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Presenting open forest ecosystems, loss, and consequences for biodiversity

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"**…the Indians frequent fiering of the woods…makes them thin of Timber in many places, like our Parkes in England**" Johnson 1654 cited in Day 1953

"On one subject, all are in accord and that is the observation that the **original forest was, in most places, extremely open and parklike,** due to the universal factor of fire, fostered by the original inhabitants to facilitate travel and hunting." Bromley 1935

What are open forests (high light forests)?

Grasslands

Savannas

Open woodlands

Closed woodlands

Closed forests

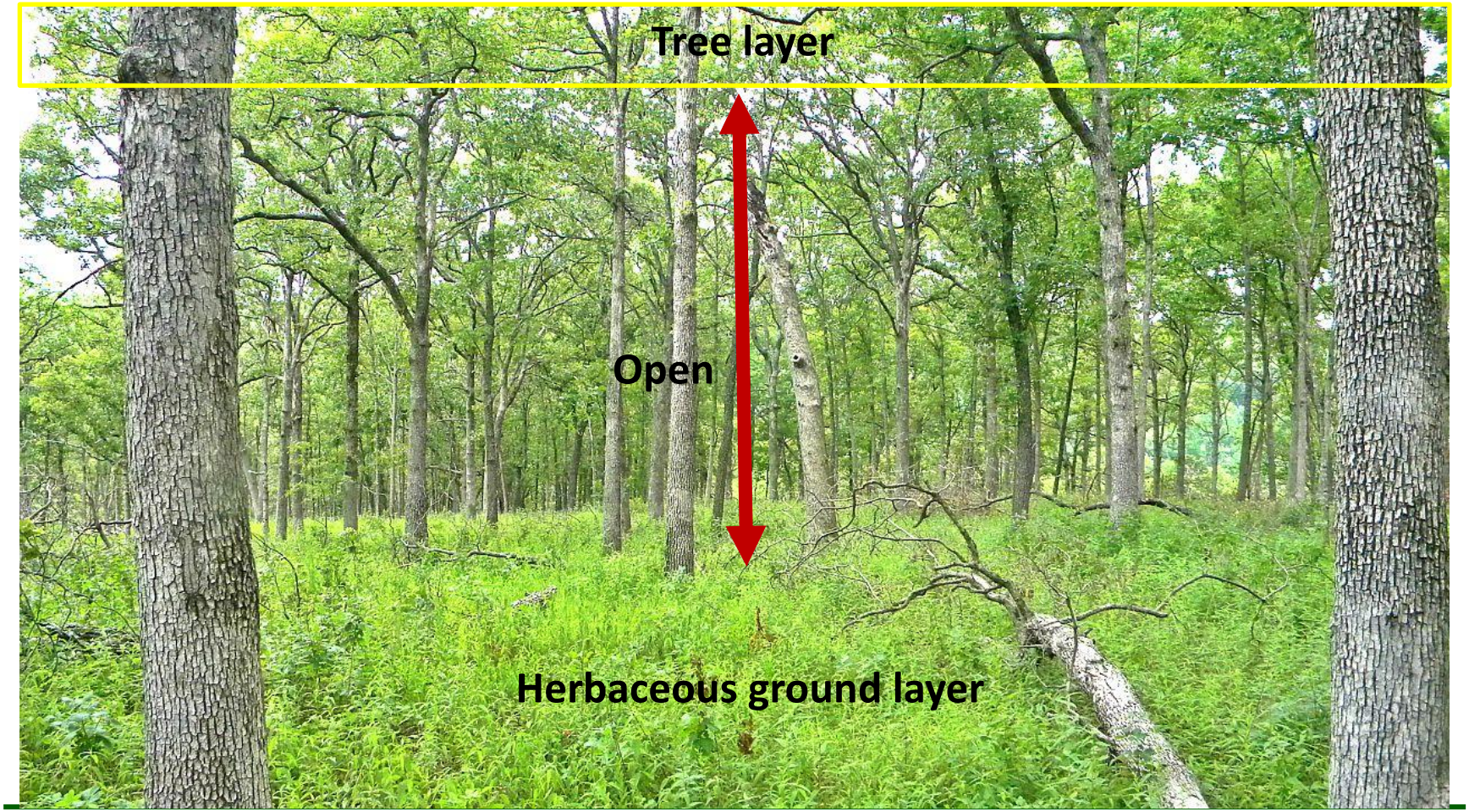
understocked

Temperate savannas

“In many of these open grounds, a man may be seen at a distance of two miles.”
Bigelow 1876 cited in Day 1953

Woodlands

Open forest structure = Overstory layer, open midstory, herbaceous ground layer



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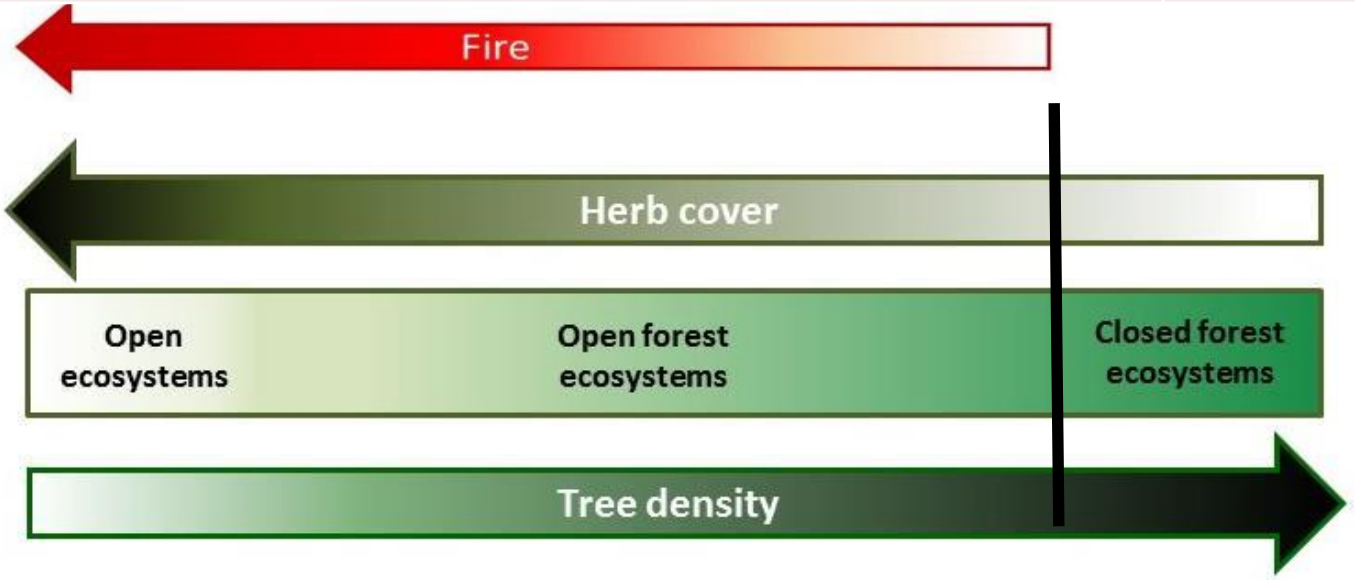
Oaks in Missouri, burn treatment, C. Kinkead

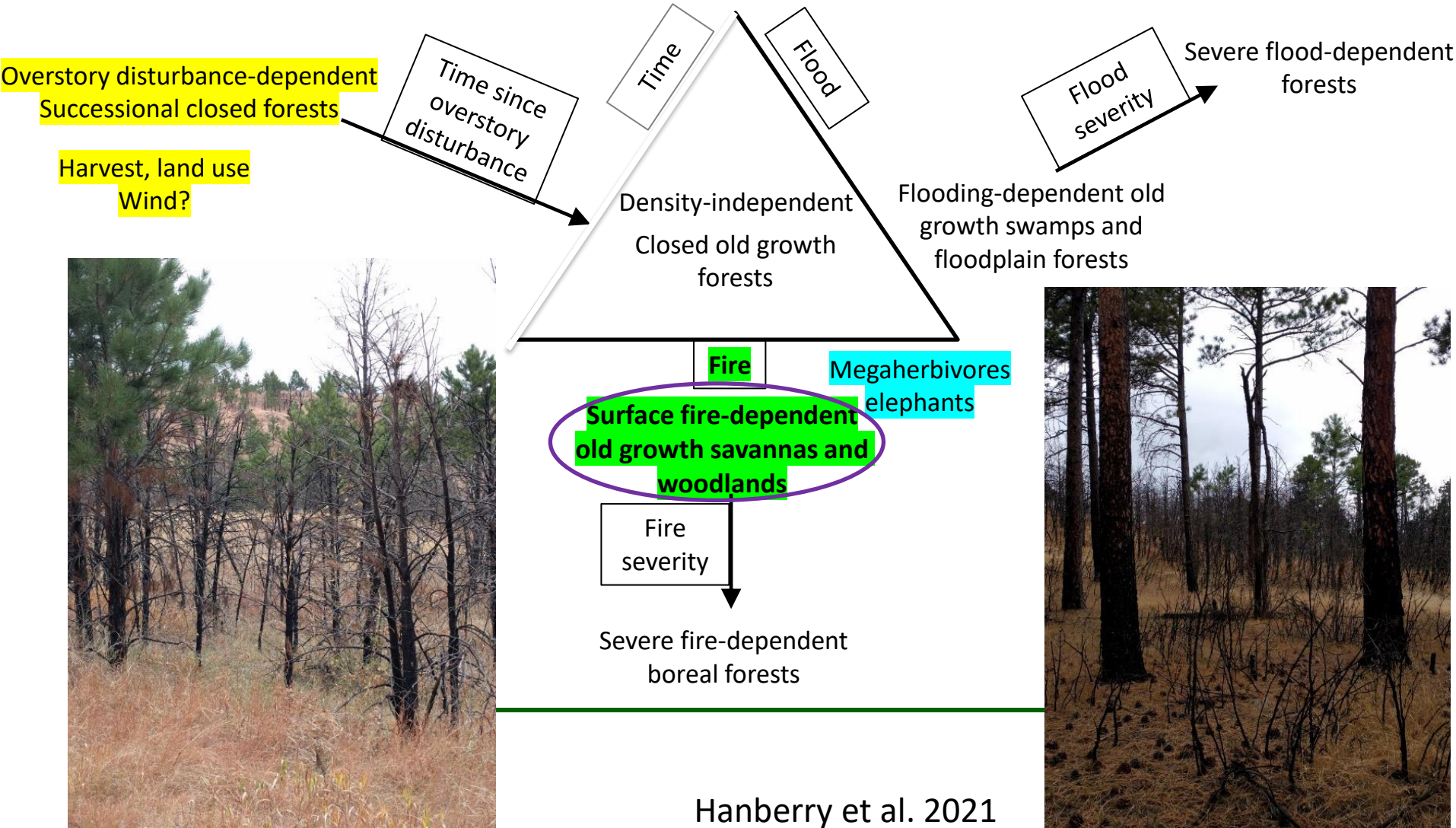
Vegetation states (trees ≥ 12.7 cm diameter) based on density (trees/ha)

Vegetation state – temperate zones	Density
Grassland	<50
Savanna	<100
Open Woodland	<175
Closed Woodland	<250
Forest	≥250



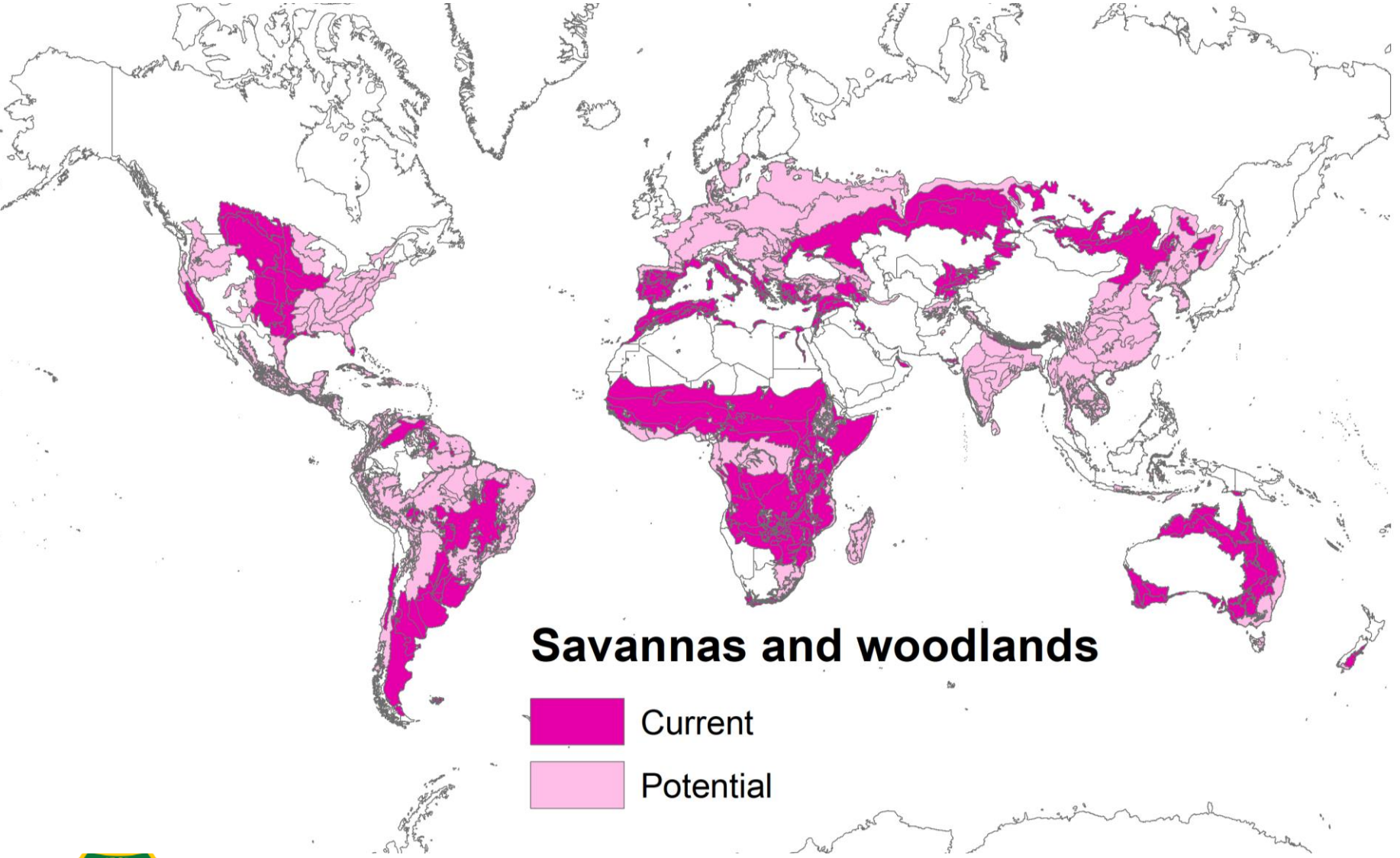
Hanberry et al. 2014, 2018

What causes open forests?



Hanberry et al. 2021

Where in the world are or were open forests?



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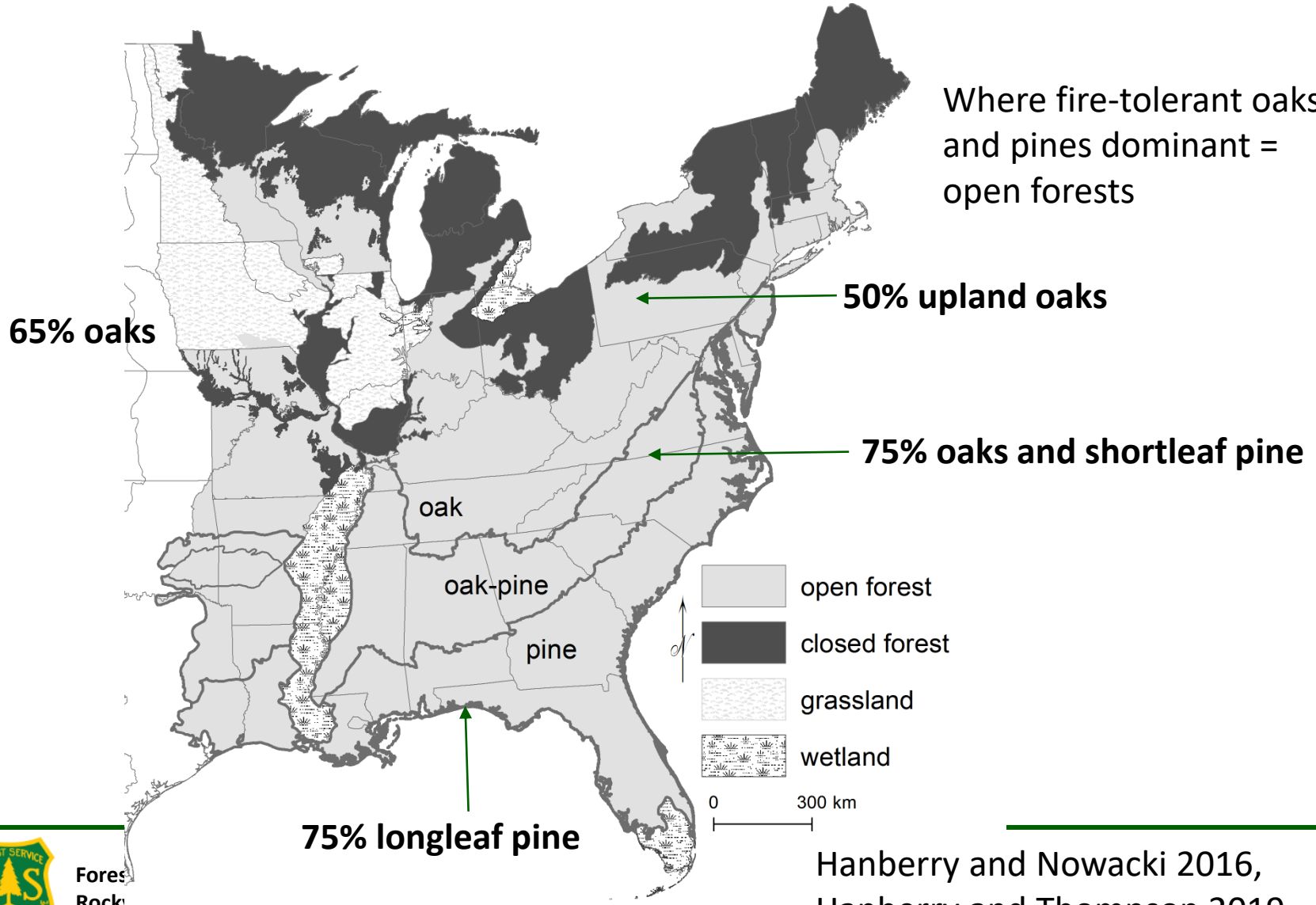
Tree composition (ca. 1620-1900): Foundational, dominant, fire-tolerant tree species



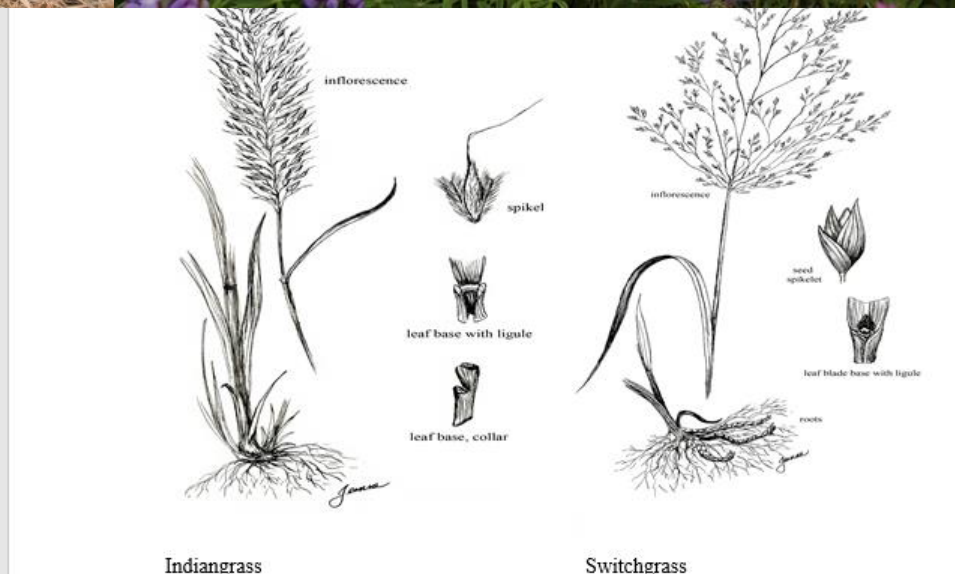
Where fire-tolerant oaks and pines dominant = open forests

Hanberry and Nowacki 2016, Hanberry and Thompson 2019

Diversity occurs in the herbaceous layer

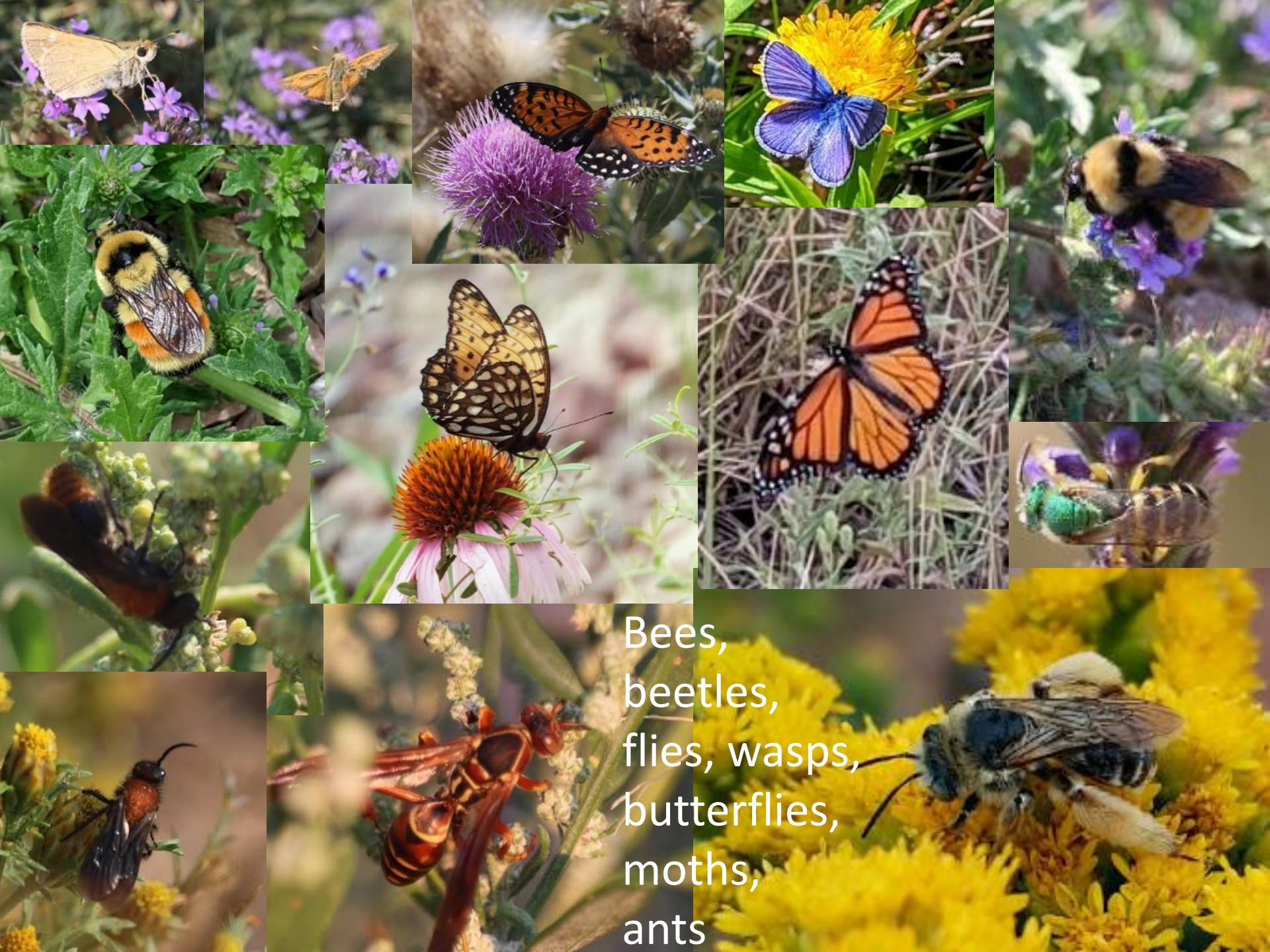
Big Bluestem

Little Bluestem



Indiangrass

Switchgrass


Bees,
beetles,
flies, wasps,
butterflies,
moths,
ants

Function – intermediate conditions

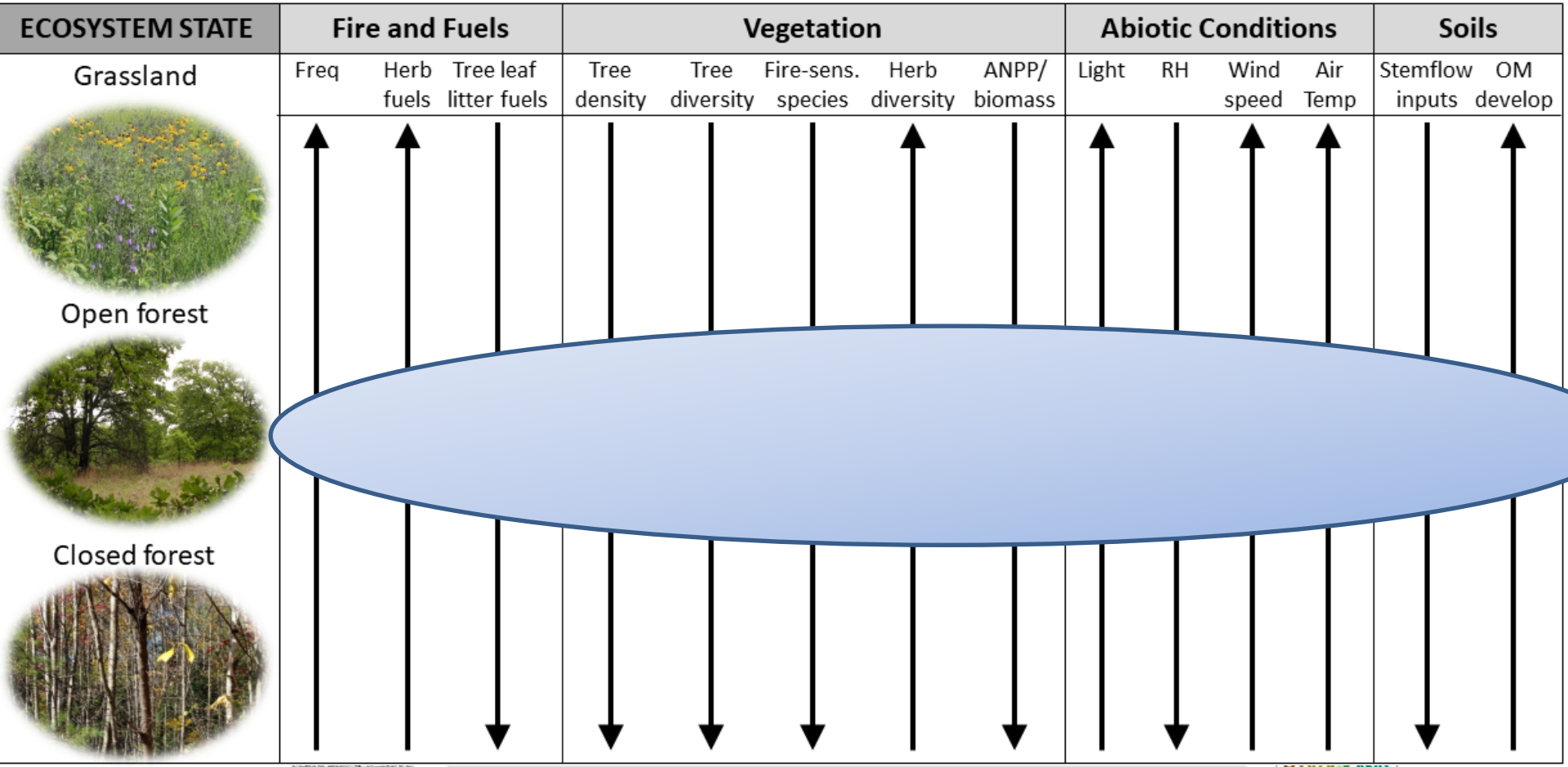


Figure 4. Gener
conditions, and
canopy forests.

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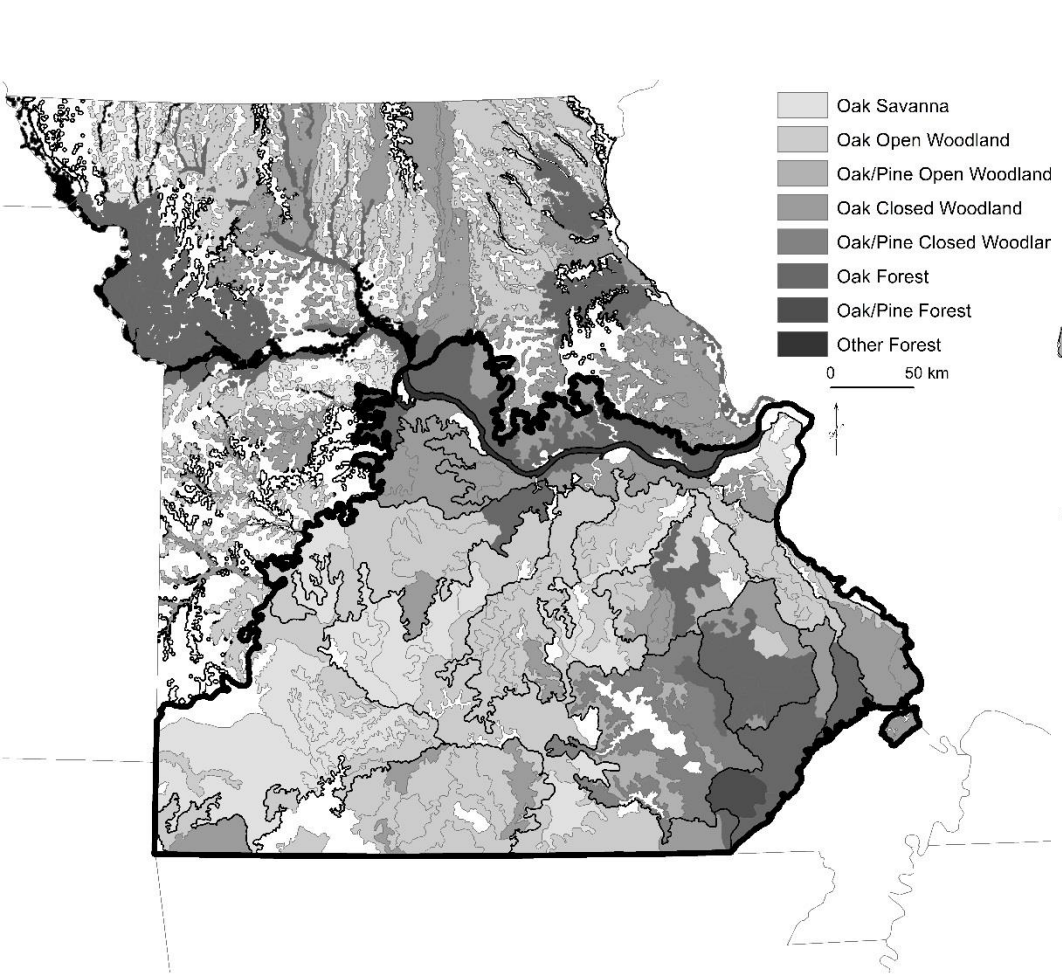
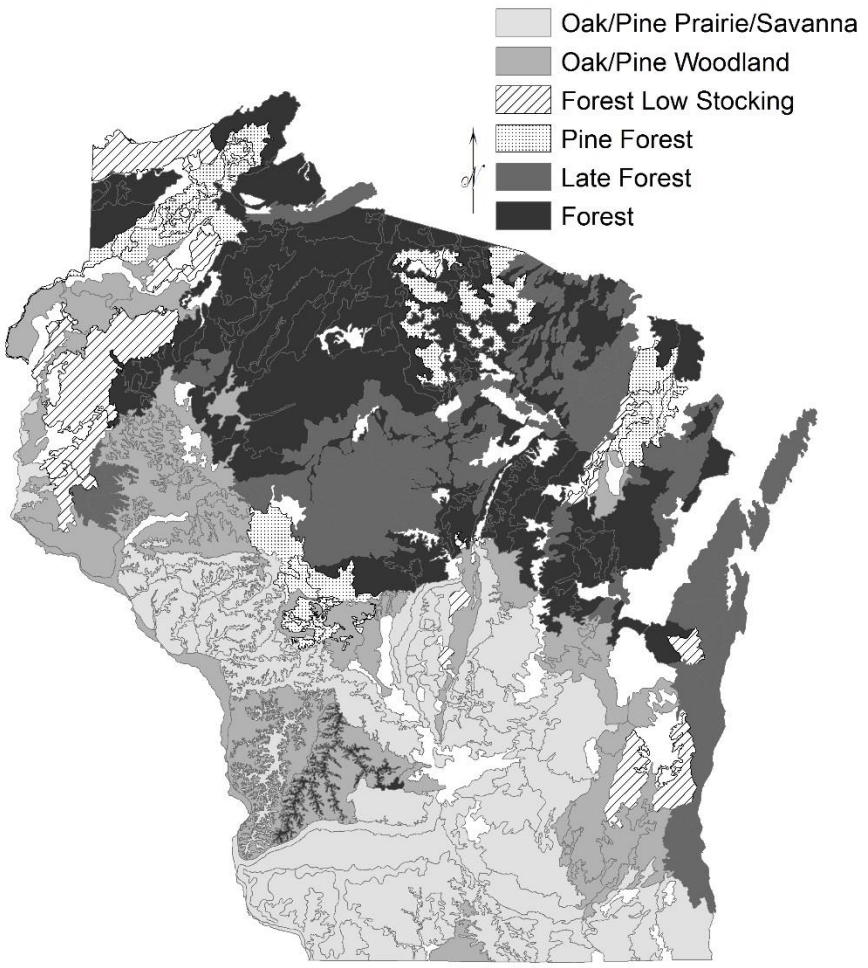
Open forest ecosystems: An excluded state

Brice B. Hanberry[a,*], Don C. Bragg[b], Heather D. Alexander[c]

Landscape scale variability – spectrum from savanna to closed forest





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Hanberry et al. 2014, Hanberry and Day 2019

Vegetation departure to current forests

fire exclusion, frequent overstory disturbance from land use

State transition from open forests of few fire-tolerant species to closed forests of many fire-sensitive species

Open Ecosystems → Closed Ecosystems

no surface fire = no disturbance to remove understory trees

Increase in fire-sensitive tree species and tree diversity
Increase in complexity of internal stand structure
Increase in tree density
Decrease in diversity of forest structure type and conditions
Decrease in abundance and diversity of herbaceous vegetation
Decrease in associated species – pollinators, 'early successional' birds
Positive feedback that increases chance of severe fires, probably insect outbreaks, drought sensitivity

Closed forests (high forests) = closed midstory

Missouri, control; C. Kinkead

Shortleaf pine-oak forest

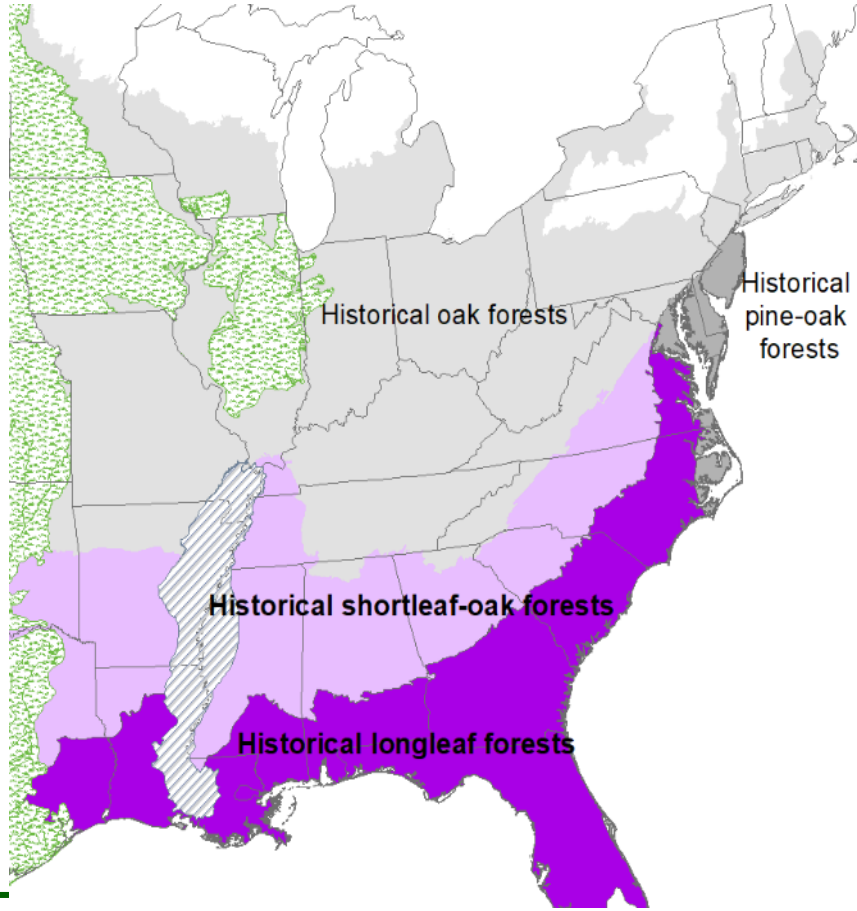
- Historically covered about 32 to 38 million ha, 75% of all trees
- Decreased to about 2.5 million ha and shortleaf pine is 3% of all trees

Longleaf pine forest

- 30 million ha, at 75% of all trees
- 1.3 million ha and 3% of all trees

Oak open forests and grasslands

- also remnants

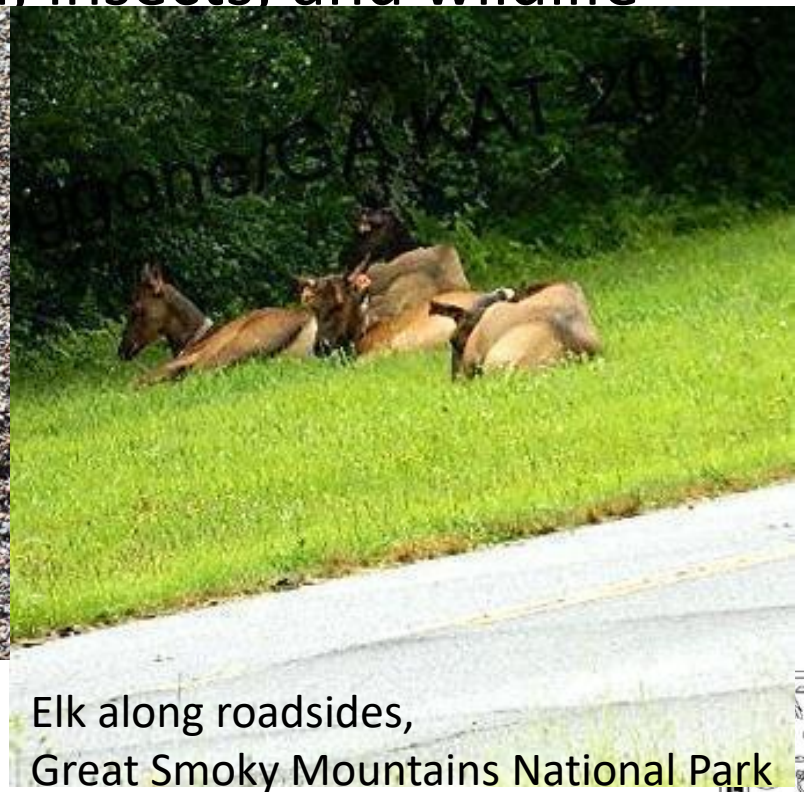


Too many trees is a problem

herbaceous plants, fungi, insects, and wildlife

Butterflies along roadsides, Great Smoky Mountains National Park

Wildlife Society Bulletin; DOI: 10.1002/wsb.957



Elk along roadsides,
Great Smoky Mountains National Park

In My Opinion

Open Forest Management for Early Successional Birds

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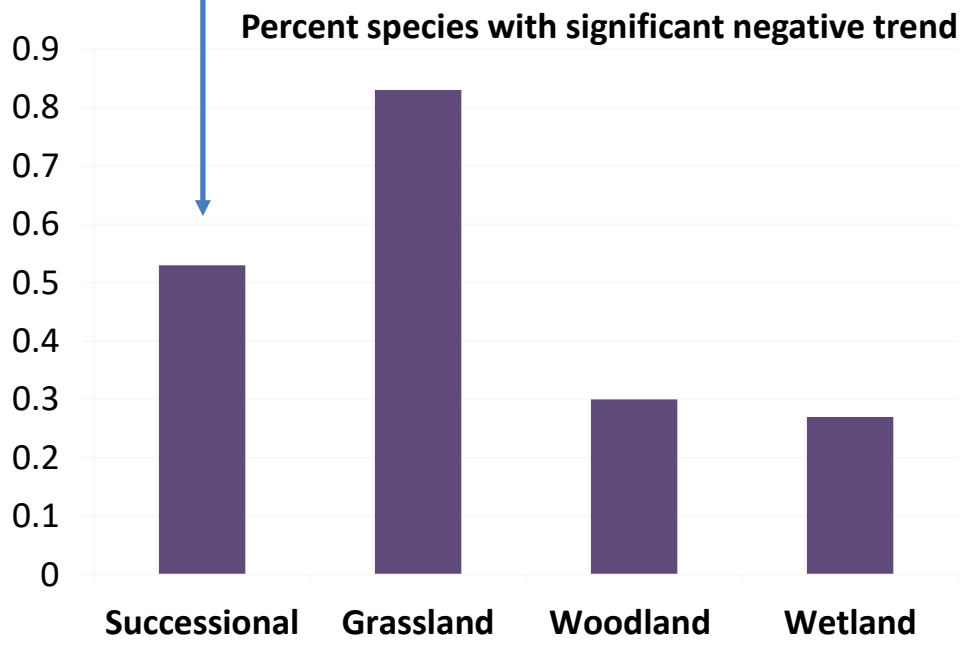
Example: Birds

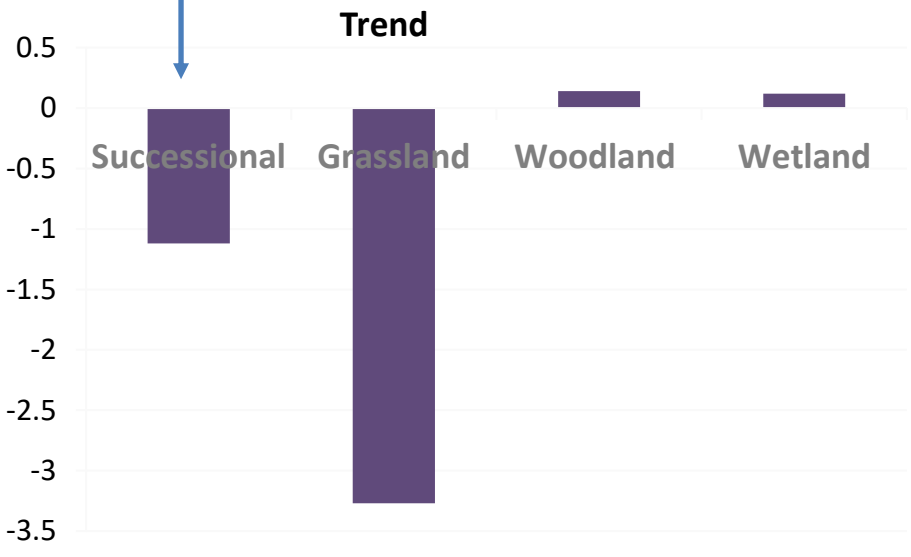
Current forests of the eastern U.S. are not supporting "early-successional" (likely open forest) or grassland bird species

(21% non-significant negative trend)

53% species significant negative trend



-1.12 all successional guild



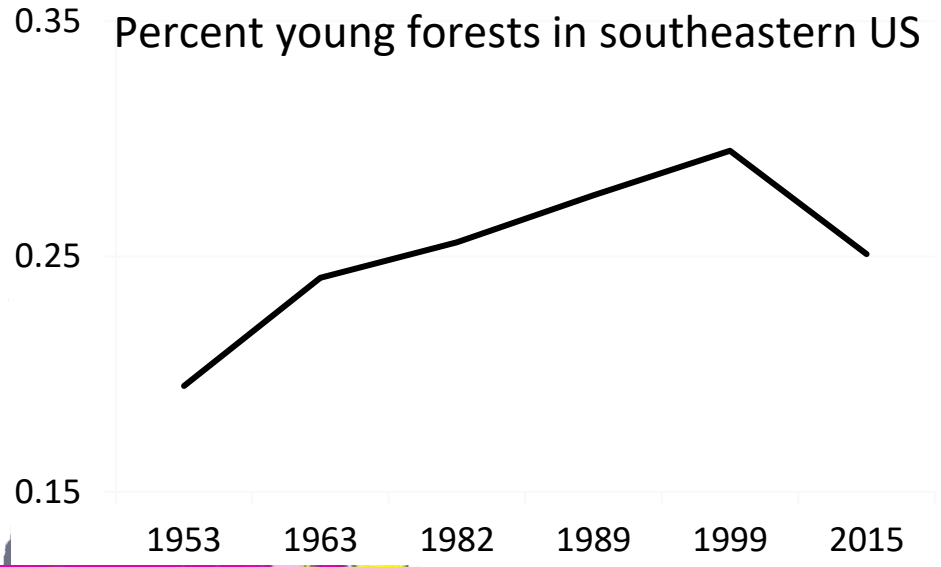
USGS North American Breeding Bird Survey 1966-2015

Successional birds aren't declining because there isn't enough successional forest

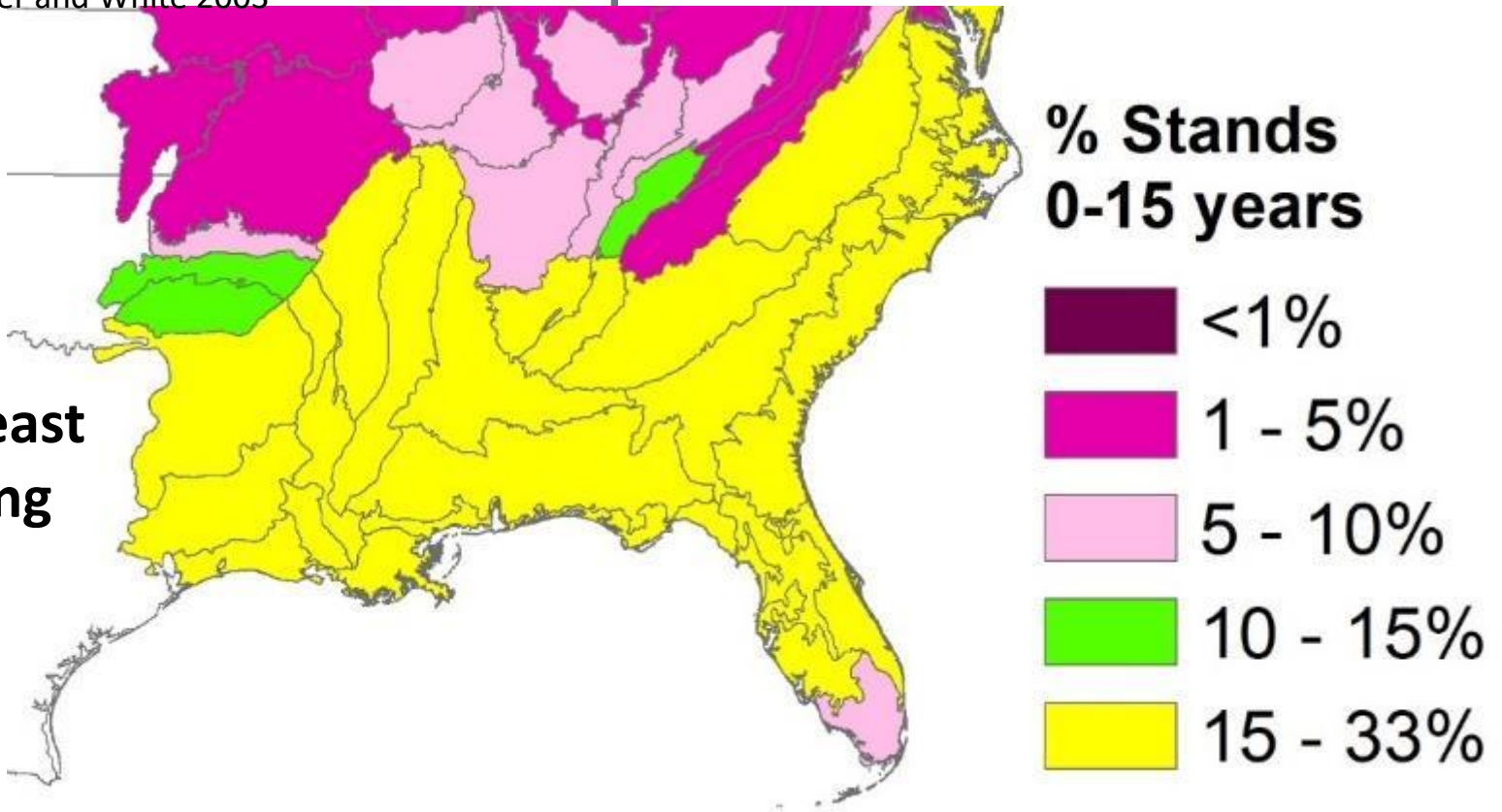
Historical (pre-settlement) early successional forests <1%-10% of landscape, depending on vegetation type

Early successional forests 1-3% landscape in oak and northern hardwood forests

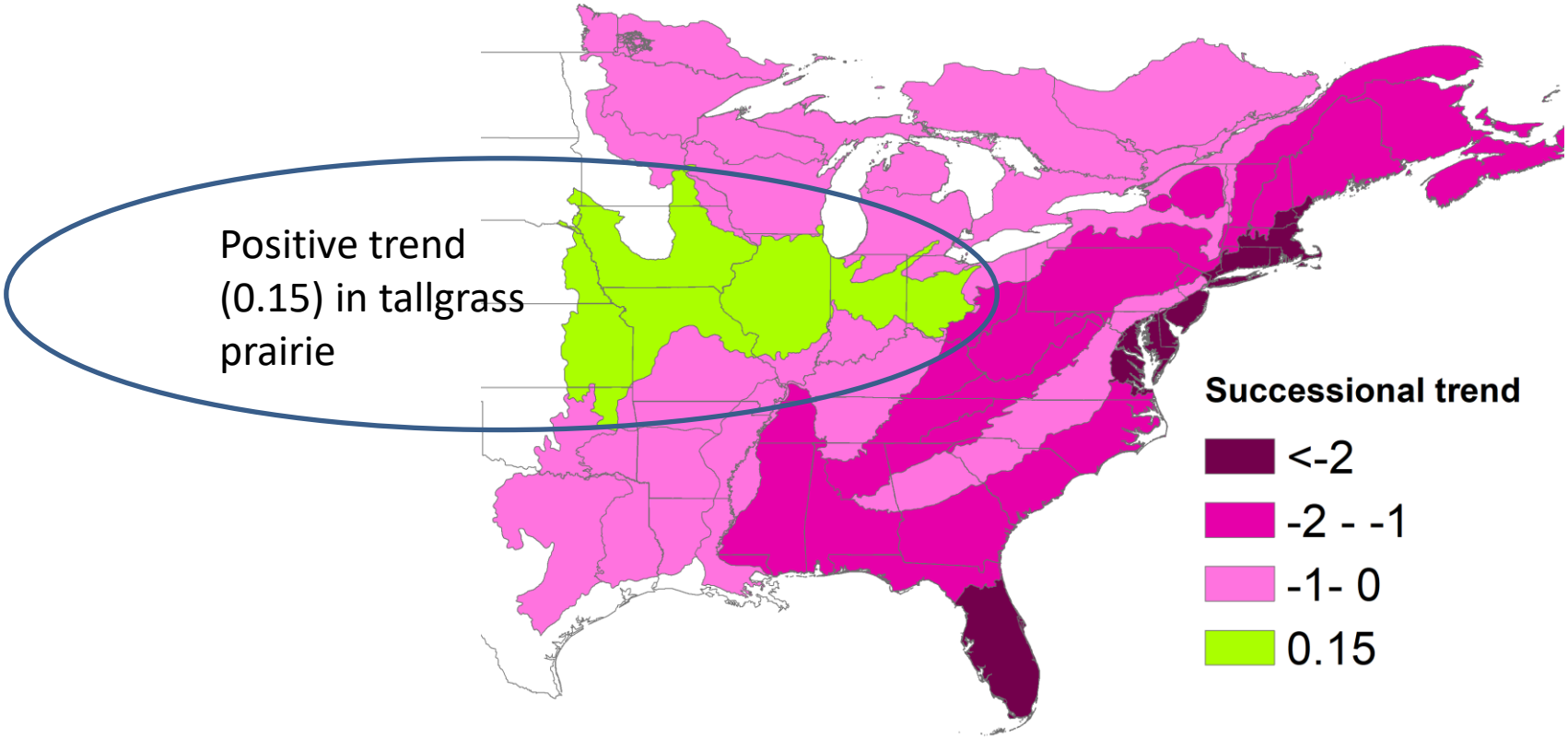
Lorimer 2001, Lorimer and White 2003



The Southeast is 25% young forest!



The only landscape in the eastern U.S. with positive successional bird trends contains 55% crops and 20% pasture, in the former tallgrass prairie



Management

Because creation of transient clearcuts to regenerate young forests appears to be ineffective in supporting successional species

Grassland and open forest restoration to support biodiversity (plants, insects, birds, mammals, fungi)

- Mechanical and chemical treatments, but fire for full diversity (asteraceae, fabaceae, geraniaceae)

Open forest management

Maintain the tree overstory and herbaceous understory

Remove tree regeneration in understory and midstory

- Rather than the focus of harvest and regeneration of traditional silviculture

Remove overstory trees of increasing, expanding fire-sensitive species if possible

- Too much removal of large overstory trees will release understory trees
- Thin some overstory trees when market values are strong

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Review and synthesis

Silvicultural options for open forest management in eastern North America

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Achieve bilayer of overstory trees and herbaceous ground layer

Strategic with resources

1) Restore forests with greatest potential

    Herbaceous plants, exposed environmental conditions (dry, flat, windy, sunny)

2) Closed woodlands may be easier to maintain than savannas

    Large diameter trees control resources

    Better to have greater area of woodlands than smaller area of savannas

3) Fire may be necessary to control trees and for germination of herbaceous plants

Recognition of another forest type option besides closed forests: Open forests of fire-tolerant species

Open Ecosystems ← Closed Ecosystems

surface fire, browsing

Increase in fire-tolerant tree species
Decrease in tree diversity
Decrease in complexity of internal stand structure
Increase in forest structure gradient and conditions
Decrease in tree density
Increase in herbaceous vegetation
Positive feedback that increases flammable conditions (reduces severe fire risk)
Increase in understory disturbance
Decrease in overstory disturbance

Distinct ecosystems with unique biodiversity, landscape diversity in conditions, and management practices!

Questions? Comments?

Please email me at brice.hanberry@usda.gov