New Advancements in Understanding Shortleaf Pine Ecology and Fire Throughout its Range

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University of Missouri

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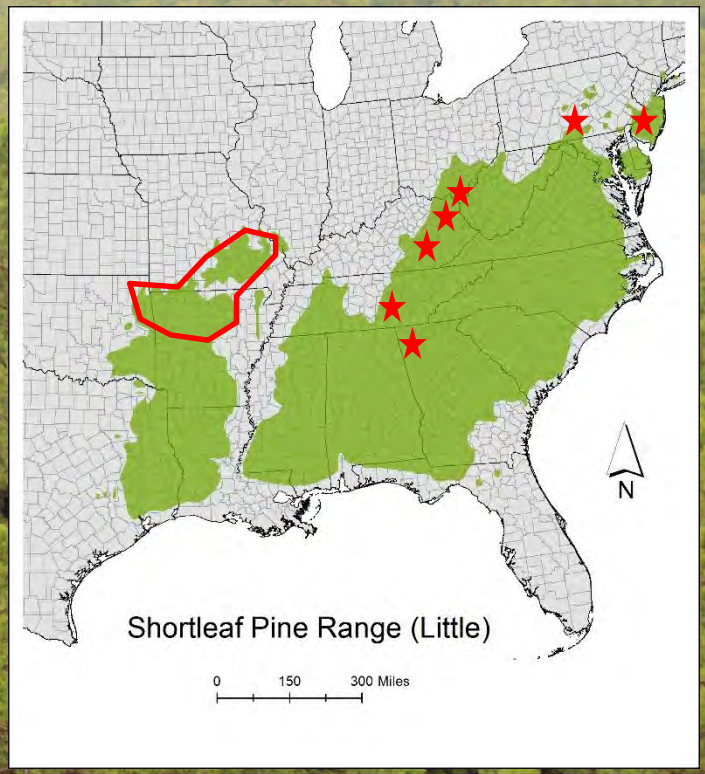
OUTLINE

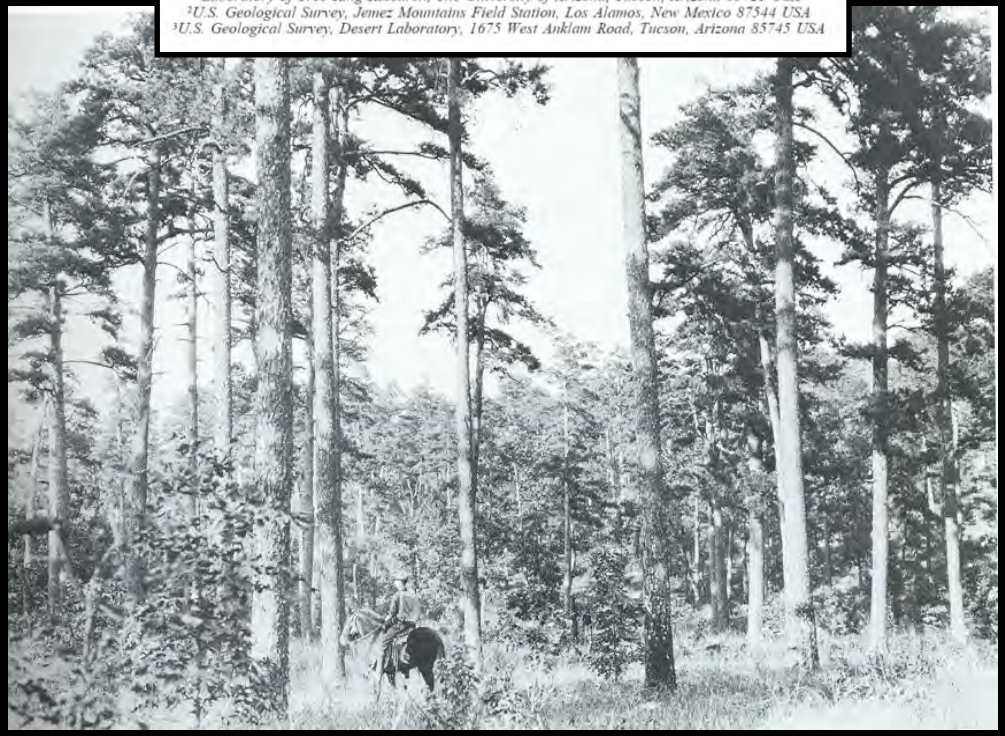
- Ozark shortleaf ecology and fire
- New pursuits, advancements, and realizations



APPLIED HISTORICAL ECOLOGY

Applied historical ecology is the consideration of historical data in the management of ecosystems.

Historical perspectives increase our understanding of the dynamic nature of landscapes and provide a frame of reference for assessing modern patterns and processes.



APPLIED HISTORICAL ECOLOGY:
USING THE PAST TO MANAGE FOR THE FUTURE

THOMAS W. SWETNAM,[1,4] CRAIG D. ALLEN,[2] AND JULIO L. BETANCOURT[3]

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[2]*U.S. Geological Survey, Jemez Mountains Field Station, Los Alamos, New Mexico 87544 USA*
[3]*U.S. Geological Survey, Desert Laboratory, 1675 West Anklam Road, Tucson, Arizona 85745 USA*

From*: Sawmill,* (Univ. of Arkansas Press)

THE GREAT DISRUPTION

Lakewood southeast project area,
Chequamegon-Nicolet NF, WI

APPLIED HISTORICAL ECOLOGY

NOT an aim to restore to some previous condition

But, rather, to provide:

- frame of reference for assessing modern patterns and processes

- ability to set 'achievable and sustainable management goals' (Swetnam et al. 1999)

"A science of land health needs, first of all, a base datum of normality, a picture of how healthy land maintains itself as an organism."

Aldo Leopold 1941


Photo: Scot Robinson

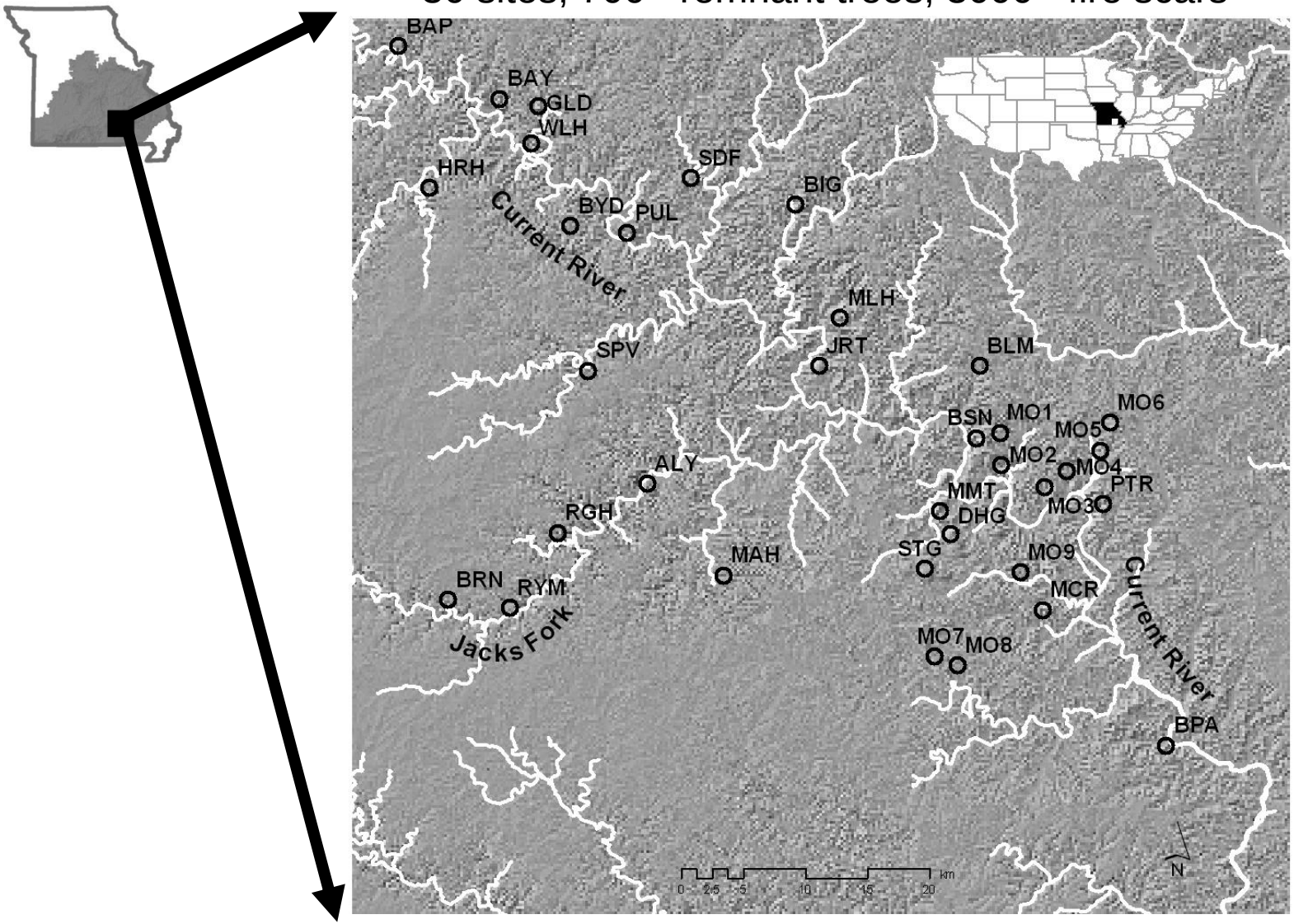

Photo: Joe Marschall

Historical fire and forest data is available from many locations

Fire History of the Current River watershed

The most studied watershed east of the Rockies

30 sites, 700+ remnant trees, 3000+ fire scars



Stambaugh and Guyette. 2008. Forest Ecology and Management 254: 463-473.

Fire History of the Current River watershed

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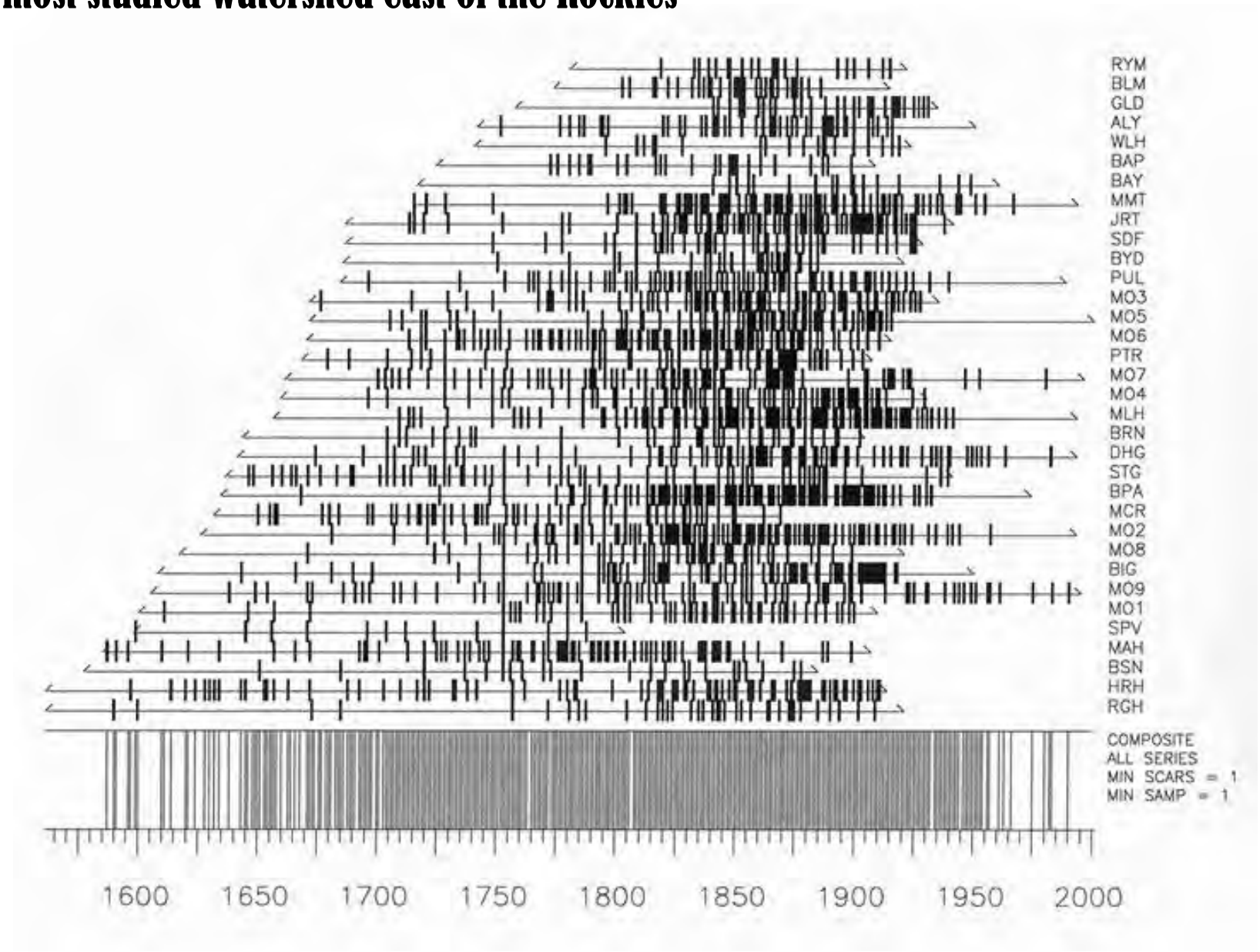
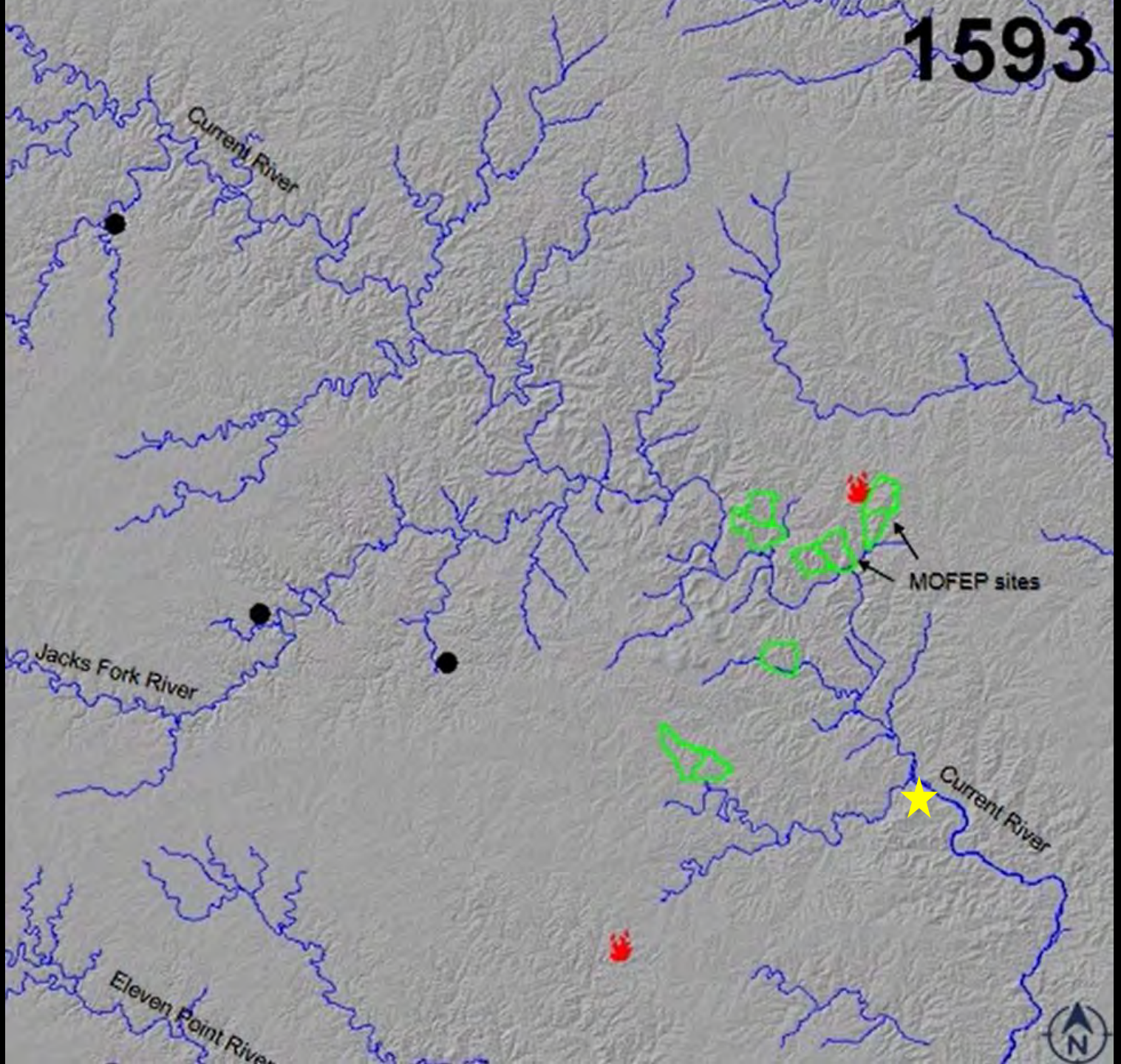
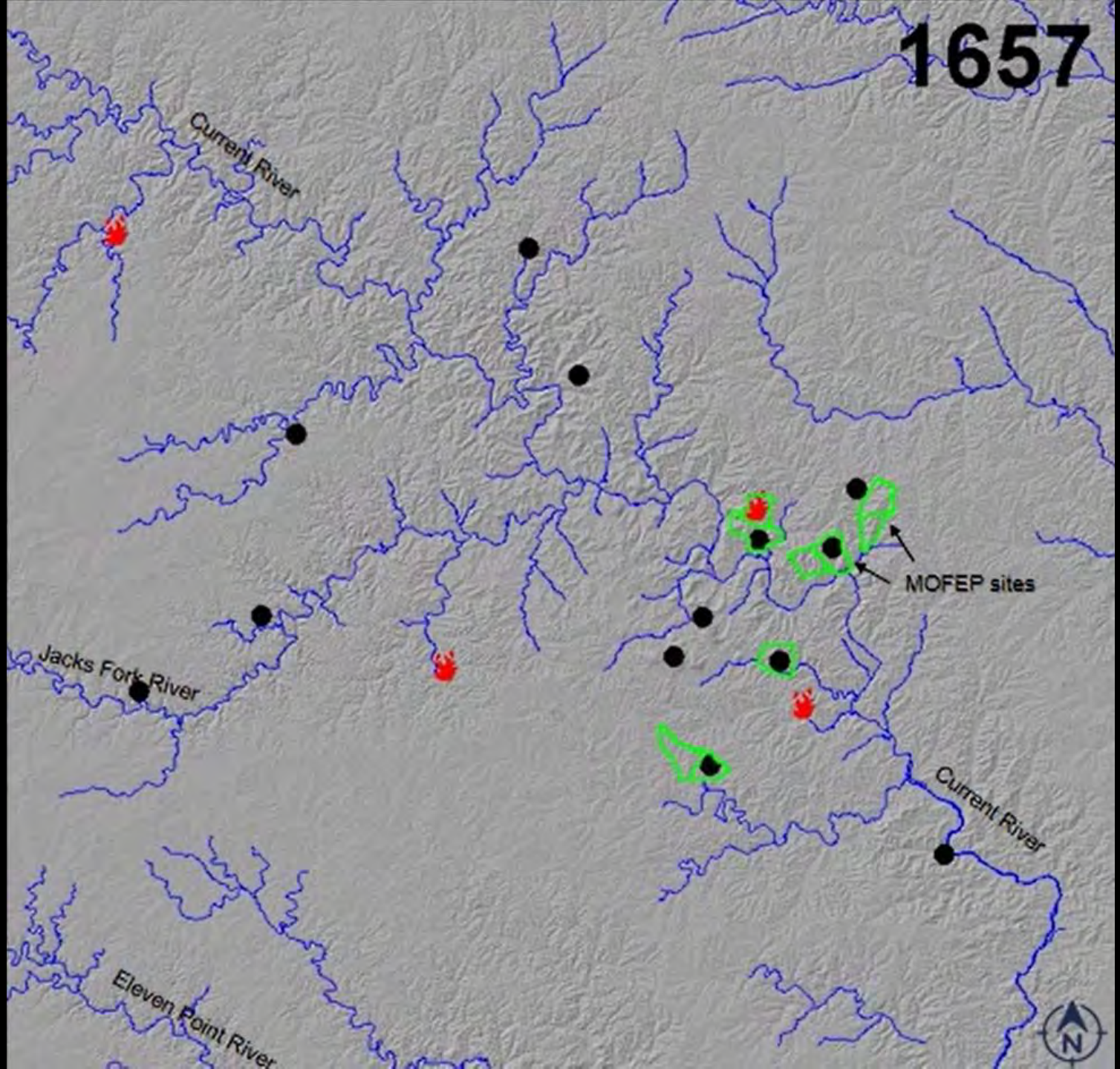
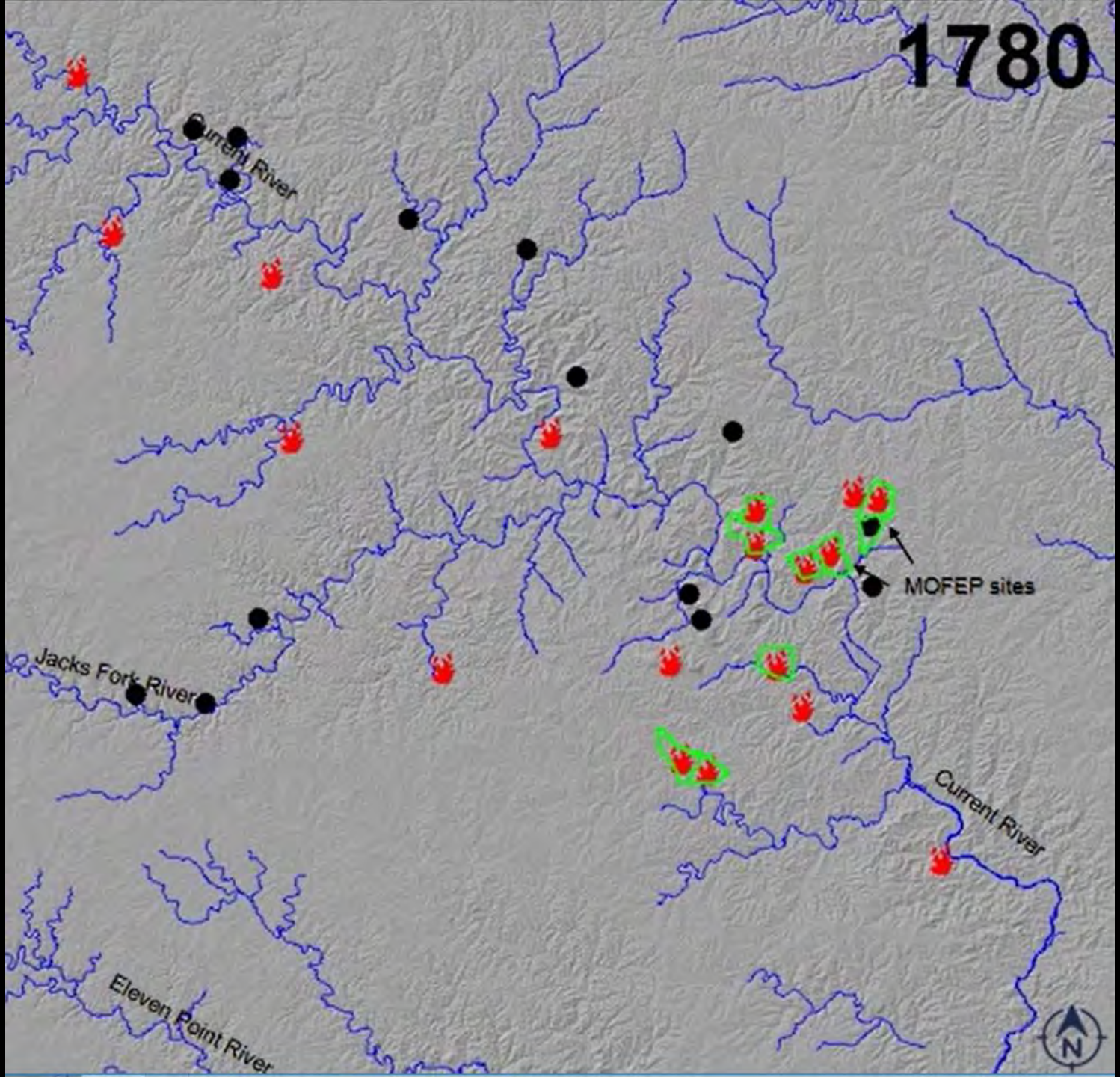
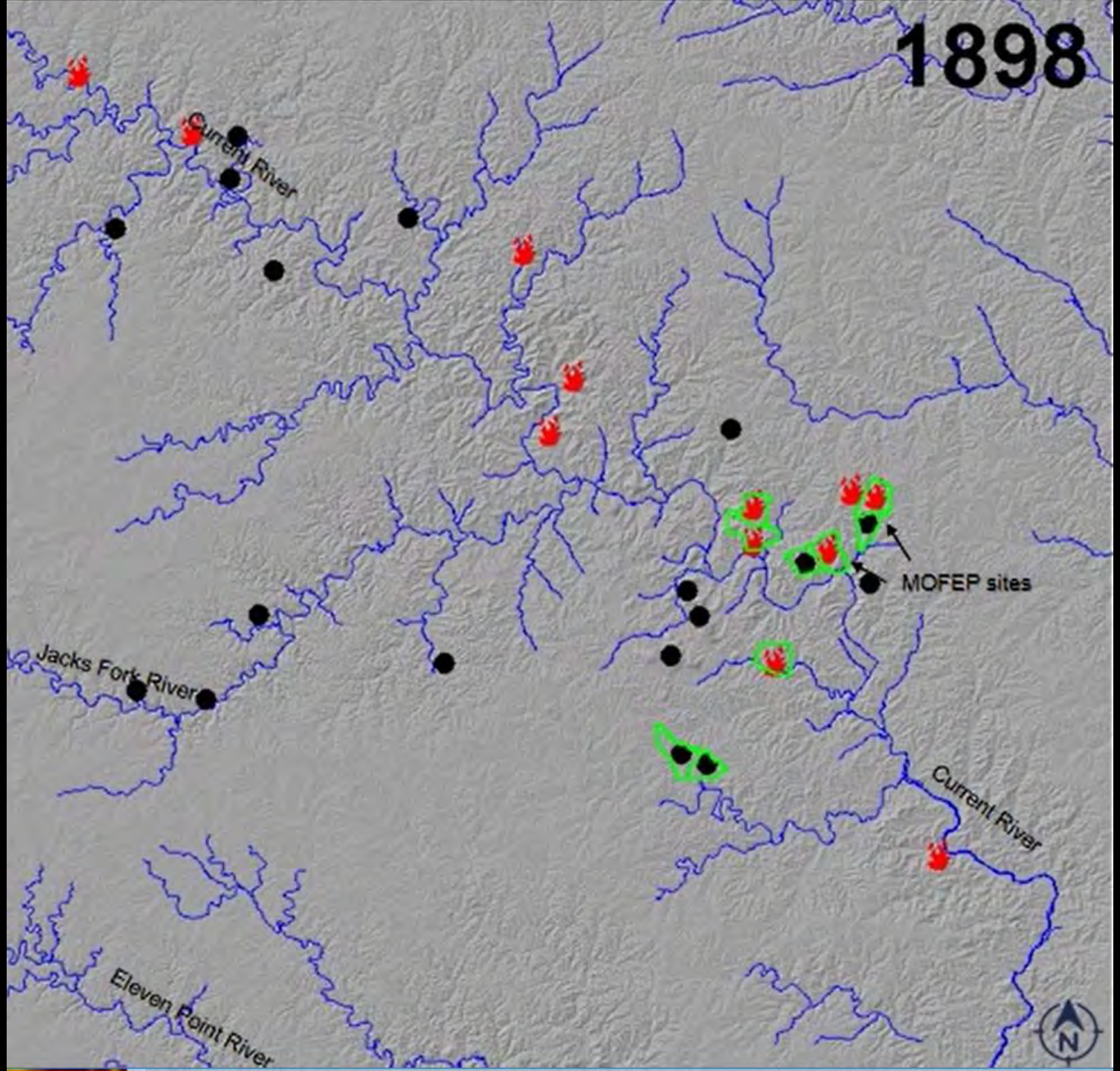


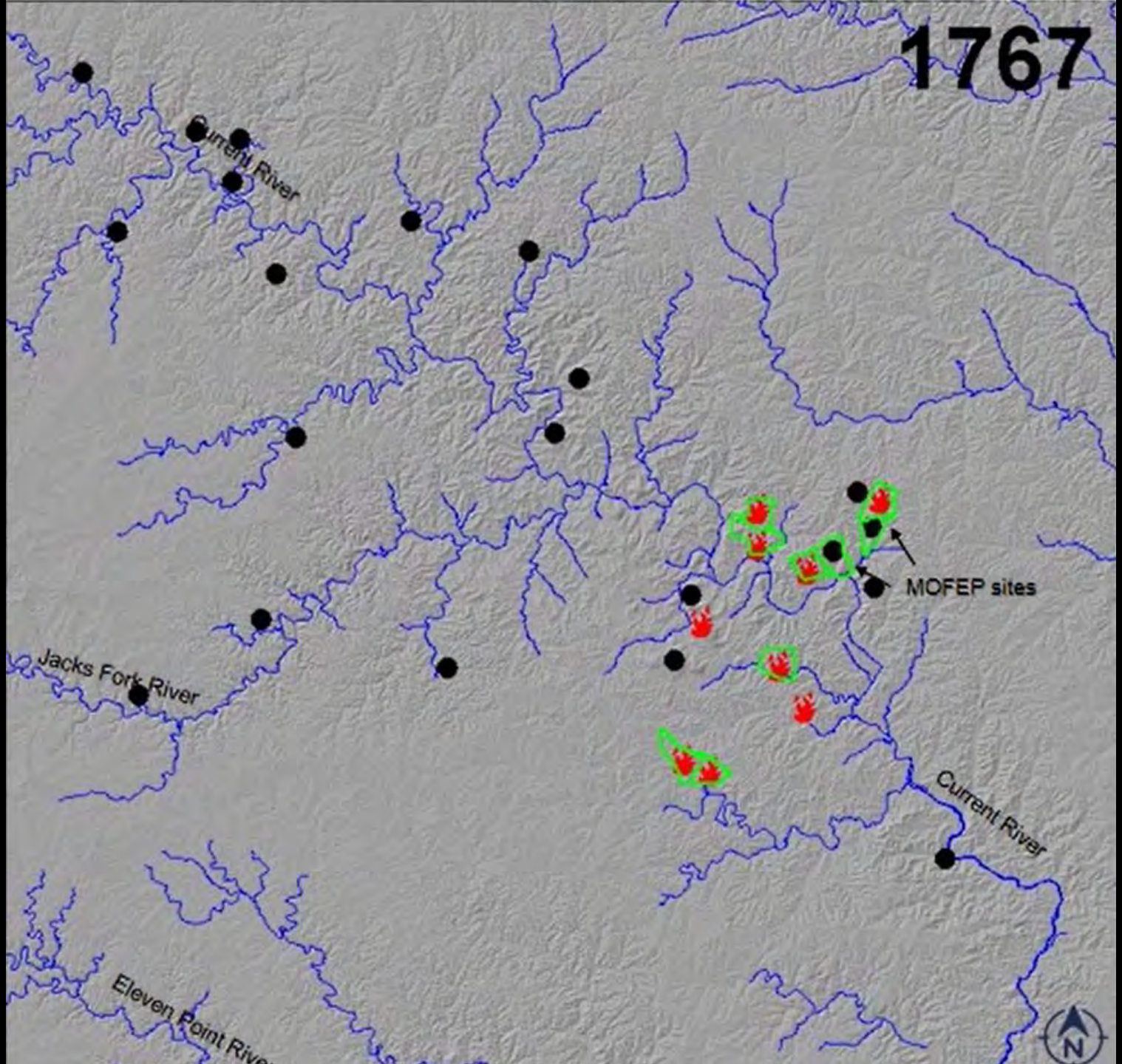
Stambaugh and Guyette. 2008. Forest Ecology and Management 254: 463-473.


1593
Current River
MOFEP sites
Jacks Fork River
Current River
Eleven Point River
N


1657
Current River
MOFEP sites
Jacks Fork River
Current River
Eleven Point River
N


1780
Current River
MOFEP sites
Jacks Fork River
Current River
Eleven Point River
N


1898
Current River
MOFEP sites
Jacks Fork River
Current River
Eleven Point River
N


1767
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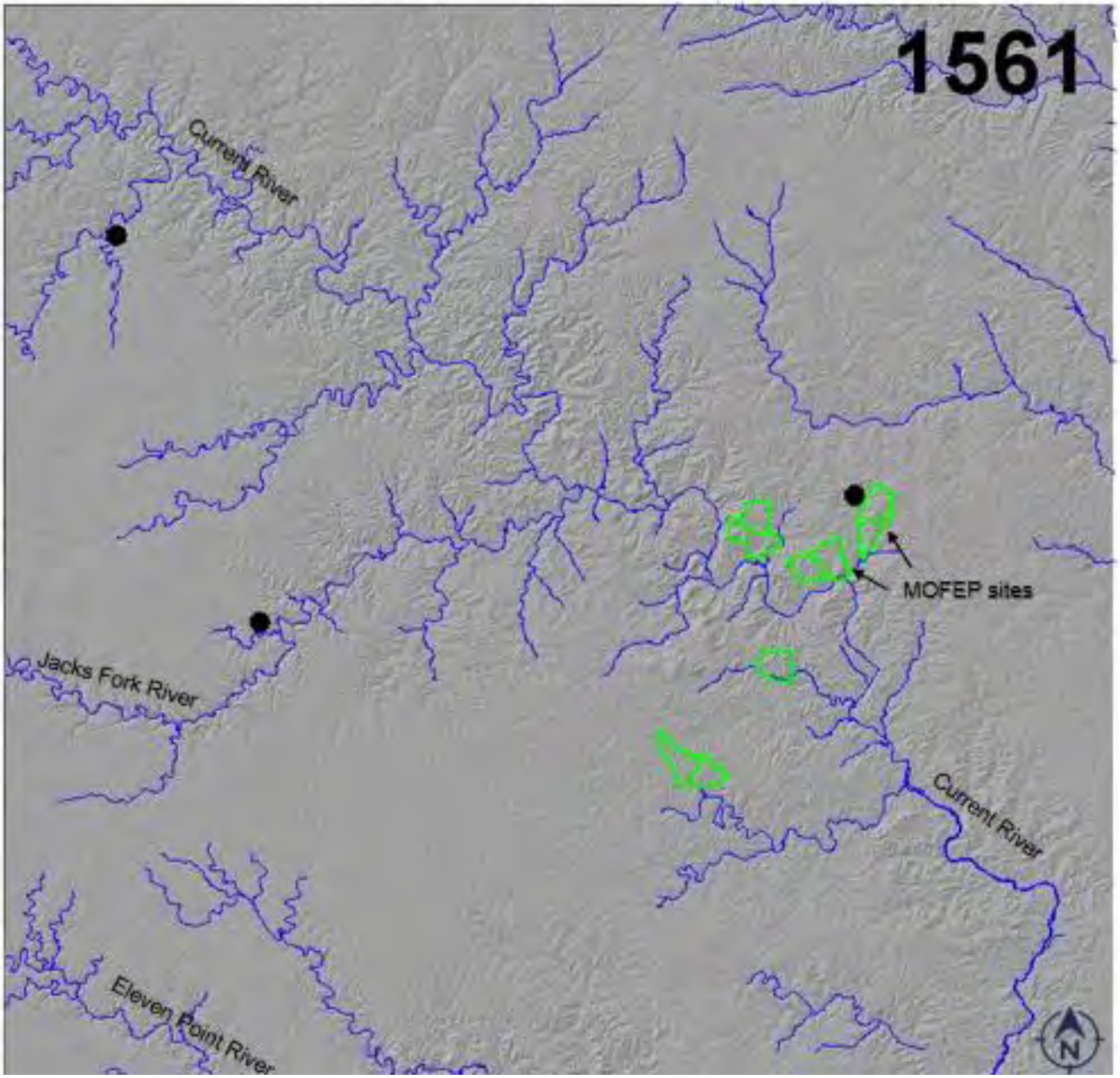
MOFEP sites
Jacks Fork River
Current River
Eleven Point River
N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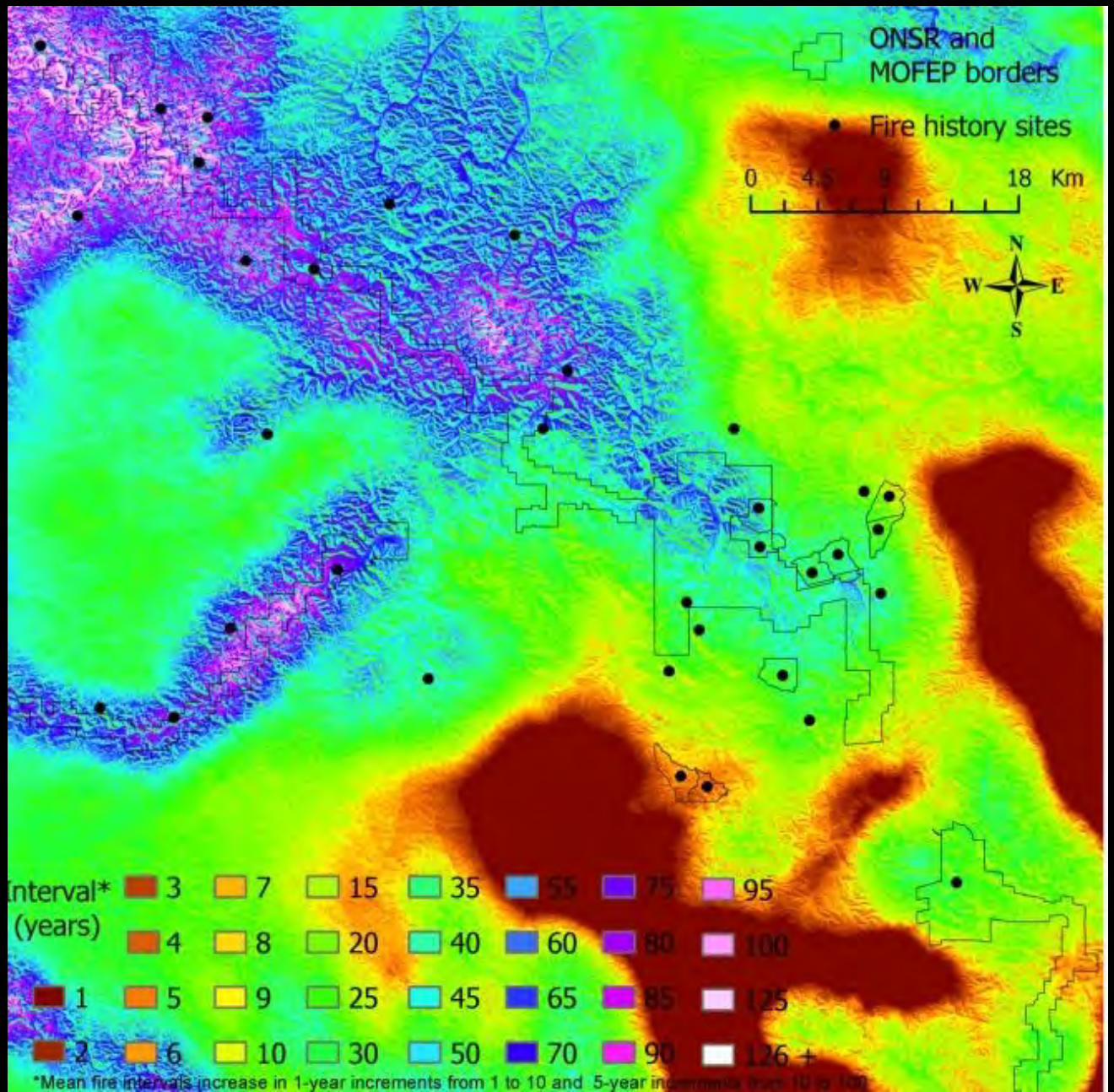
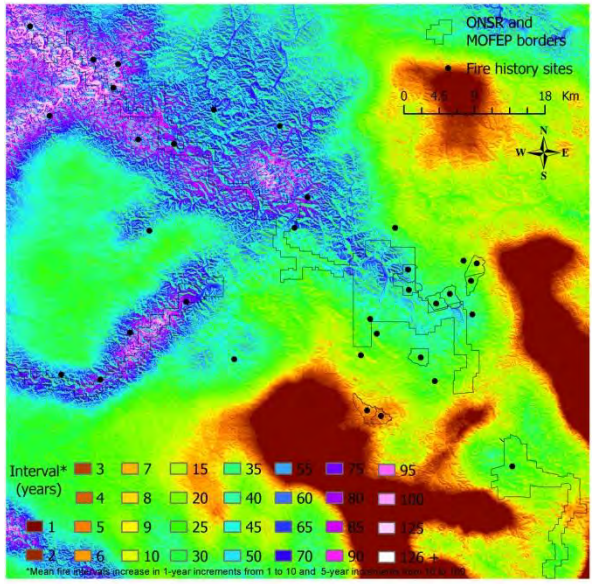
MOFEP sites
Jacks Fork River
Current River
Eleven Point River
N

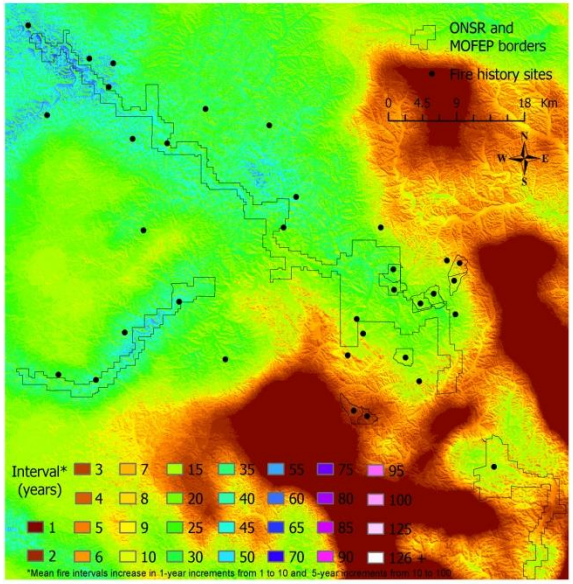
1620-1700


ONSR and
MOFEP borders
Fire history sites
0
4.5
9
18 Km
N
W
E
S
Interval*
(years)
1
2
3
4
5
6
7
8
9
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
95
100
125
126 +
*Mean fire intervals increase in 1-year increments from 1 to 10 and 5-year

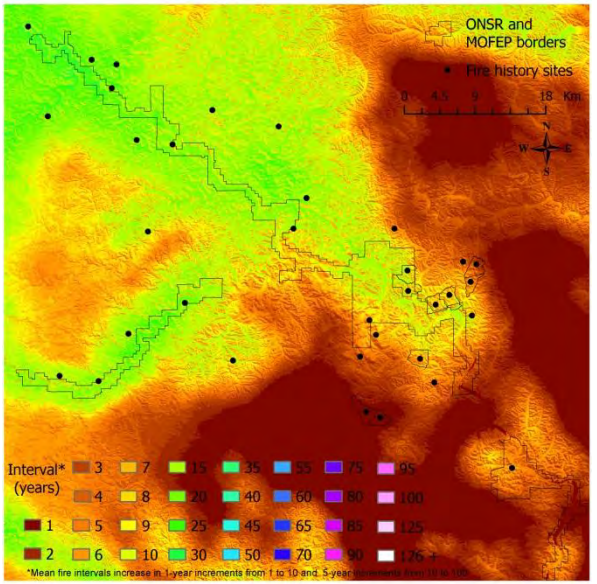
1620-1700



1701-1780



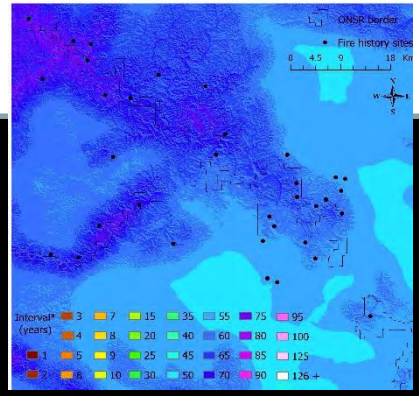
1781-1820



Stambaugh and Guyette. 2008. Forest Ecology and Management 254: 463-473.

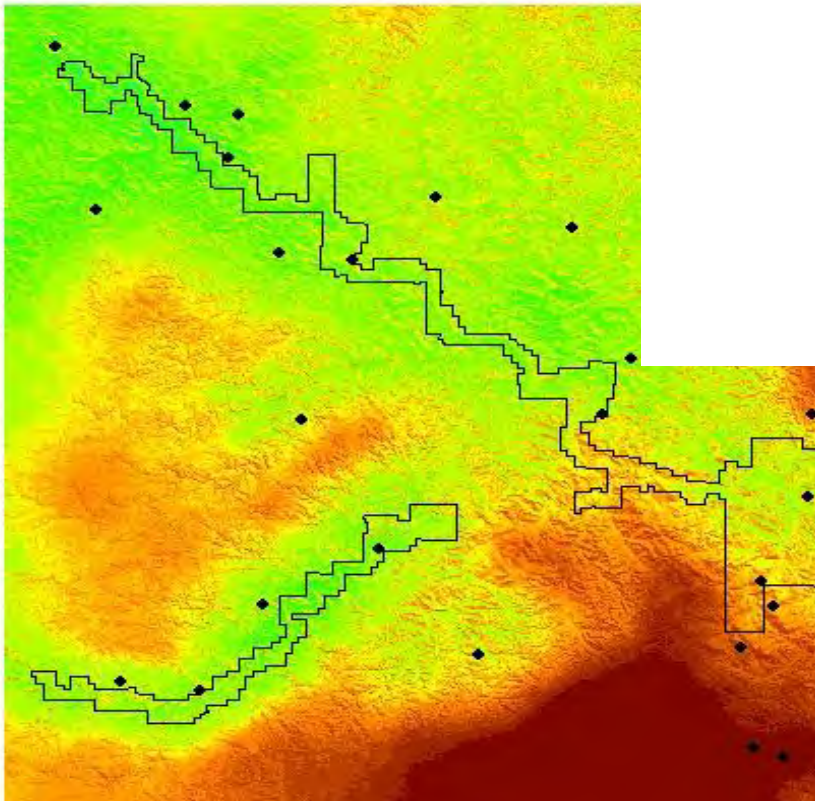
1950-2000

(not modeled)



Historical Fire Frequency 1781-1820

(Guyette et al. 2002, Stambaugh and Guyette 2008)



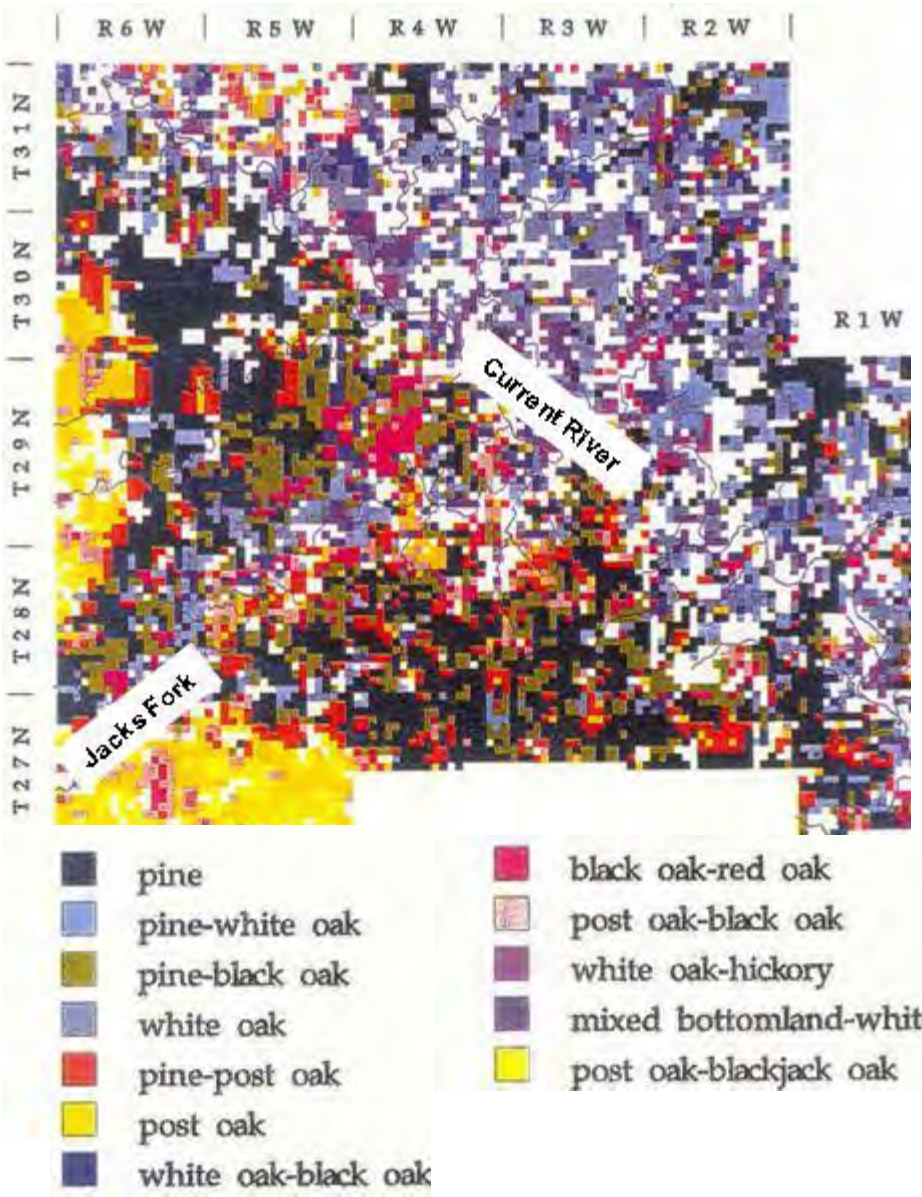
Interval* (years)

1	3	7	15	35	55	75	95
2	4	8	20	40	60	80	100
	5	9	25	45	65	85	125
	6	10	30	50	70	90	126 +

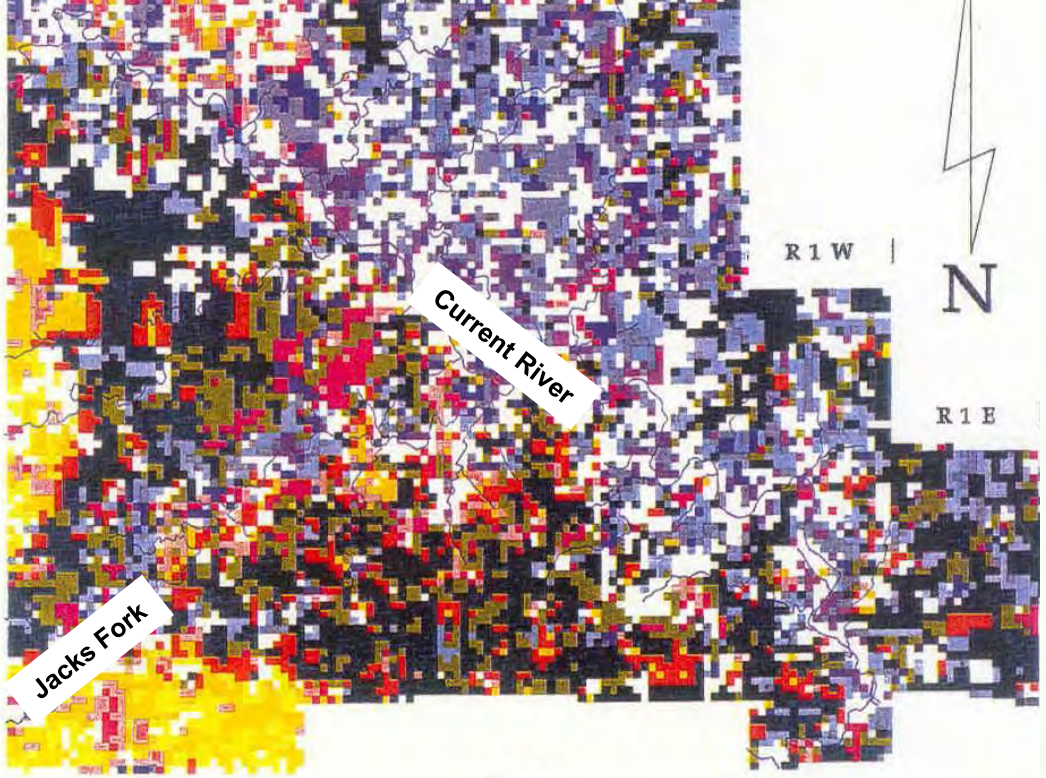
*Mean fire intervals increase in 1-year increments from 1 to 10 and 5-year increments from 10

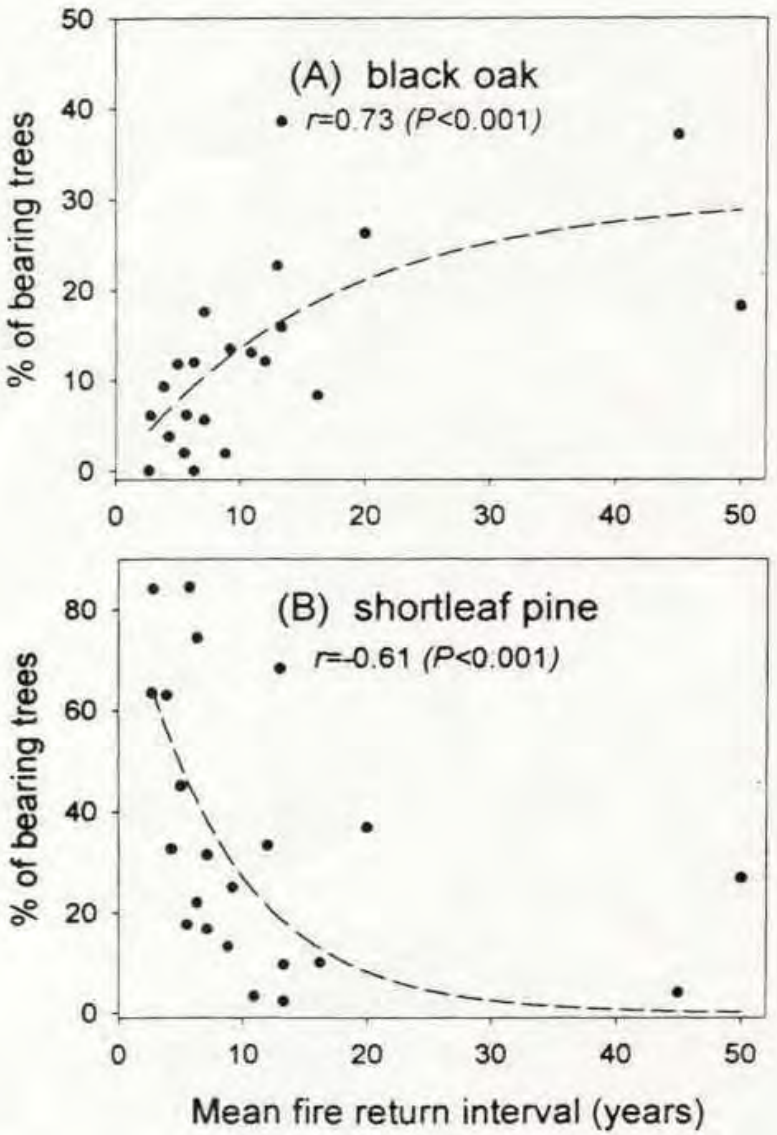
Historical Vegetation 1815-1850

(Batek et al. 1999)



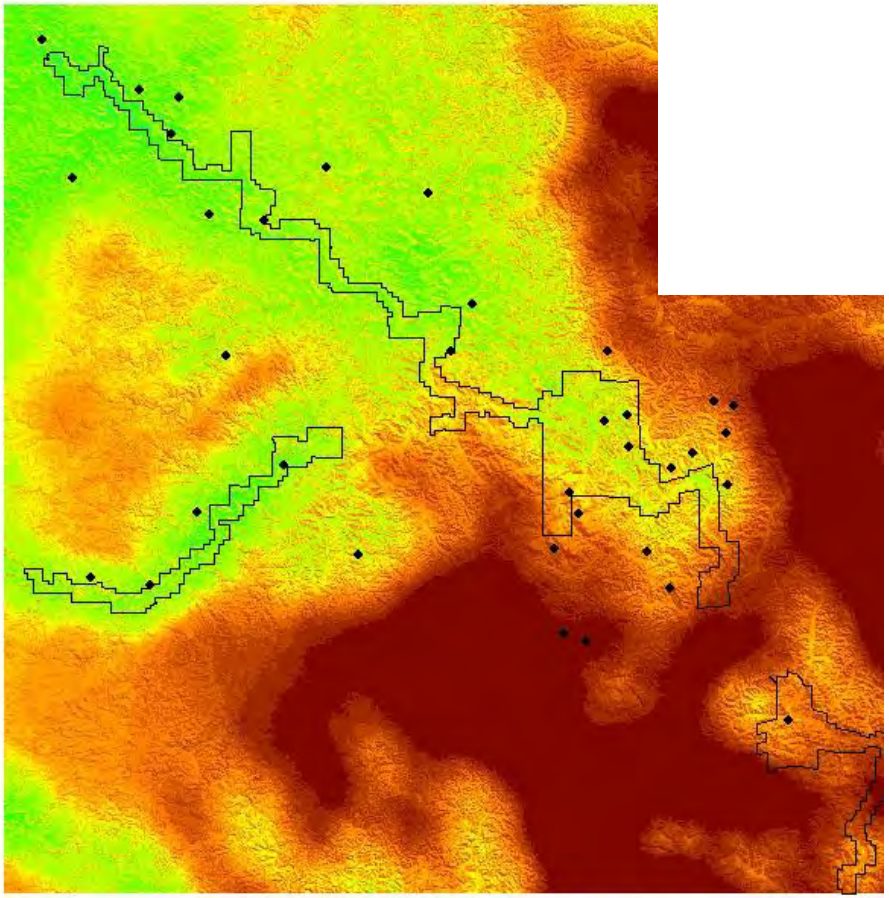
GLO Survey note reconstructed forest vegetation of the Current / Jacks Fork Rivers region (Batek et al. 1999)





Historical Fire Frequency 1781-1820

(Guyette et al. 2003, Stambaugh and Guyette 2008)



Interval* (years)

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	5	9	25	45	65	85	125
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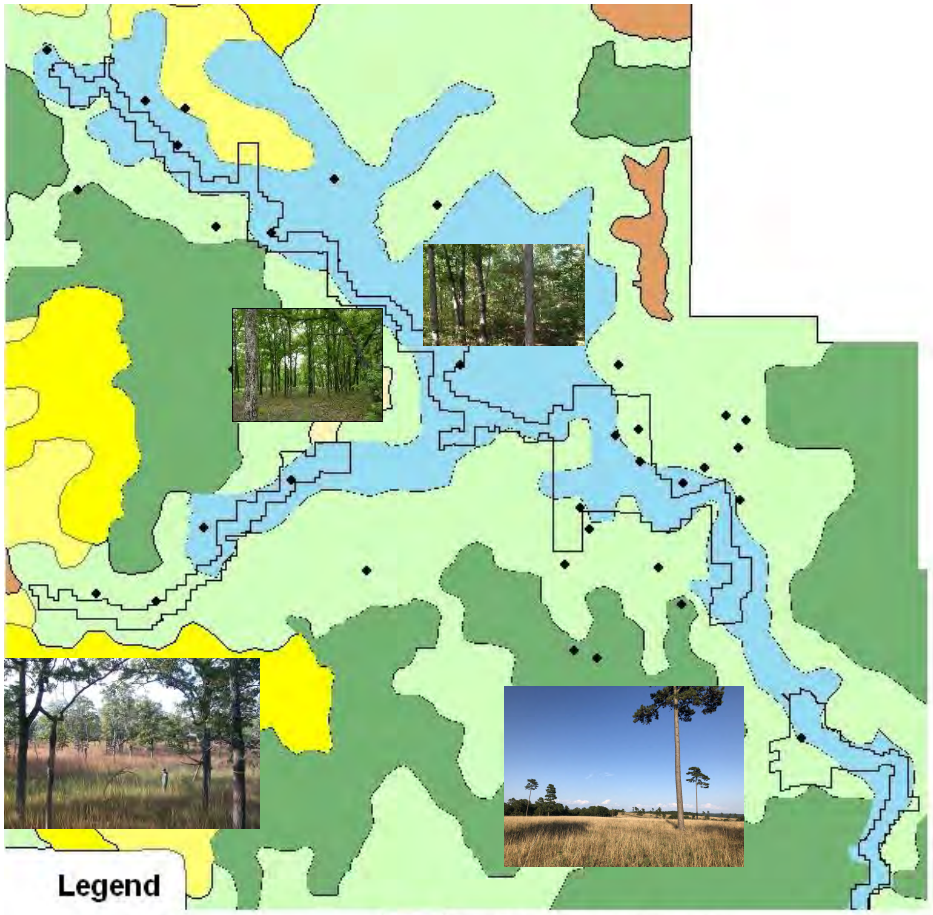
*Mean fire intervals increase in 1-year increments from 1 to 10 and 5-year increments from 10 to 100

Historical Vegetation 1815-1850

(Hughes & Nigh 2000)



Legend

Historic Veg

ASSOC_TYPE

- Bootheel Mixed Bottoms
- Mesic Mixed Oak-Riparian
- Mixed Oak Forest
- Oak-Pine Woodland/Forest
- Pine Savanna/Woodland
- Post Oak Savanna
- Post Oak-Black Oak Savann
- Post Oak-Black Oak Woodla

Summary of shortleaf pine fire regime in the Ozarks

Fire frequency

Range 1– 30 yrs (Pre-EuroAmerican settlement), mean 5-15 yrs pre-EAS, biannual burning during EAS

Season

historically and presently dominated by "dormant" season fires

Intensity and severity

predominantly surface fires, mixed severity fires possible, intensity and severity a function of fuels, slope, and drought, fires scarred shortleaf

Size

spot fires to potentially > 1 million acres, synchrony across MO, AR, OK (1728, 1780)

Landscape pattern

mosaic pattern broken by topography and roughness, potential for shapes elongated with prevailing wind (SW to NE), confined to fire compartments?

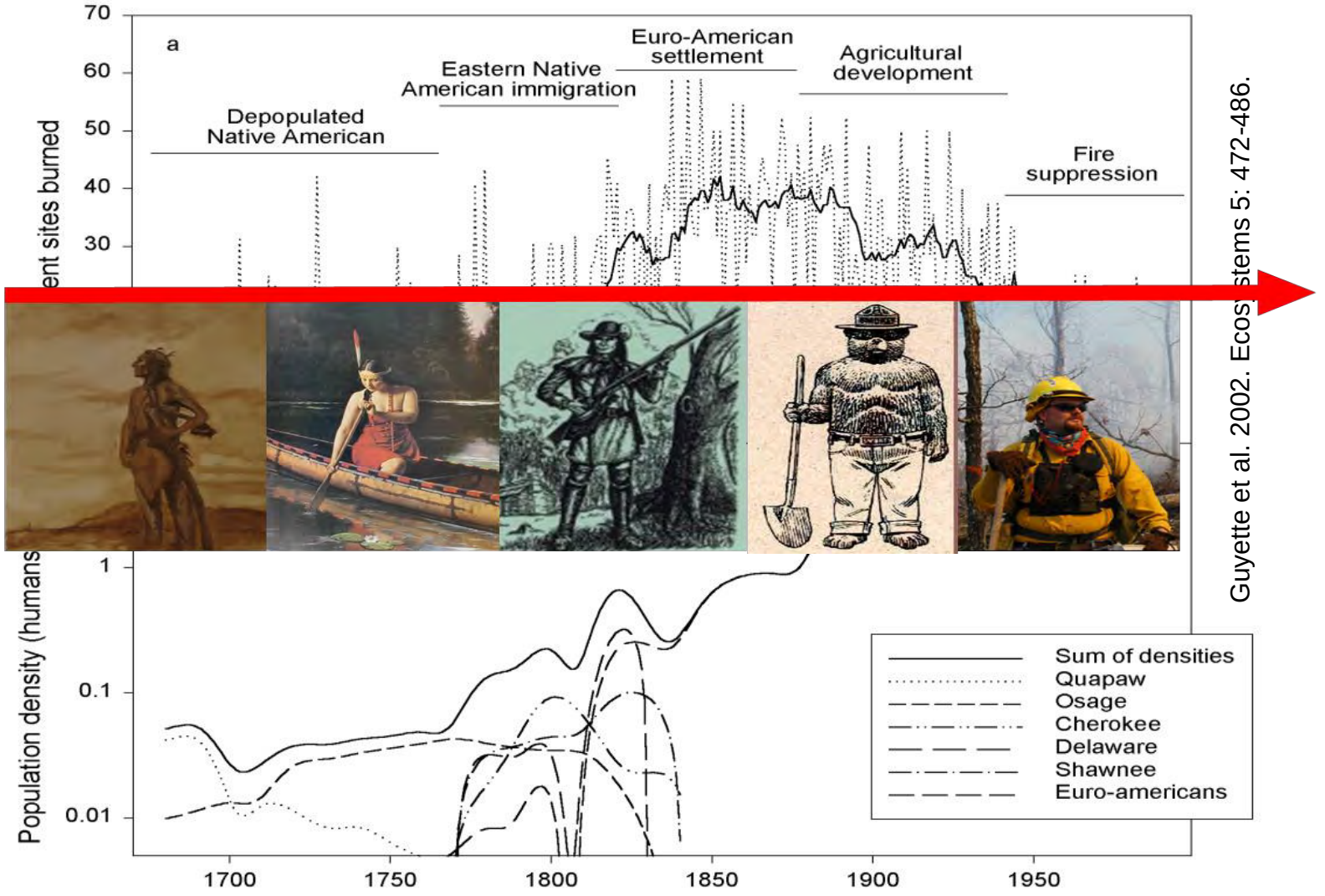
Fuel type / model

historical: grass, litter and 1 to 10 hour fuels; present: long-unburned, litter, heavy fuels

Fire regime dynamics

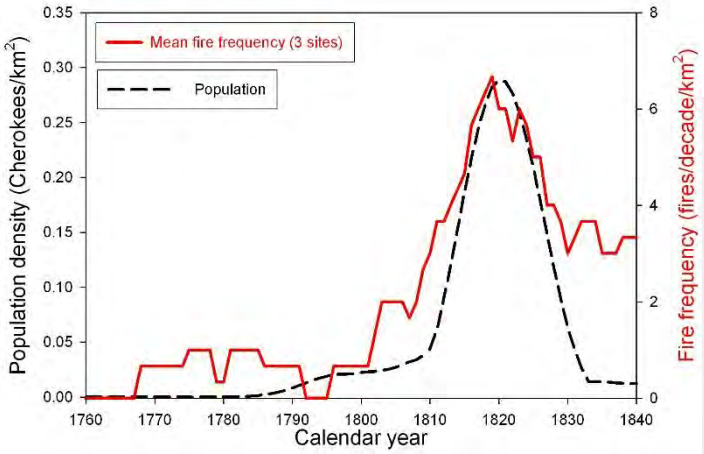
long history of intentional human ignitions influenced by cultural values, some large-scale climate influence

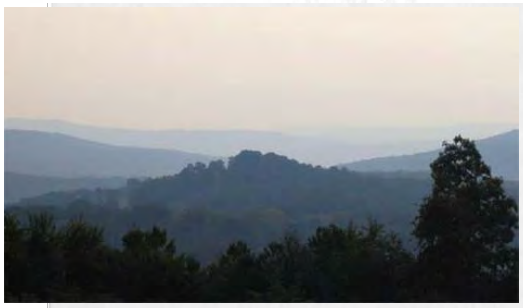
Human control of fire in Missouri Ozarks



Guyette et al. 2002. Ecosystems 5: 472-486.

Lower Atoka Hills, Arkansas River Breaks, AR





Guyette et al. 2006

Desperate times, "Desperation fires"

European colonization, Native American decline,

Native American migration, EuroAmerican settlement

Source: National Park Service

Humans, fire, and ecology in the southern Missouri Ozarks, USA

The Holocene
1–11

DOI: 10.1177/0959683619875807
journals.sagepub.com/home/hol
SAGE

William P Nanavati[1,2] and Eric C Grimm[3]

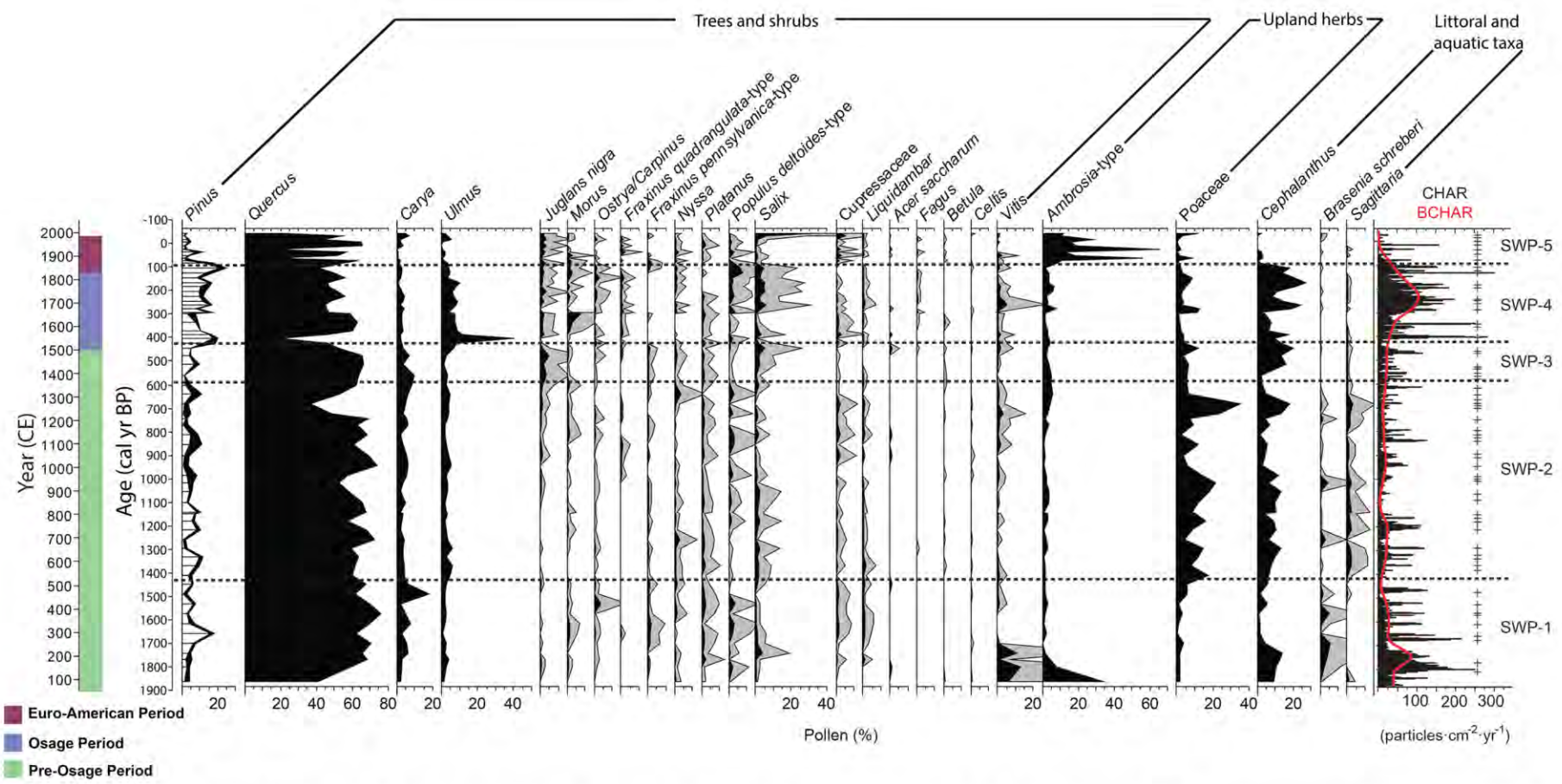
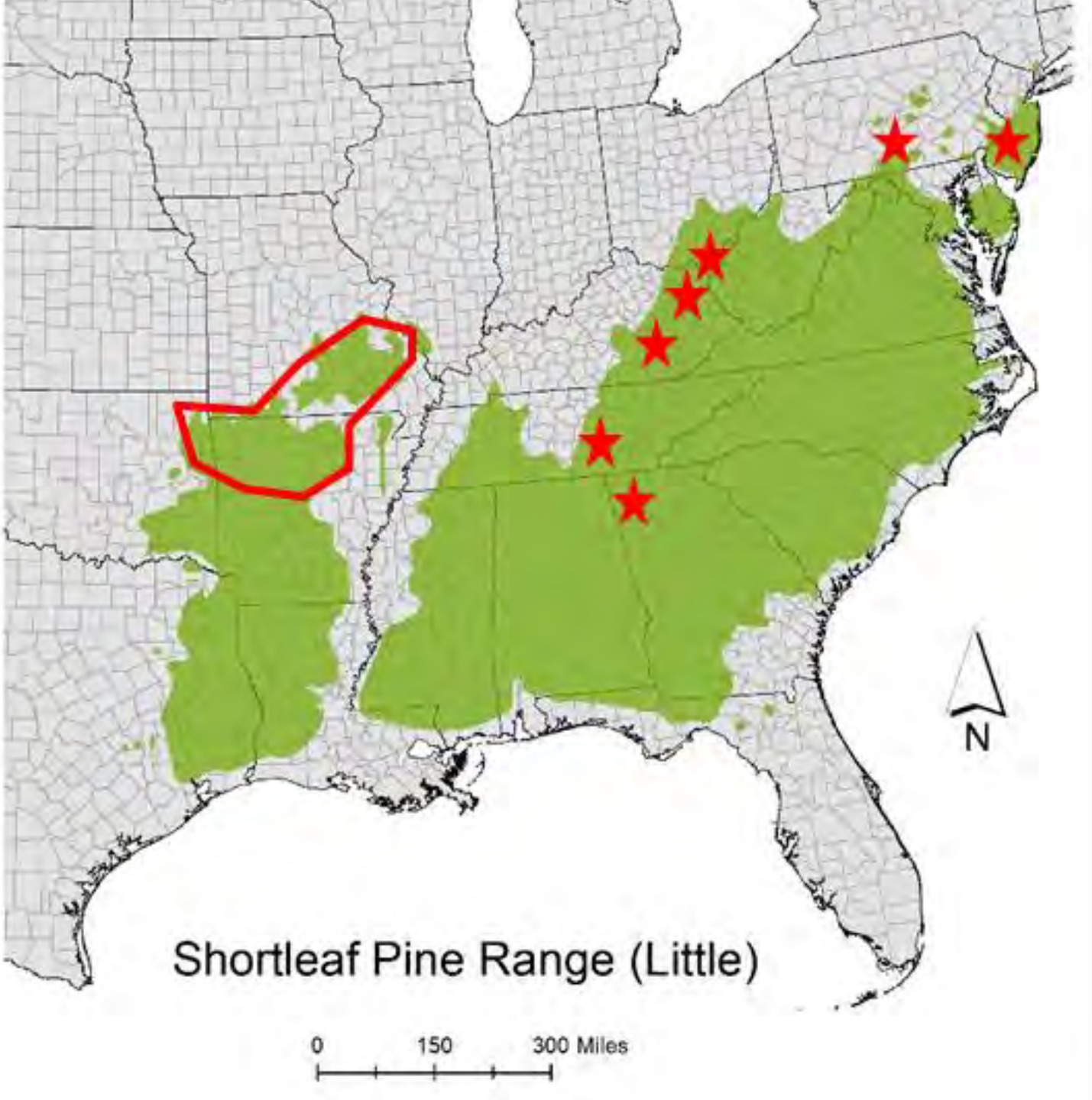


Figure 3. Pollen percentage diagram from Sweeton Pond showing dominant pollen taxa and charcoal data. Rarer taxa are provided with a 5× exaggeration (gray). Pollen zones were identified based on CONISS analysis (Grimm, 1987). Charcoal accumulation rates (CHAR, black line) and background CHAR (red line) describe variations in fire activity, and significant charcoal peaks (+) represent fire episodes. Sociocultural periods used to discuss the record are provided and explained in the text.



JOINT FIRE SCIENCE PROGRAM

PENNSYLVANIA GAME COMMISSION 1895

FOREST SERVICE U S DEPARTMENT OF AGRICULTURE

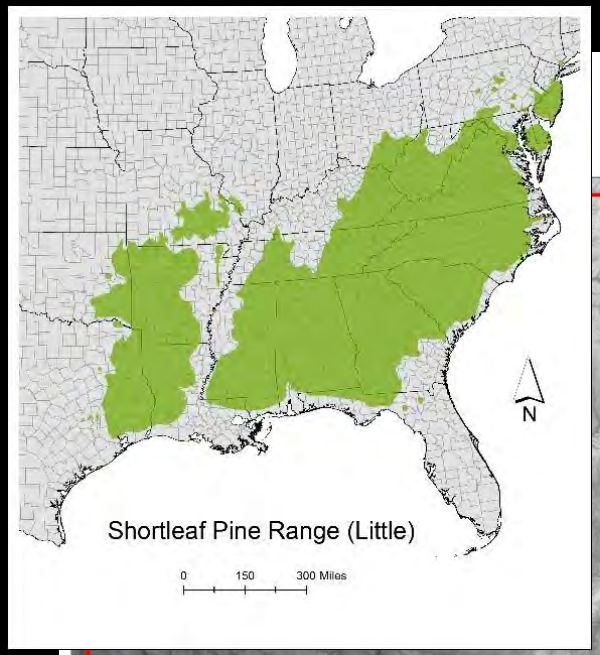
DCNR

Shortleaf Pine INITIATIVE

RESTORING AN AMERICAN FOREST LEGACY

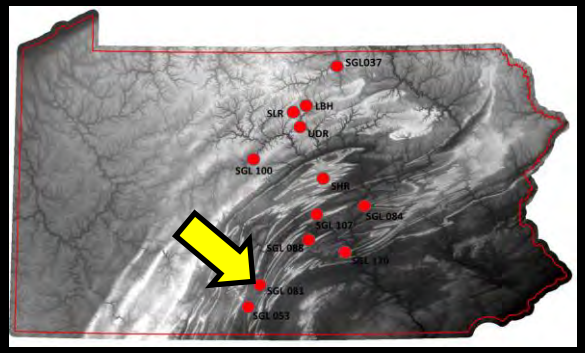
Pennsylvania Fire Regimes

12 sites, 600+ trees, 1000+ fire scars



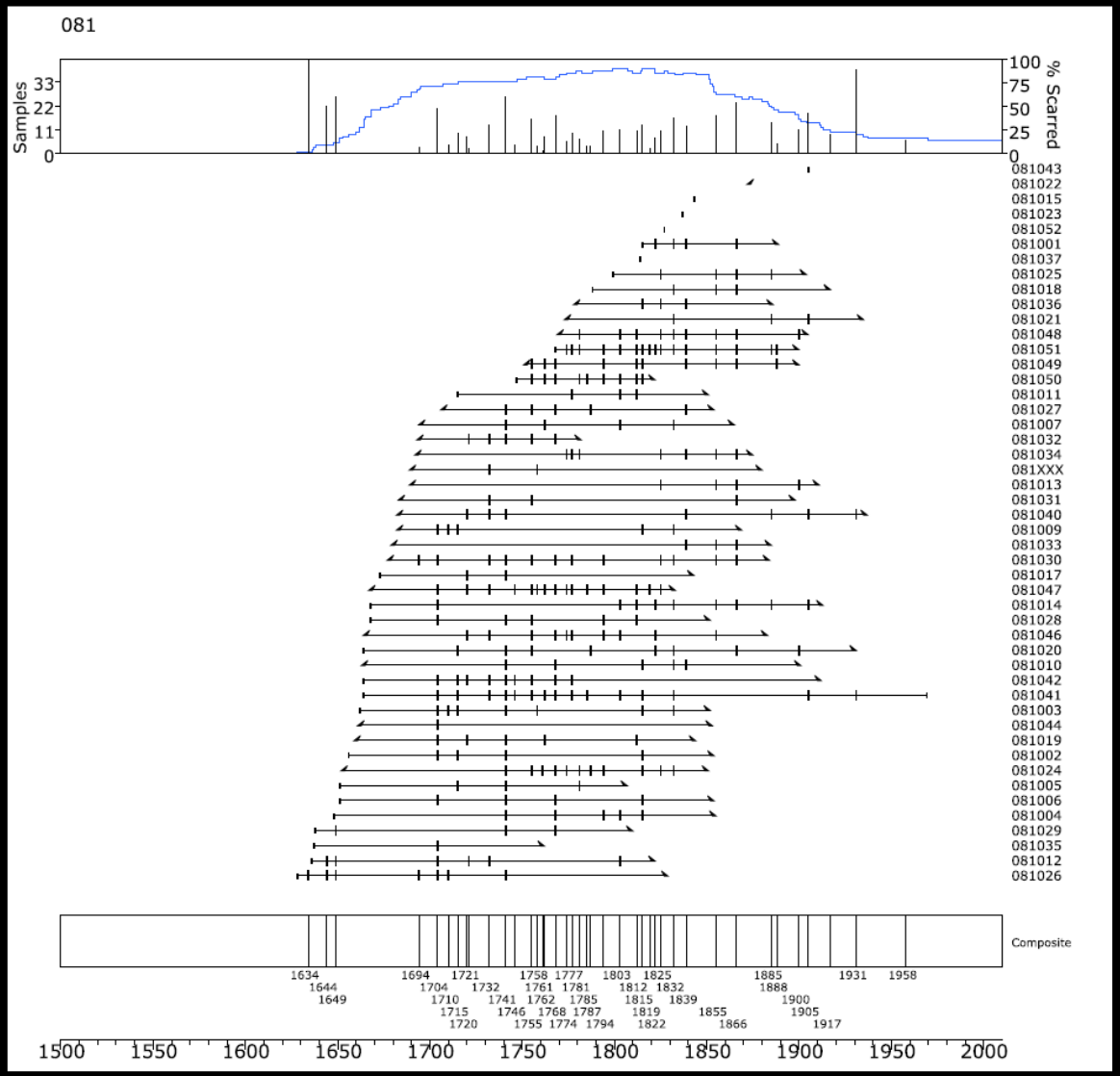
SGL037
LBH
SLR
UDR
SGL 100
SHR
SGL 084
SGL 107
SGL 088
SGL 170
SGL 081
SGL 053

Pennsylvania - State Game Land 081



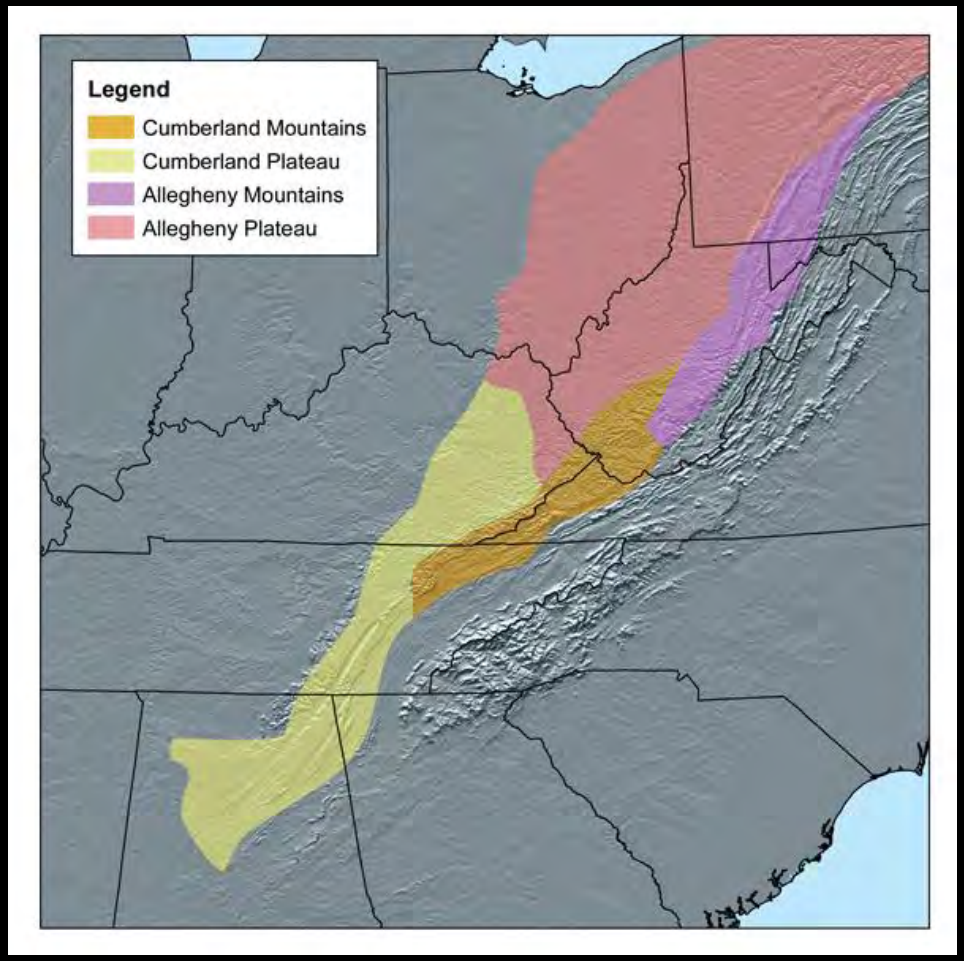
Mean Fire Interval
1638 to 1754 = 10.2 years
1755 to 1914 = 6.25 years

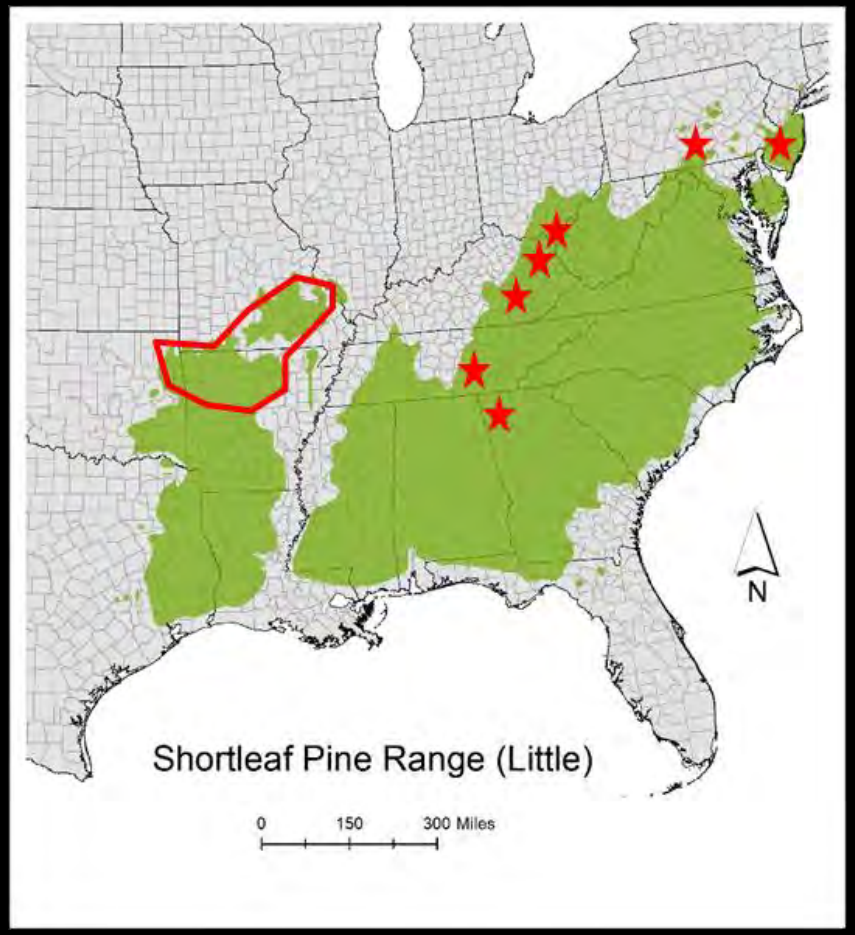
Seasonality
67% Dormant
12% Early growing



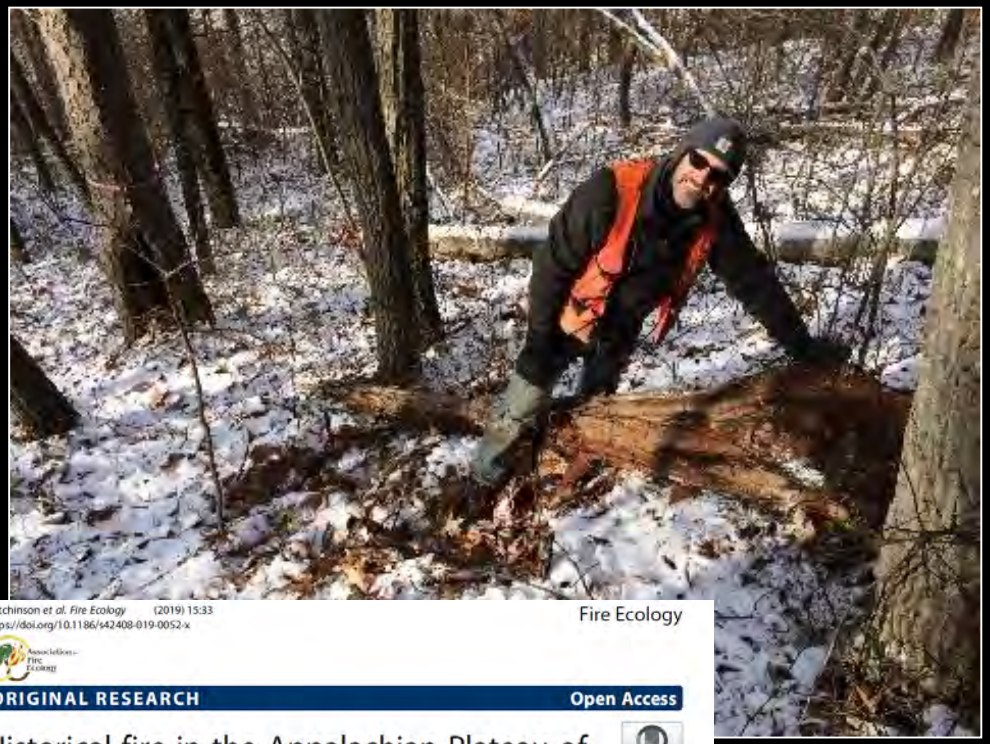
Stambaugh et al. 2018

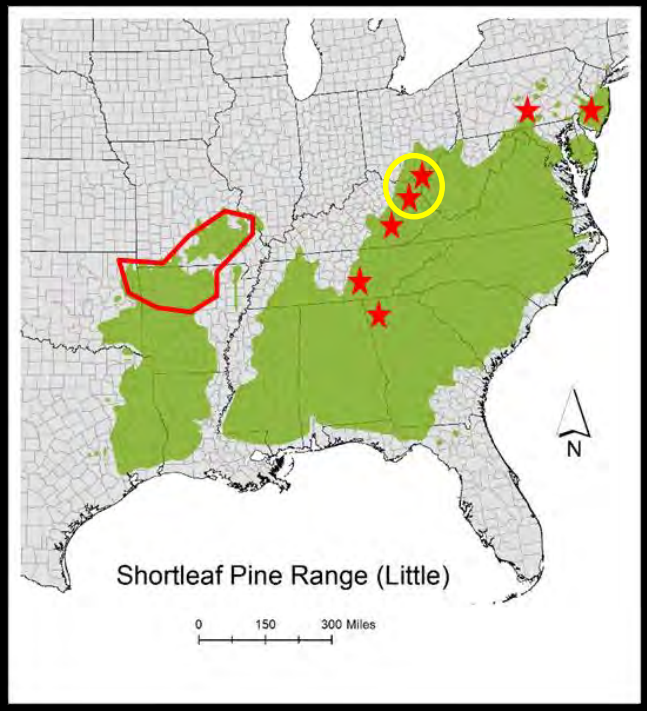
Appalachian Plateau Shortleaf Fire Regimes





Appalachian / Cumberland Plateau Shortleaf Fire Regimes





Hutchinson et al. Fire Ecology (2019) 15:33
https://doi.org/10.1186/s42408-019-0052-x

Fire Ecology

ORIGINAL RESEARCH Open Access

Historical fire in the Appalachian Plateau of Ohio and Kentucky, USA, from remnant yellow pines

Todd F. Hutchinson[1*], Michael C. Stambaugh[2], Joseph M. Marschall[2] and Richard P. Guyette[2]

Mean Fire Interval

Pre-1850 = 6.6 & 8.4 years

1850 to 1930= 3.5 & 2.7 years

Seasonality

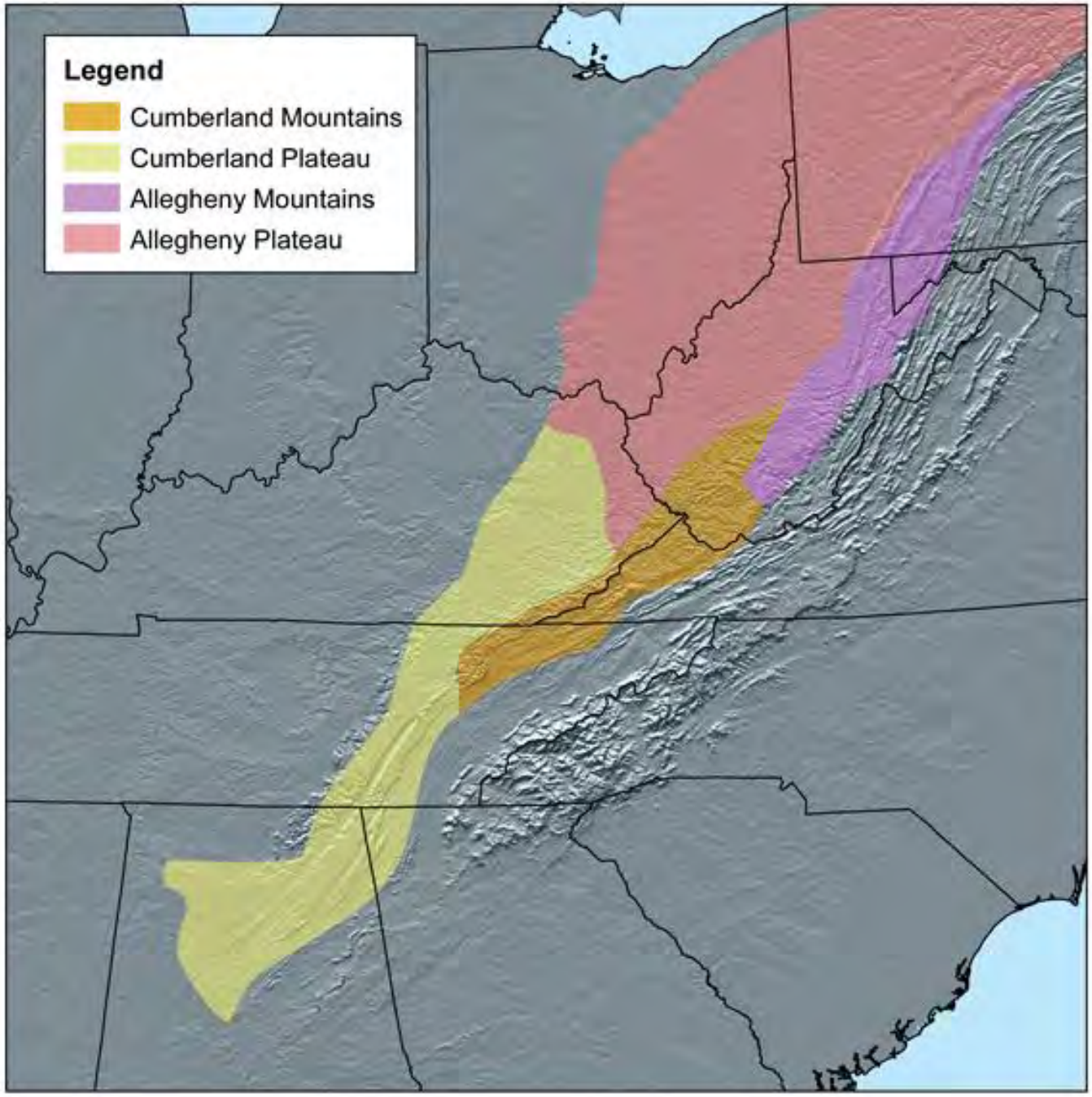
85% an 99% Dormant

Regeneration

Historical: episodic and recurring

Current: "none"

Hutchinson et al. 2019


Legend
Cumberland Mountains
Cumberland Plateau
Allegheny Mountains
Allegheny Plateau

Cumberland Plateau Shortleaf Fire Regimes

Area surveyed	State	Charcoal evidence of past fires	Remnant old shortleaf pines	Fire history site identified
Big South Fork National River and Recreation Area	KY, TN	Y	Y	Y
Beaman Park	TN	Y	Y	U
Catoosa WMA	TN	Y	Y	Y
Savage Gulf State Natural Area	TN	Y	Y	Y
John's Mountain WMA, Chattahoochee NF	GA	Y	Y	Y
Skyline WMA	AL	N	N	N
Bear Hollow Mountain WMA	TN	N	N	N
Grundy Forest State Natural Area	TN	Y	Y	N
Obed Wild and Scenic River	TN	Y	Y	U
Goernt Family Timberlands	TN	Y	Y	N
Prentice-Cooper State Forest	TN	Y	Y	N
Daniel Boone National Forest (multiple sites)	KY	Y	Y	Y

Missouri Tree-Ring Laboratory, unpublished data

A) Big South Fork

B) Catoosa WMA

C) Savage Gulf SNA

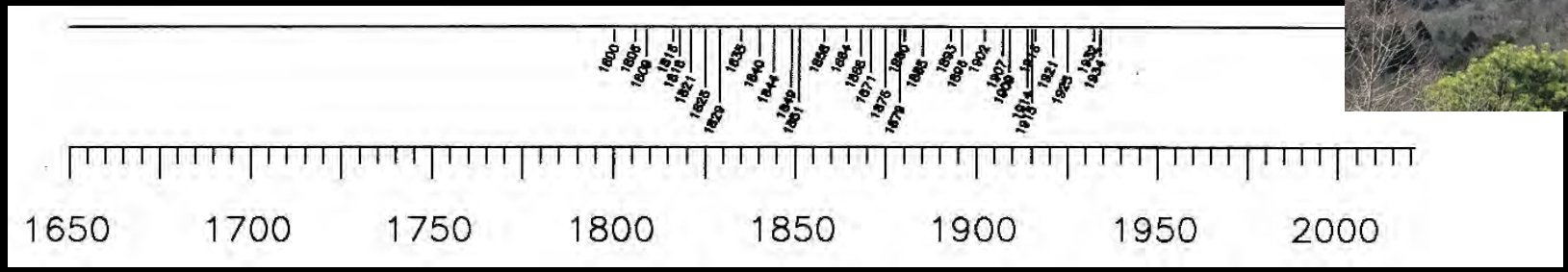
D) Johns Mountain

E) Grundy Forest SNA

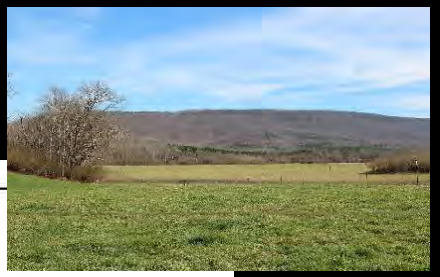
F) Angel Hollow

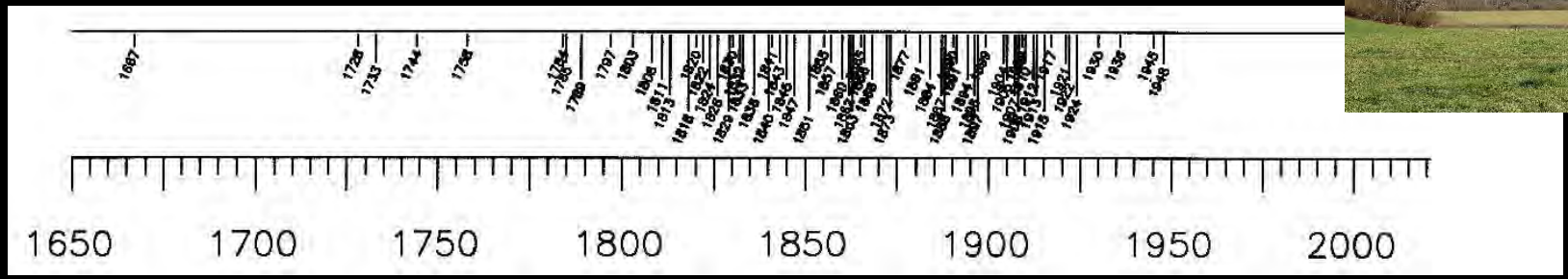
Cumberland Plateau Shortleaf Fire Regimes

Angel Hollow, Daniel Boone NF, KY



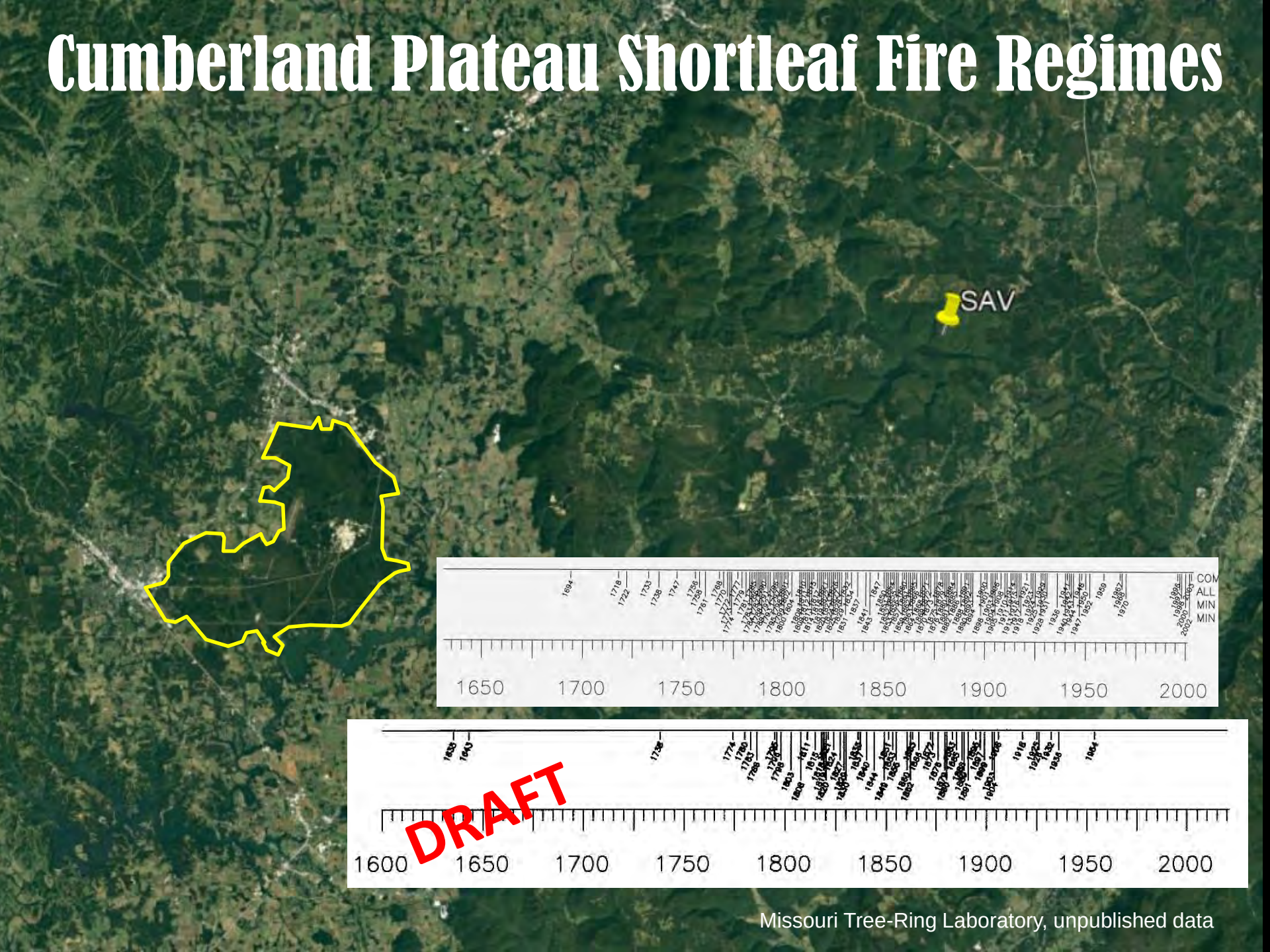
Johns Mountain, Chattahoochee National Forest, GA



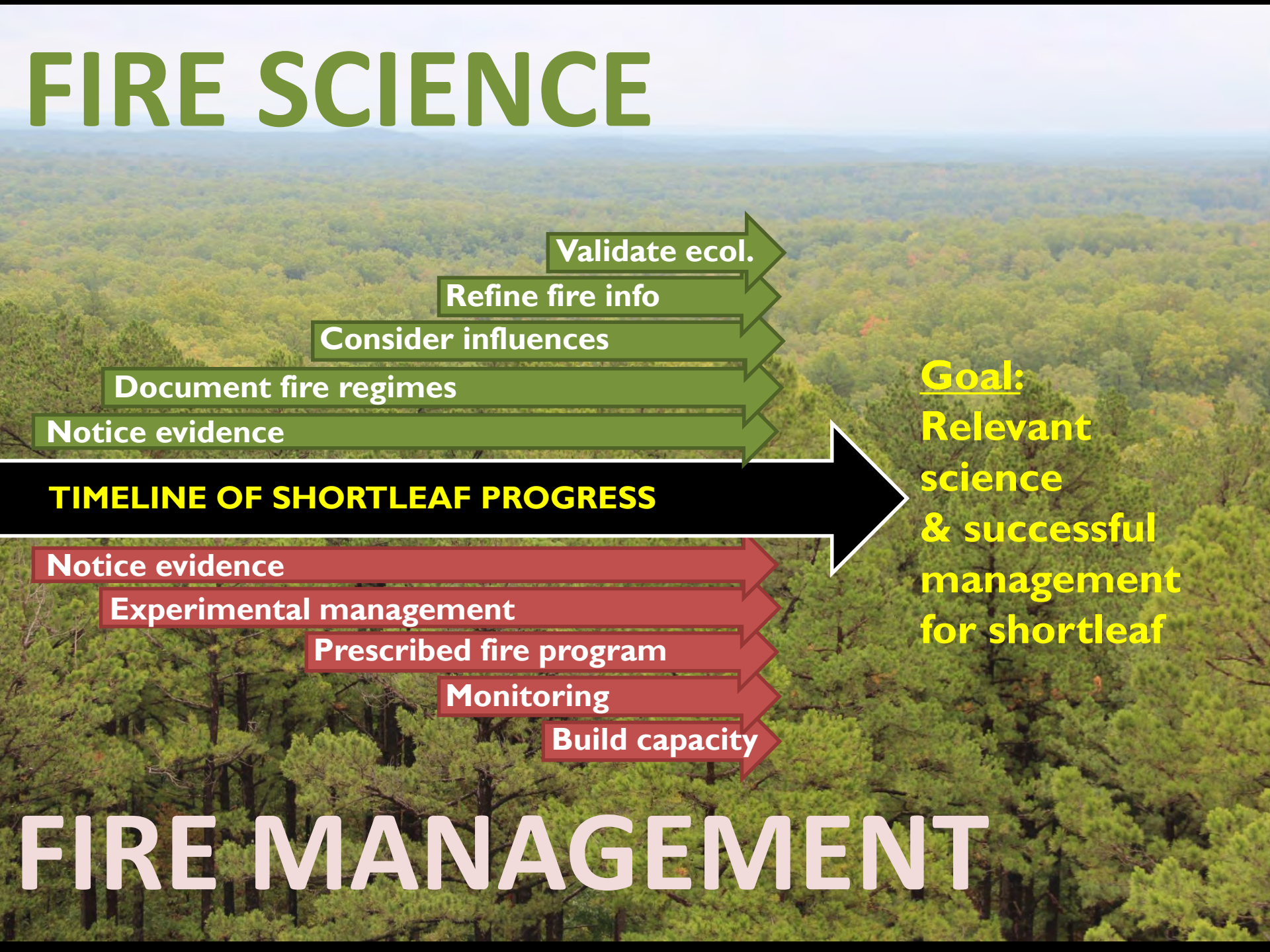


Missouri Tree-Ring Laboratory, unpublished data

Cumberland Plateau Shortleaf Fire Regimes



Missouri Tree-Ring Laboratory, unpublished data


FIRE SCIENCE
Validate ecol.
Refine fire info
Consider influences
Document fire regimes
Notice evidence
TIMELINE OF SHORTLEAF PROGRESS
Goal:
Relevant science & successful management for shortleaf
Notice evidence
Experimental management
Prescribed fire program
Monitoring
Build capacity
FIRE MANAGEMENT

Does management following historical information sustain shortleaf communities?

Test & validate ecology of shortleaf

Forest & fire management

- Regeneration, survival, growth
- Stand density, longevity
- Community: are species promoted / function

Fire

- Do historical fire conditions cover the important components needed for management?
- Spatial extent and heterogeneity of burns?
- Fire severity? How fire tolerant is shortleaf?
- High end of fire frequency?

Conclusion

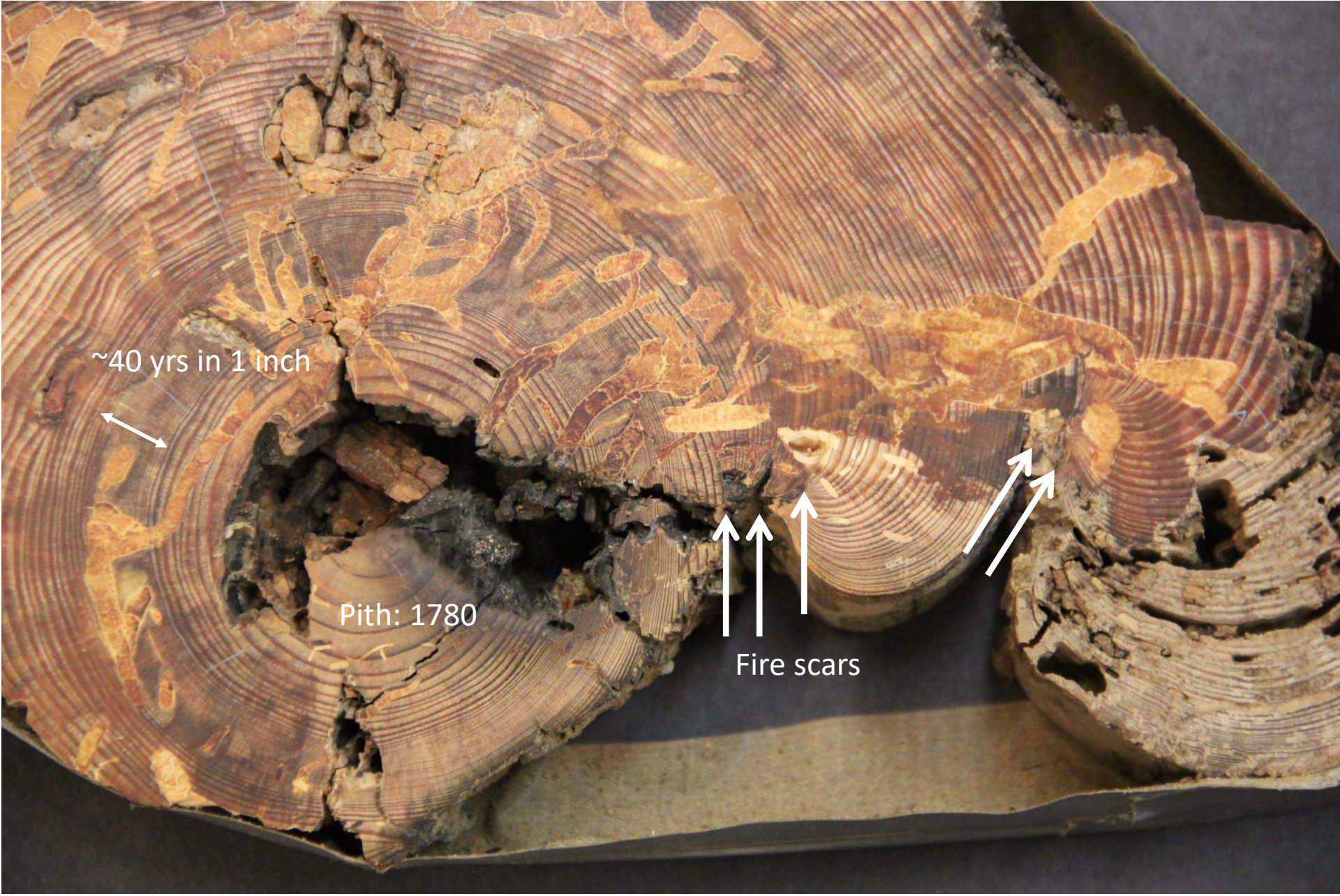
Tremendous potential for understanding environmental history and ecology from remnant shortleaf trees

Historical information can inform management

Humans were / are a primary source of fires and vegetation patterns. We will determine fate of shortleaf, particularly through fire

Acknowledgements

- Richard Guyette, Dan Dey, Joe Marschall, University of Missouri
- USDA Forest Service, Northern & Southern Research Stations
- Joint Fire Science Program
- National Park Service, ONSR
- Missouri Department of Conservation
- Pennsylvania Game Commission
- Shortleaf Pine Initiative
- Mark Twain National Forest
- Daniel Boone National Forest
- Chattahoochee National Forest
- Tennessee DEC
- Shawnee State Forest
- Oklahoma DWC


~40 yrs in 1 inch
Pith: 1780
Fire scars