapes, variations in human population and land use, topography, and riparian areas (firebreaks) created a mosaic of burned and unburned vegetation types (Heinselman 1973, Anderson 1991, Whitney 1994).

Fire regimes changed in various ways with European settlement, often profoundly. In many instances, fire frequency and severity increased as forests were cut and burned, either intentionally (for agricultural land clearing) or unintentionally (e.g., sparked by wood- and coal-burning steam engines). This transition was most stark for mesic hardwood

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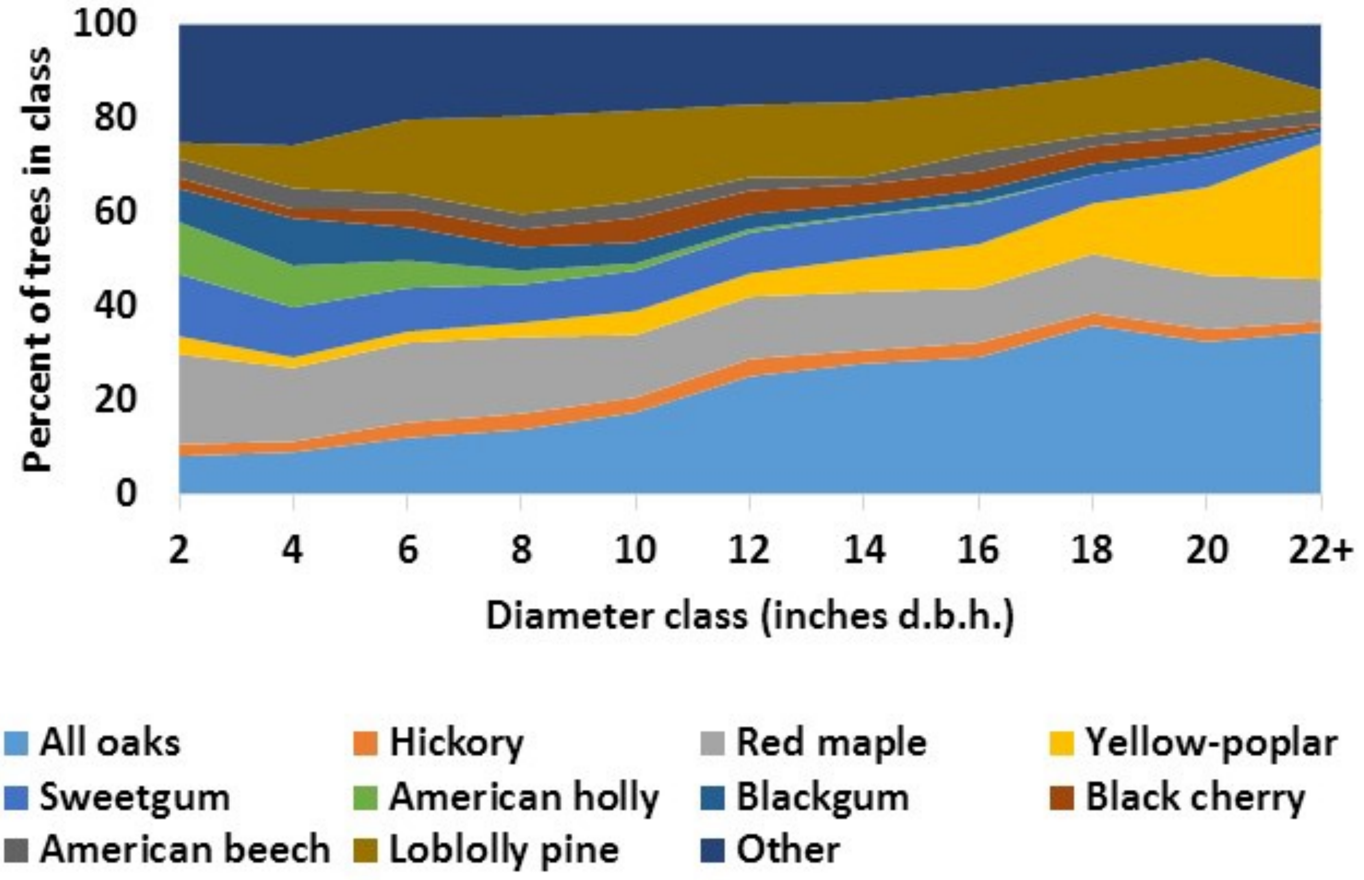
Current species composition Maryland's forests

(Lister and Widmann 2016)



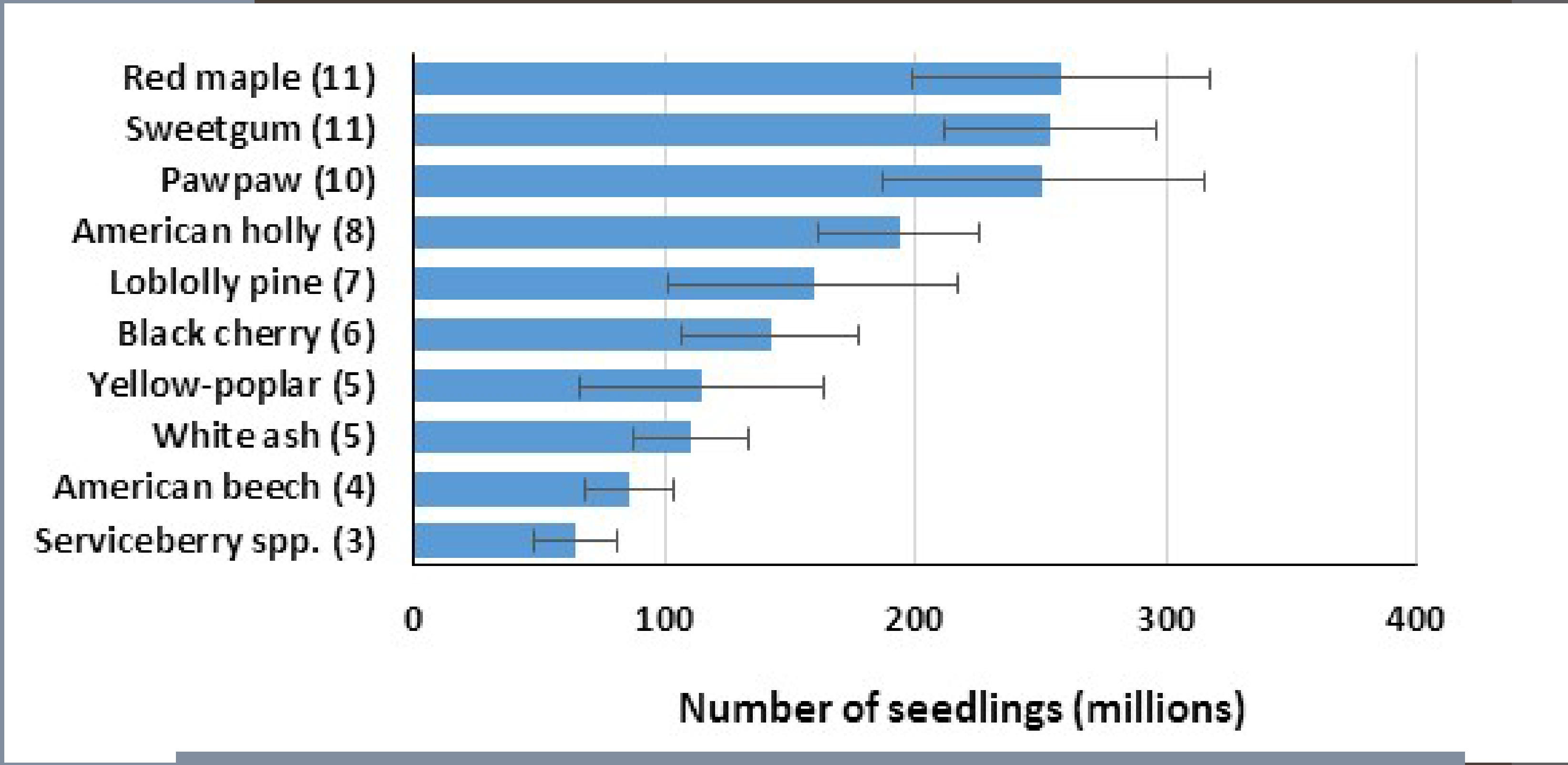


Figure 7.—Top 10 species by numbers of seedlings (less than 1-inch d.b.h. and at least 1 foot tall), on forest land, Maryland, 2015. Percent of total seedlings is shown in parentheses.

summary

- Short fire return intervals but variable
- Mainly dormant season
- Influenced by ecological setting
- Removal of fire has consequences

So what?

- So, should we burn every site every 5 years?
- Why are we burning?
- What are the goals?