

# Southern Appalachian Fire Regimes as a Cultural-Climate Phenomenon

**Steve Norman**

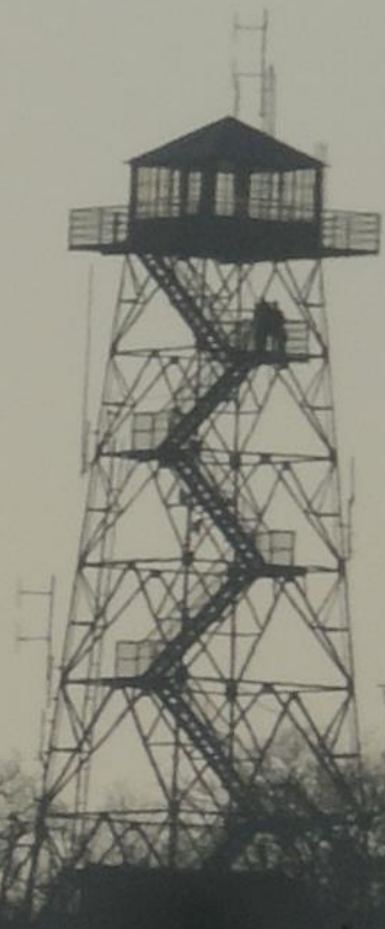
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Paul Burton Seminar Series  
Department of Biology  
Western Carolina University  
November 10, 2017



# **FIRE SEASON: FALL 2016**



The fire season fell well outside our prior experience.

CE 1870

# TIMES

## Wildfire season price tag: \$36.8M

ABIGAIL MARGULIS  
AMARGULIS@CITIZEN-TIMES.COM

**F**ighting fire isn't cheap. And that's especially true in the historic fire season, which North Carolina forests from October to December have charred more than 36.8 million acres on national forest land. The price tag of \$36.8 million for the fire season for the state is the highest in the history of the state.

### Smoke billows from the Party Rock fire above Lake Lure in November. While nature has erased some of the obvious signs of fire damage, Chimney Rock Village businesses are still in recovery mode.

But since a historic fire whipped through Chimney Rock Village in smoke, store owner Peter O'Leary has had the added task of just getting visitors to come to town.

...ebb and flow of everything" ... said O'Leary, ... the win- ... ern weren't ... a con- ... he win- ... ed to do ... for the ... ased ob- ... resters ... from the ... s of state ... Nov. 5.

... helps other



CLINT CALHOUN/COURTESY PHOTOS

## Lake Lure, Chimney Rock take stock after historic fire

O'Leary estimates an evacuation at the fire's peak cost him about \$30,000 in profits, or about 25-30 percent of what he was hoping to accumulate for the winter.

"It's not like people are desperate, but it certainly had a negative impact and everyone is feeling the pinch," he said.

The Party Rock fire ignited during a historic

See FIRE, Page 4A

## Planet

ASHVILLE'S GREATEST NEWS SOURCE  
Serving Greater Asheville

www.ashevilledailyplanet.com

### ate speech in city

... action will not be tolerated in Asheville." ... "Asheville's people are accepting, open- ... minded and respectful. As a community, we ... have an even greater challenge to come together ... with kindness and compassion for each other. ... I call on every individual for each other ... stance that insurance and hatred will not ... be accepted. As mayor of Asheville, I am ... dedicated to maintaining Asheville as an ... equitable and inclusive city where we can ... acknowledge our differences, and allow ... everyone to feel safe and respected." ... To that end, the mayor cited several com- ... plaints about incidents of hate speech in the ... community to local news media.

See SLAMS, Page A7

### Wildfires? Mainly arson, officials say

WNC blazes under control; Asheville's fall driest ever

From Staff Reports

About 80,000 acres in Western North Carolina have been burned by wildfires that have forced residents to evacuate their homes and businesses to close to shut down temporarily.

Firefighters from all 50 states were brought in to work a 24-hour shift to keep blazes from destroying structures or infrastructure.

This is Asheville's driest fall ever, with no rain in the area in November at the Asheville Regional Airport.

Relegated with the National Weather Service, about 5 inches of rain is expected in the next few days.





Fire progression of the  
Rock Mountain Fire





Smoke from Nantahala NF fires  
Great Smoky Mountains National Park





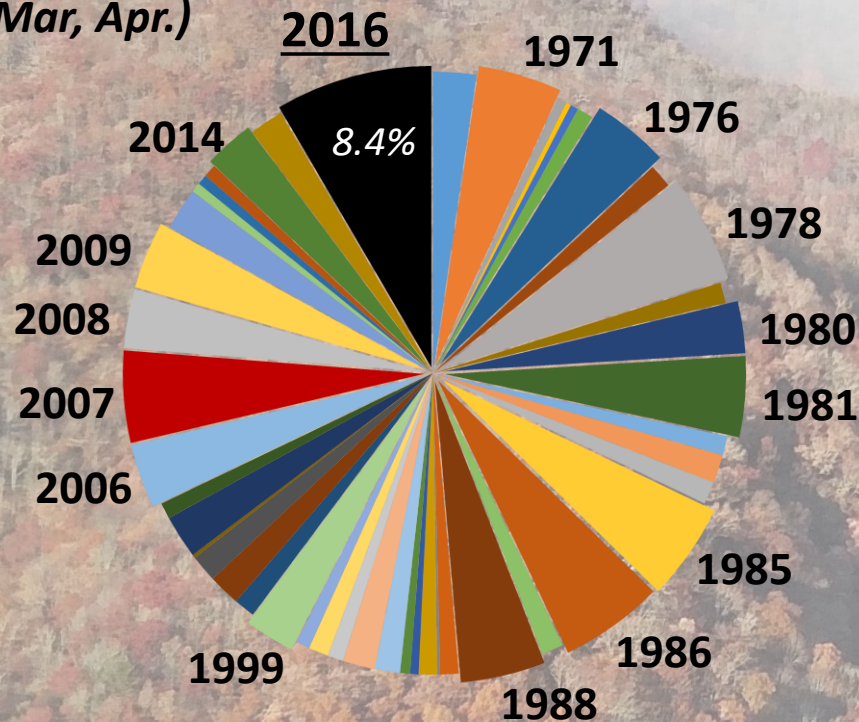
Remnants of Gatlinburg, TN



# Yearly share of seasonal area burned by wildfire across Southern Appalachian federal lands, 1970-2016

## SPRING

(Mar, Apr.)



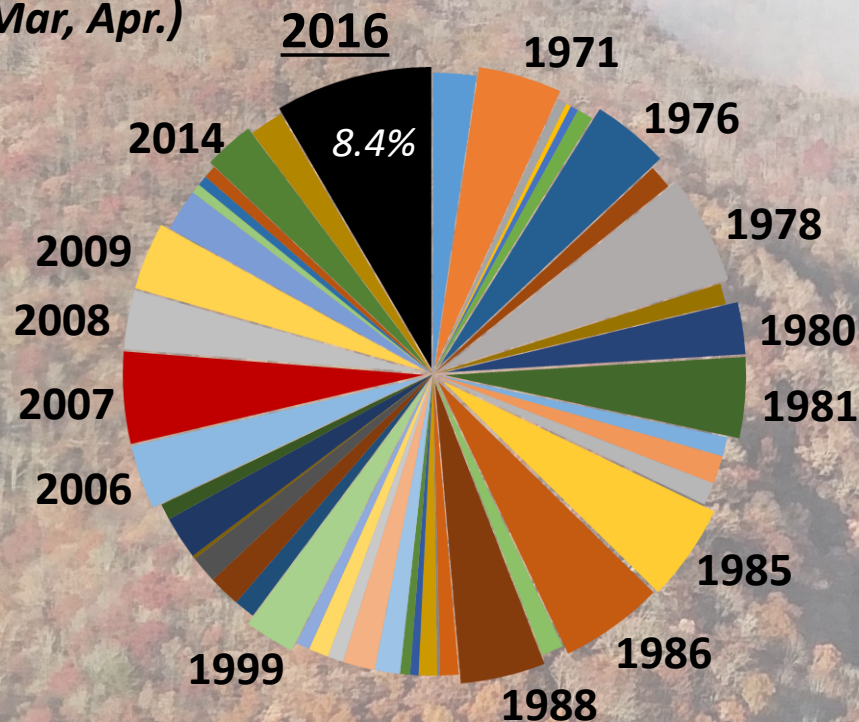
Labeled years exceed 2.5% of the 47-year season total.



# Yearly share of seasonal area burned by wildfire across Southern Appalachian federal lands, 1970-2016

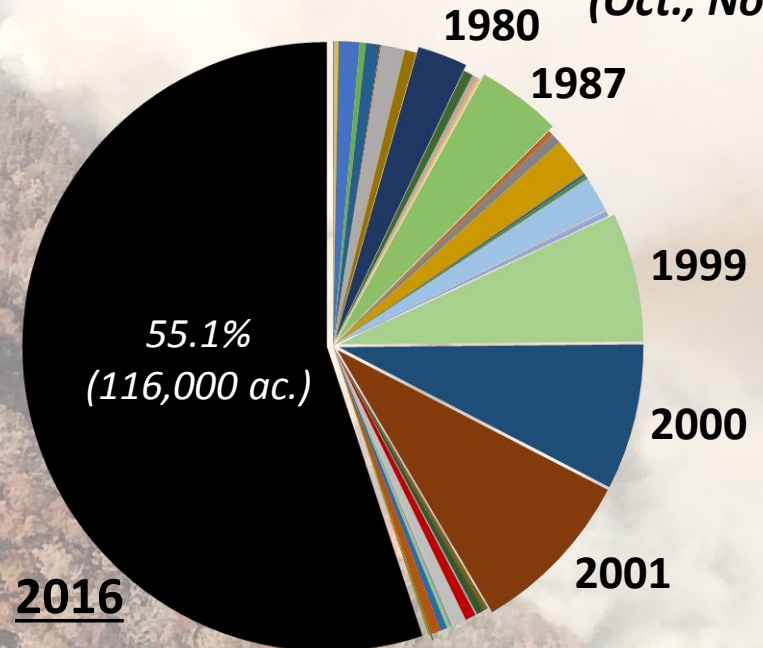
## SPRING

(Mar, Apr.)



## FALL

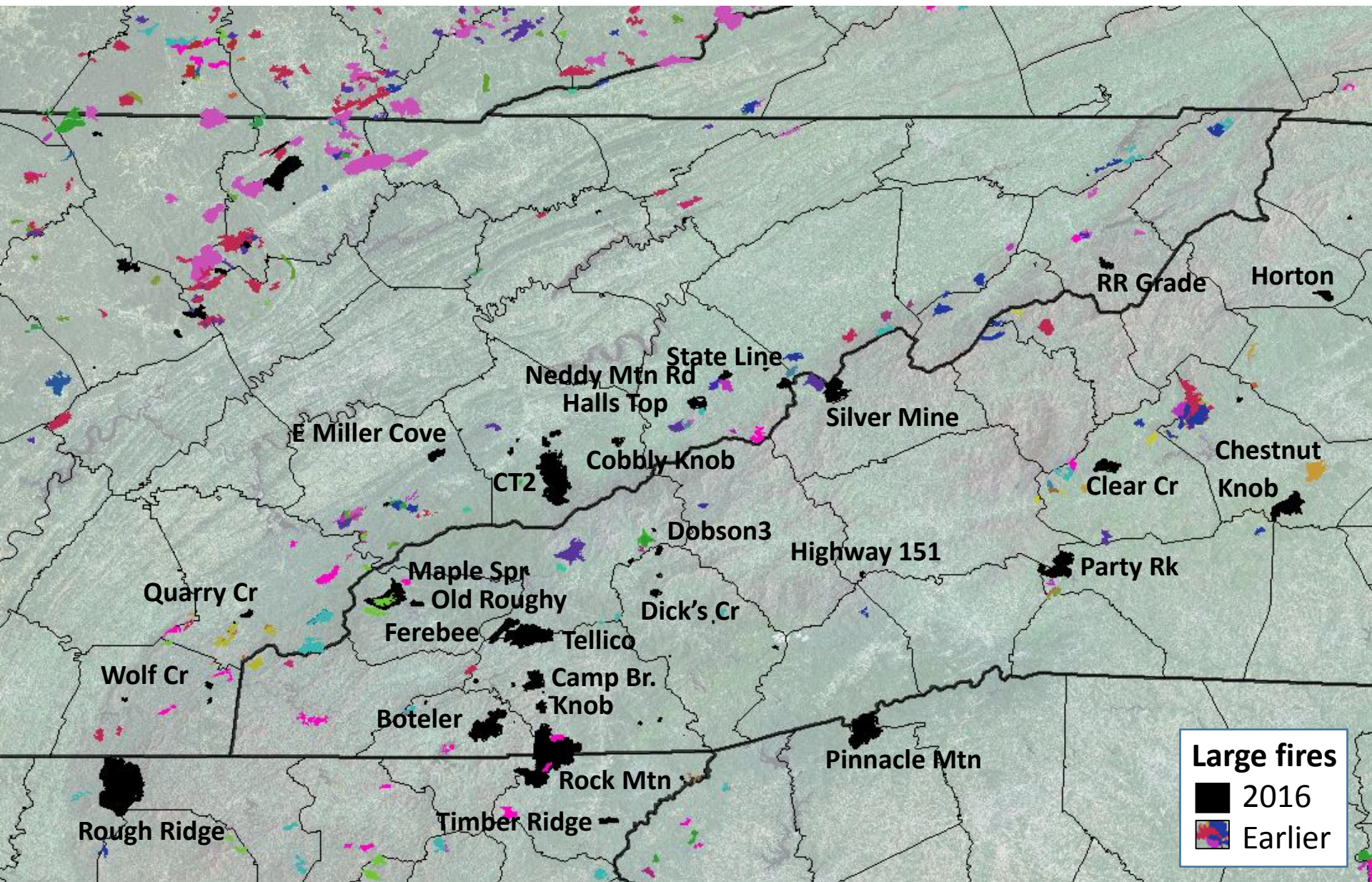
(Oct., Nov.)



Labeled years exceed 2.5% of the 47-year season total.



# Large Southern Appalachian Wildfires since 1984





A photograph of a forest fire. A dirt path leads from the bottom center towards a large fire in the distance. The fire is bright orange and yellow, with thick black smoke rising into the air. The surrounding trees are mostly bare, with some evergreens on the right. The sky is filled with smoke and some lighter clouds.

**Where are we headed?**



A photograph of a forest fire. A dirt road leads from the bottom center towards a large, intense fire in the distance. The fire is bright orange and yellow, with thick black smoke rising into the sky. Bare tree branches frame the top and sides of the image. The overall scene is dramatic and ominous.

**Where are we headed?**

**IGNITIONS**

**FUELS**

**CLIMATE CHANGE**

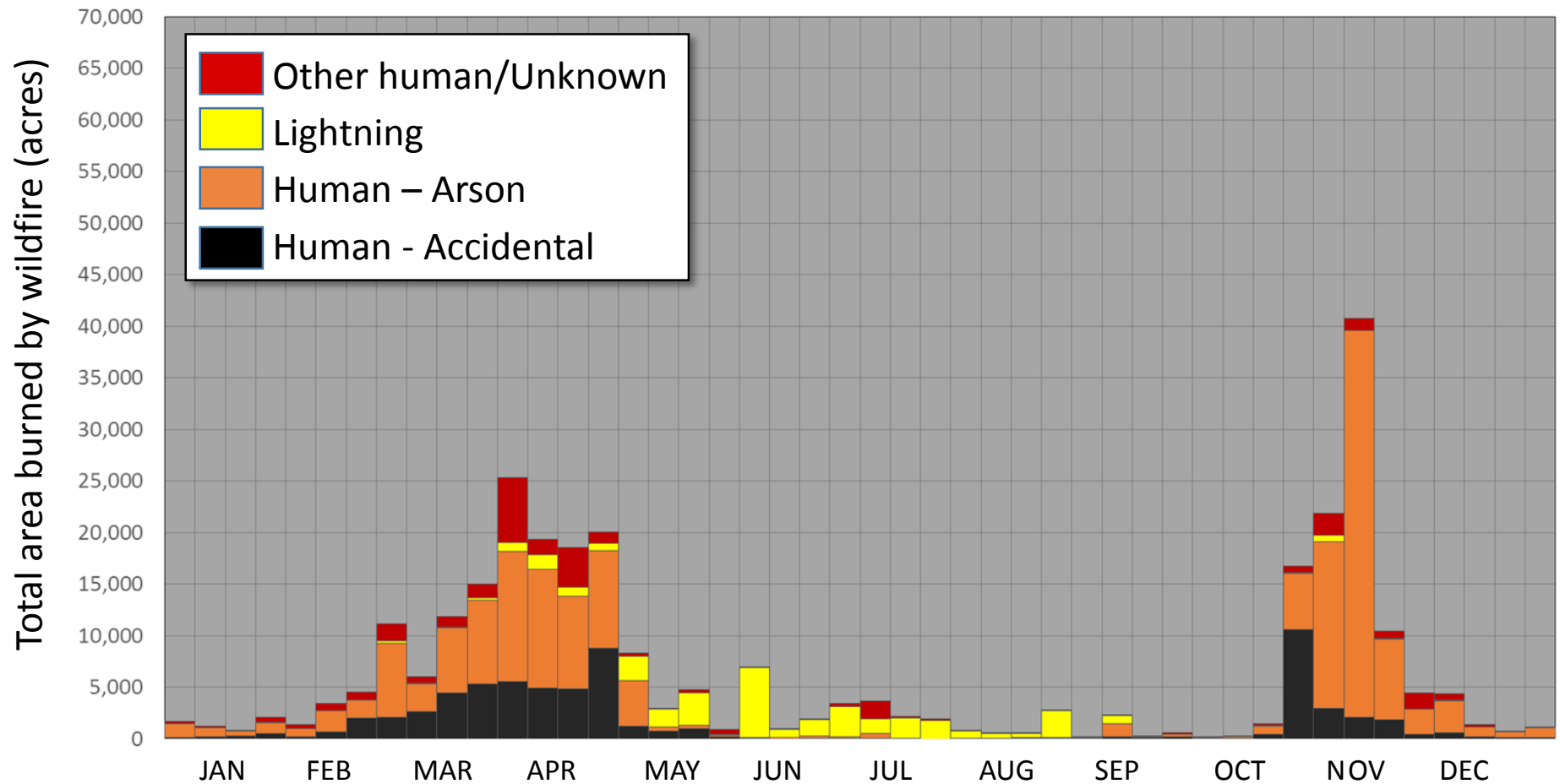


# IGNITIONS





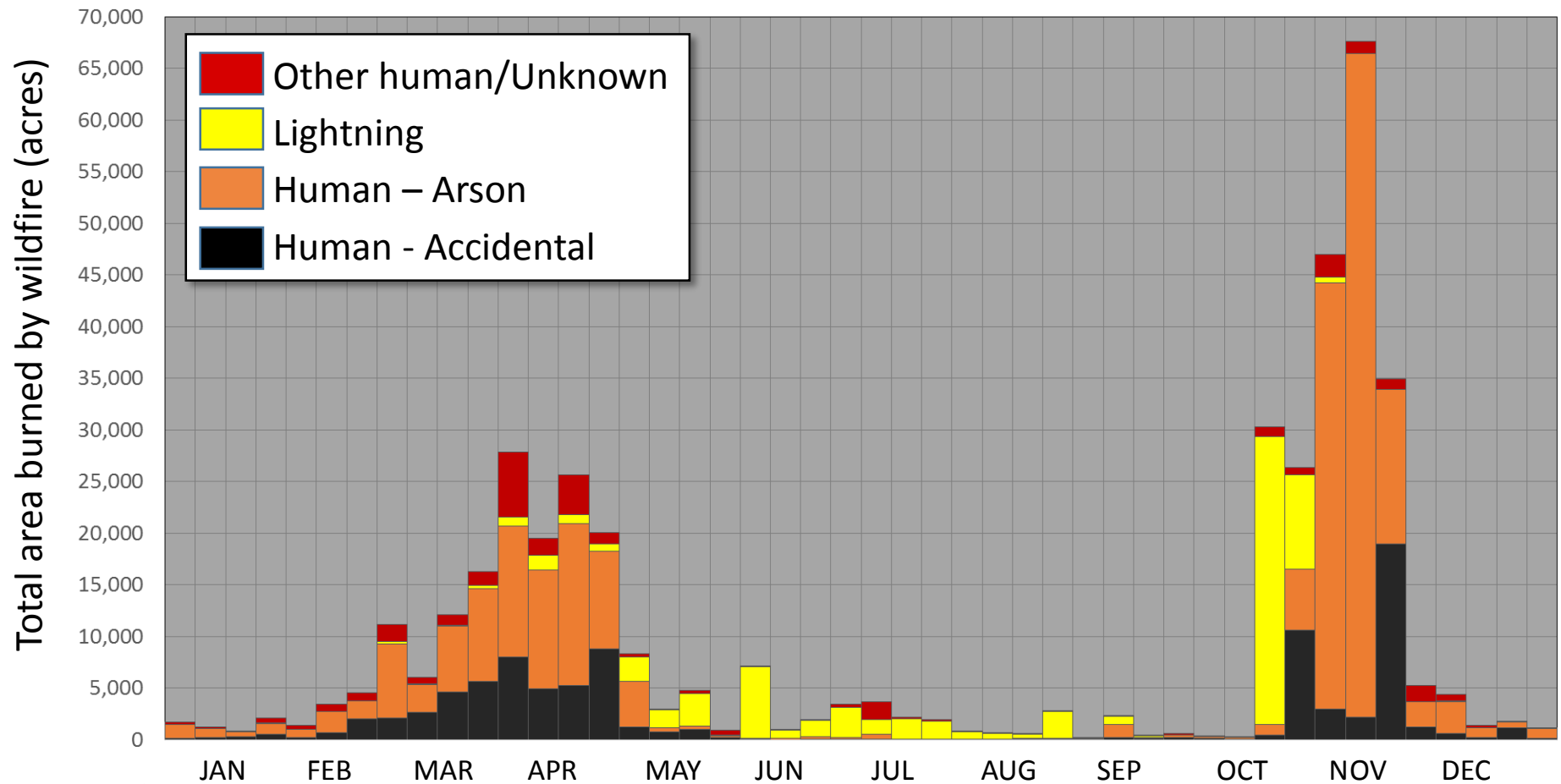
# The seasonality of wildfire ignition causes on federal lands of the Southern Appalachians\* 1970-2015



\*Nantahala NF, Pisgah NF, Cherokee NF, Chattahoochee NF, Sumter NF, Great Smoky Mountains National Park



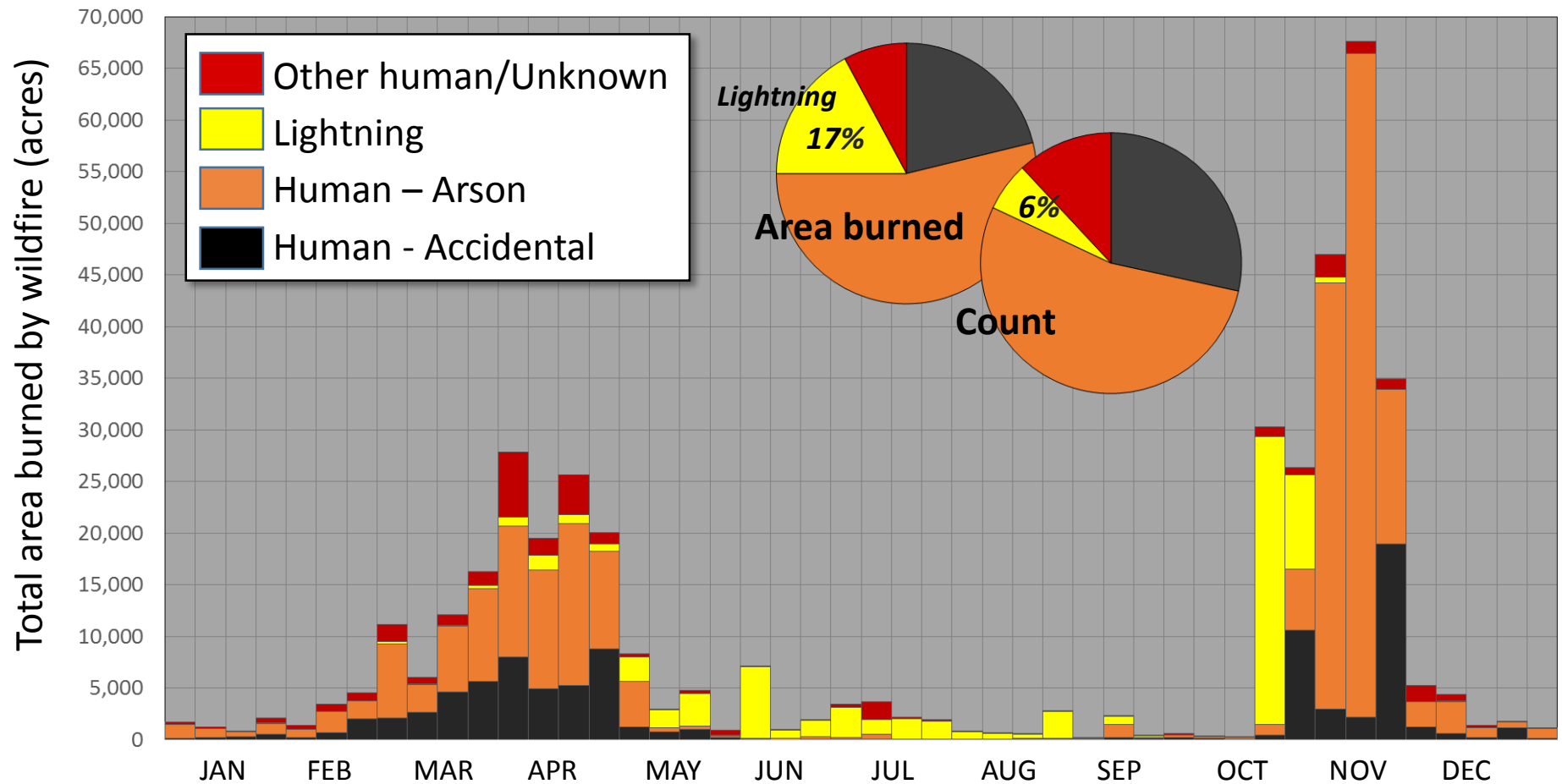
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# Fires-Are-Us

**MR.  
BURNIT  
THE  
MaliCious  
WOODS  
burnER  
ROBS  
THE  
SOUTH**



**FIRE  
DESTROYS**

**GAME  
AND  
FORESTS  
BE CAREFUL**

**PENNSYLVANIA GAME COMMISSION**

JOE WOLF



# FUELS







Patchy duff consumption  
Highway 151 Fire





Ericaceous shrub top kill  
Highway 151 Fire





**Ericaceous shrub effects below Wayah Bald  
Camp Branch Fire**


Photo credit: Kenny Frick FHP





**Fire burning before leaf fall (late October)**  
**Rough Ridge Fire**



An aerial photograph showing a large fire burning on a forested ridge. Thick, white and grey smoke billows upwards from the fire, partially obscuring the sky. The forest below the ridge is covered in trees with autumn-colored foliage in shades of orange, red, and brown. In the background, more forested hills are visible under a clear blue sky.

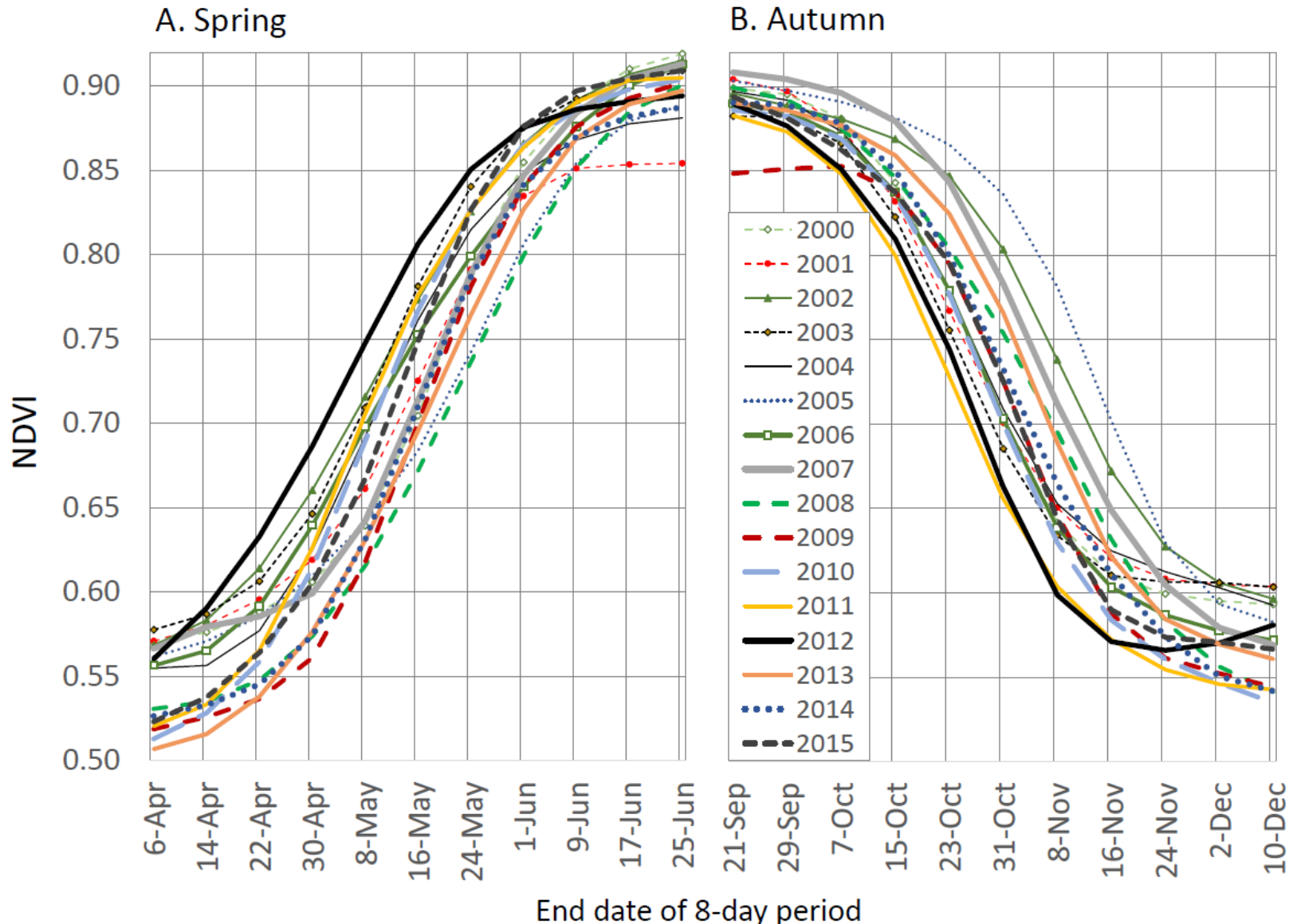
“In normal years, much of the leaf fall is compressed by precipitation and moisture as it lies on the forest floor. At the time of the fire in late November 2016, however, due to the drought and infrequency of rain, much of the hardwood litter could be described as “fluffy”—loose, not compacted, and easily moved by wind.”

## **:Chimney Tops 2 Fire Review**

*Credit: Kenny Frick FHP  
Tellico Fire. Nov 4, 2016*



# Regional variation in greenup and browndown timing, 2000-2015



Source: Norman, SP, WW Hargrove, WM Christie. 2017. Spring and autumn phenological variability across environmental gradients of Great Smoky Mountains National Park, USA. *Remote Sensing*. 9:407.



Coweeta Sun Nov 06 13:31:36 2011  
Exposure: 88

2011





Coweeta Mon Nov 05 12:31:35 2012  
Exposure: 95

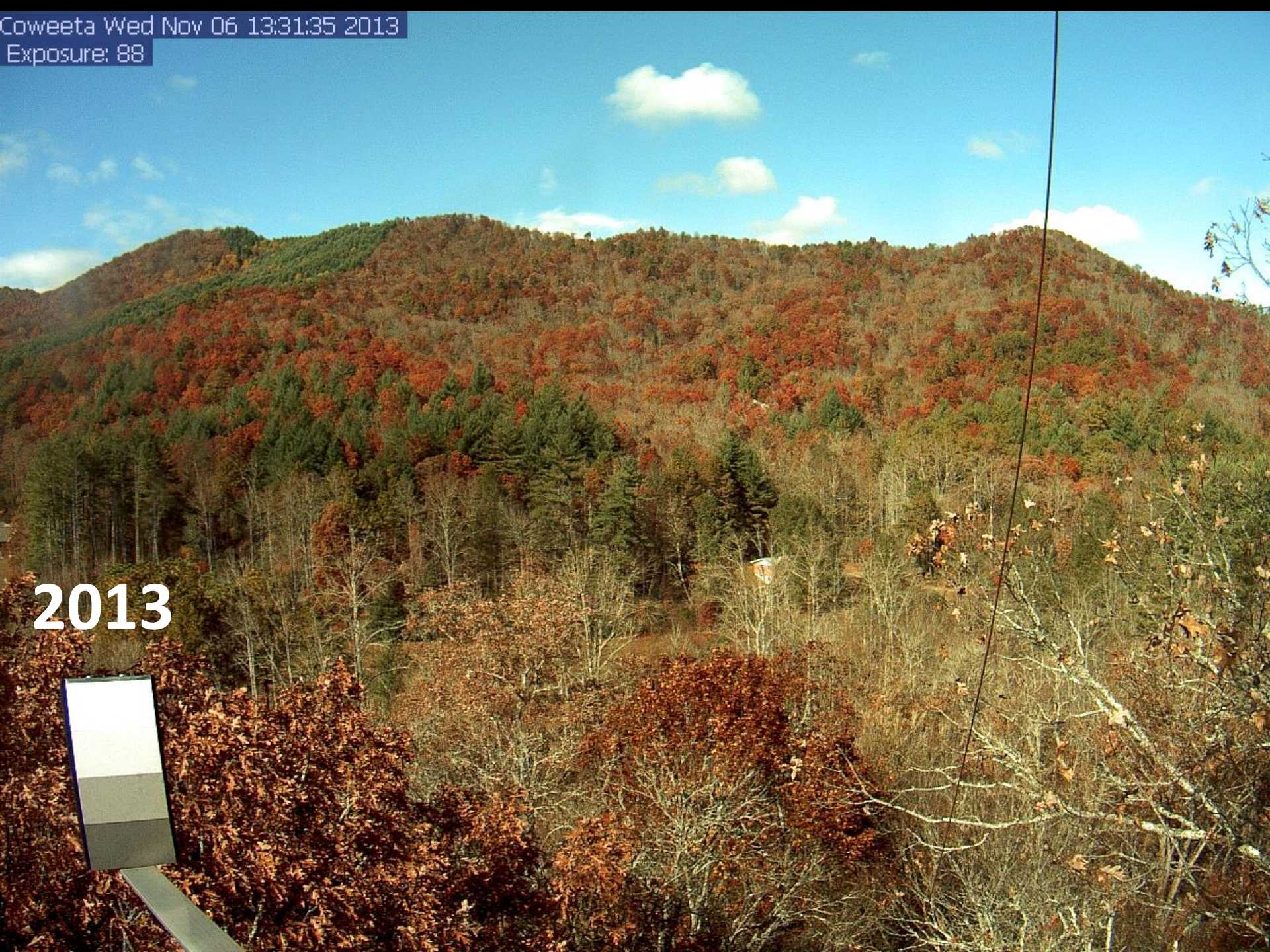


2012



Coweeta Wed Nov 06 13:31:35 2013  
Exposure: 88

2013





Coweeta Thu Nov 06 13:31:48 2014  
Exposure: 97

2014





Coweeta Fri Nov 06 13:31:48 2015  
Exposure: 92

2015



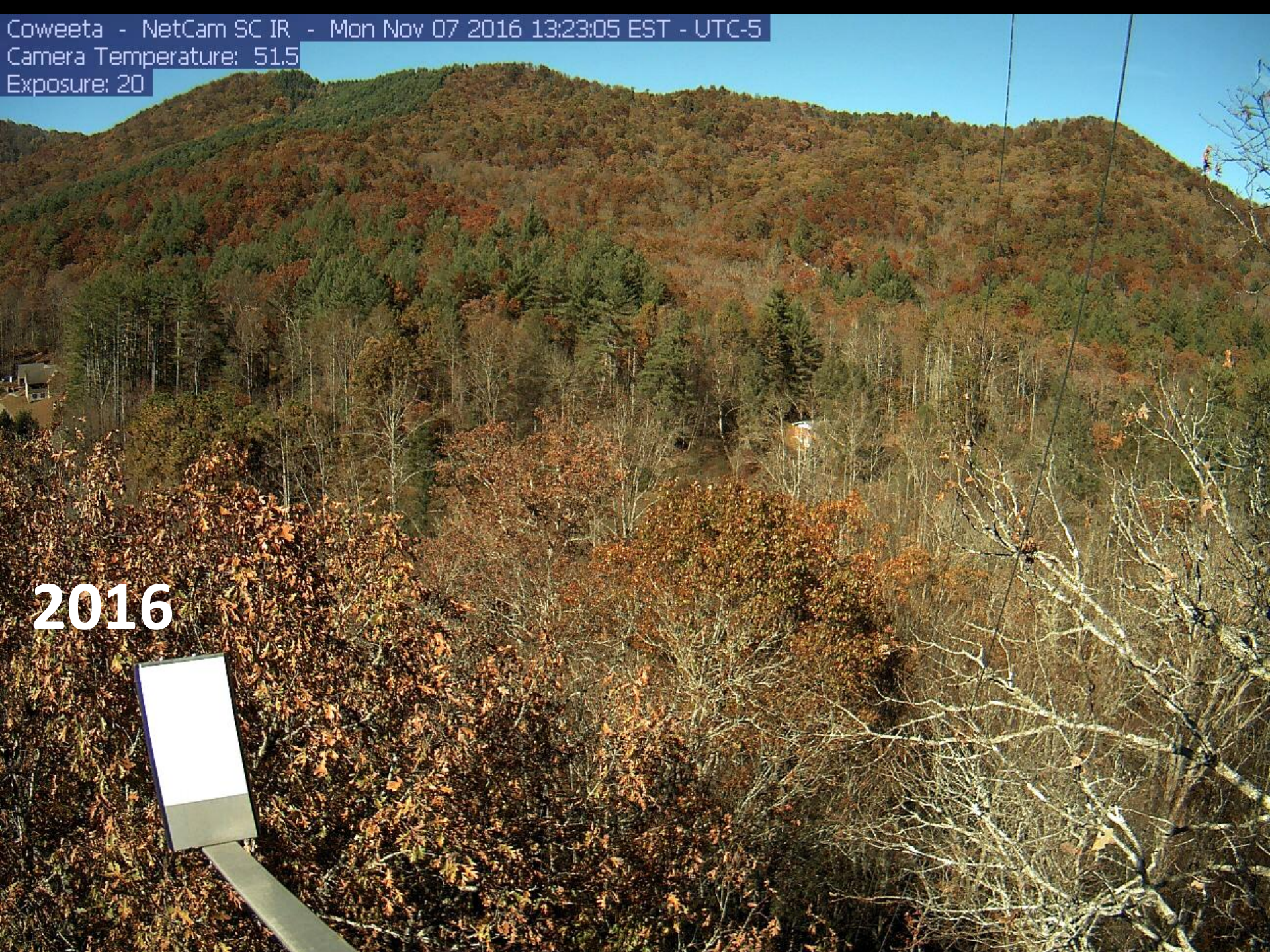


Coweeta - NetCam SC IR - Mon Nov 07 2016 13:23:05 EST - UTC-5

Camera Temperature: 51.5

Exposure: 20

2016





Coweeta - NetCam SC IR - Sun Nov 05 2017 13:53:05 EST - UTC-5

Camera Temperature: 53.0

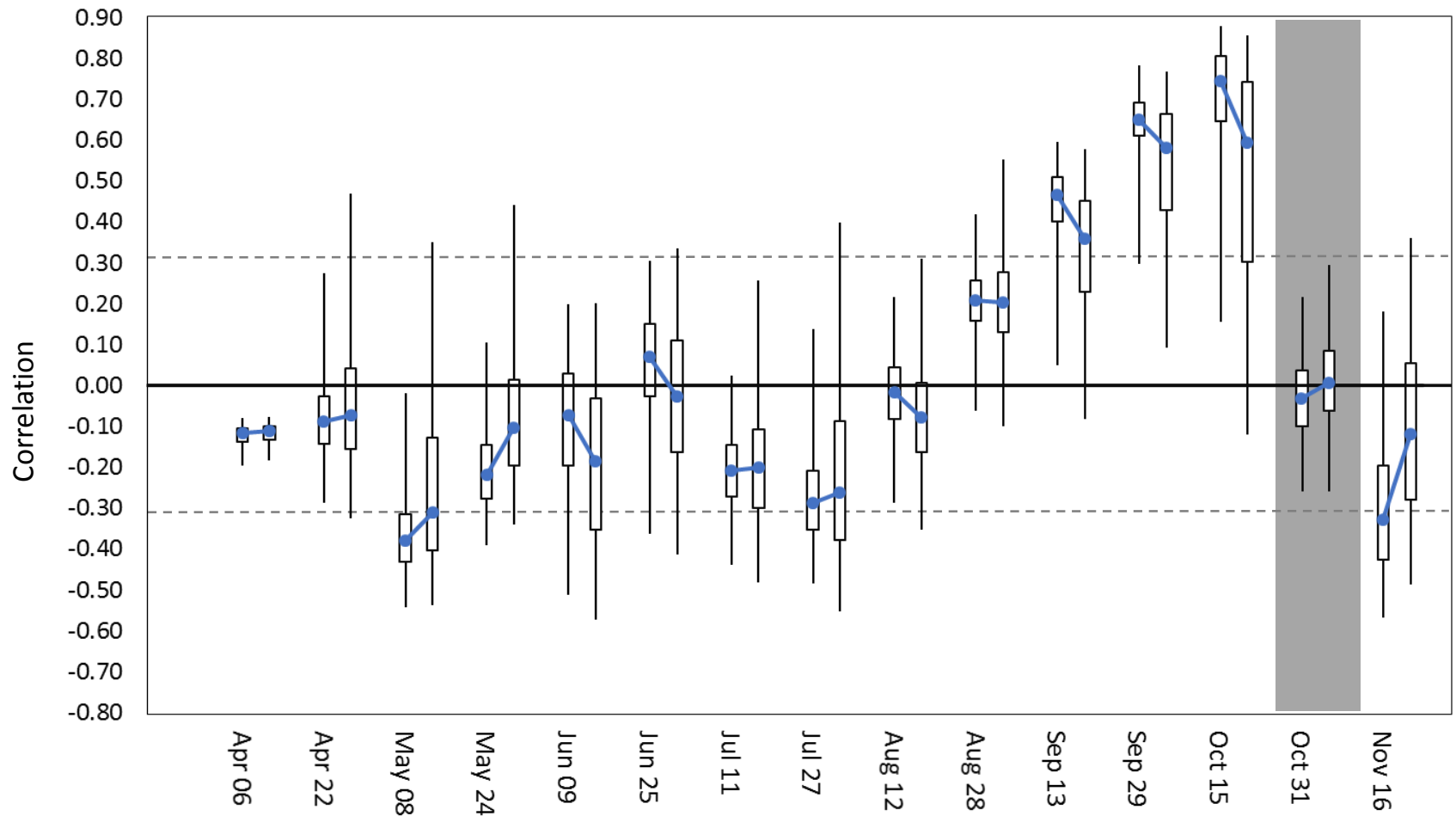
Exposure: 20



2017



# Autumn heat (Growing Degree Days) delays fall browndown, 2000-2015



Source: Norman, SP, WW Hargrove, WM Christie. 2017. Spring and autumn phenological variability across environmental gradients of Great Smoky Mountains National Park, USA. *Remote Sensing*. 9:407.





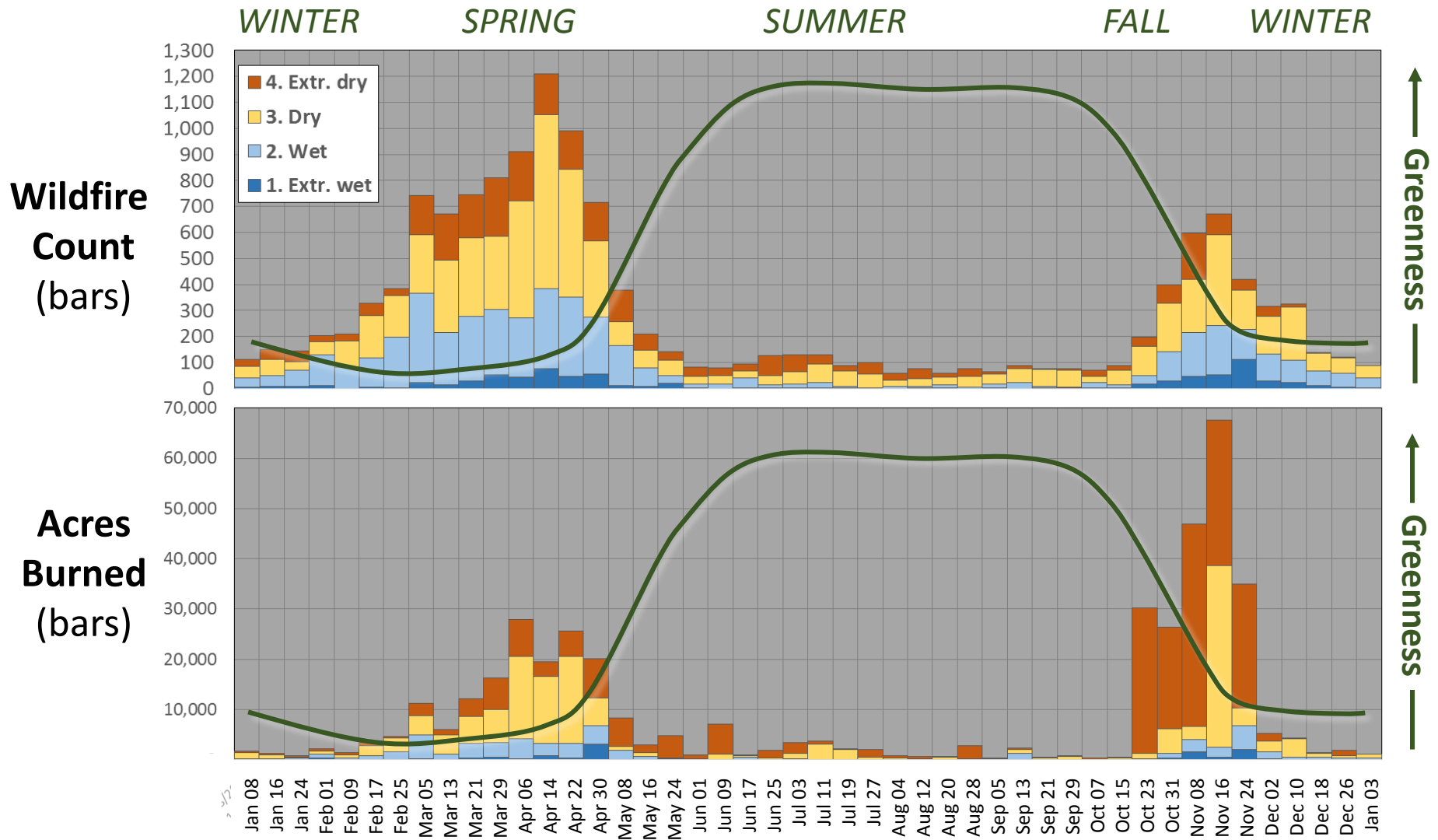
EXTREME  
DROUGHT  
CONDITIONS

# WEATHER and CLIMATE

Maggie  
Lake Jun  
EXIT



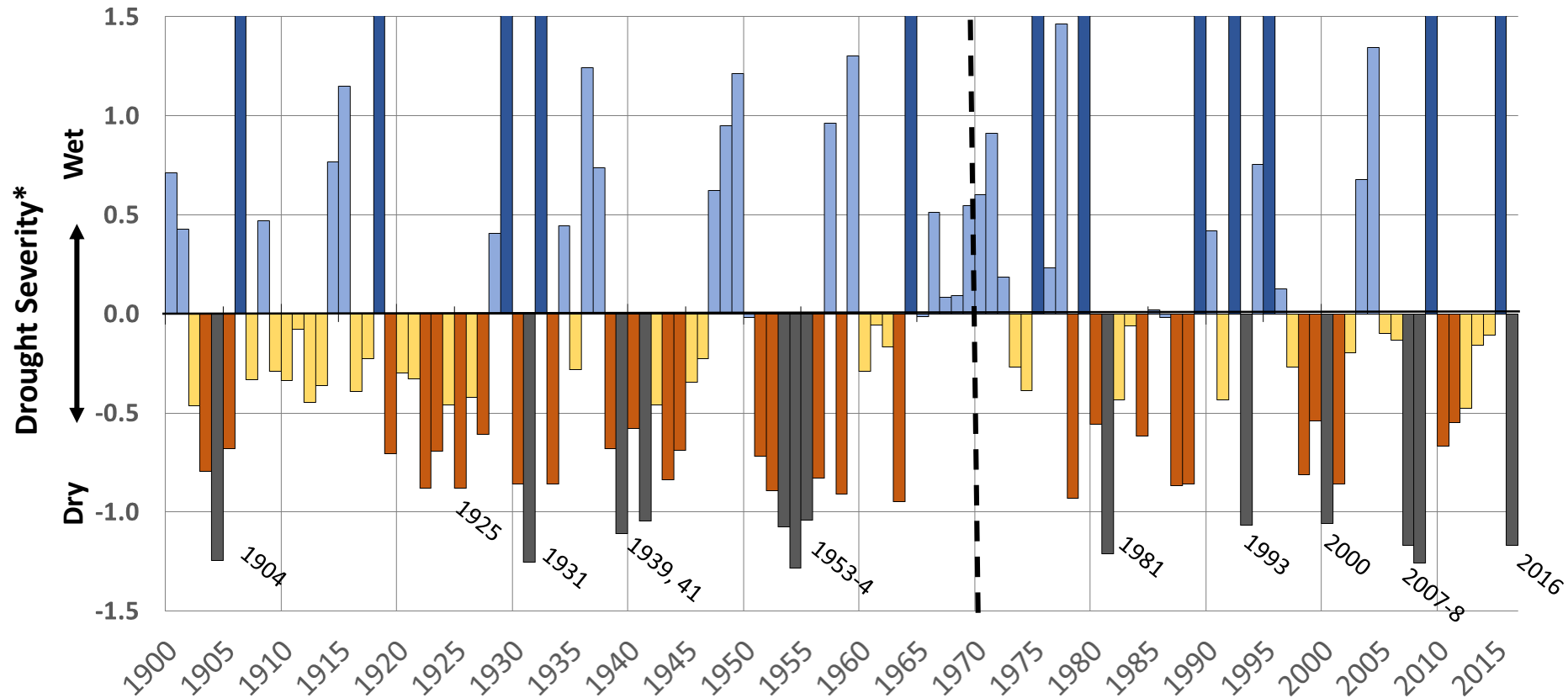
# Drought and canopy phenology at the time of wildfire discovery for the Southern Appalachians, 1970-2016





# How unusual was the fall of 2016 drought as measured by French Broad River flow?

(USGS 03451500)

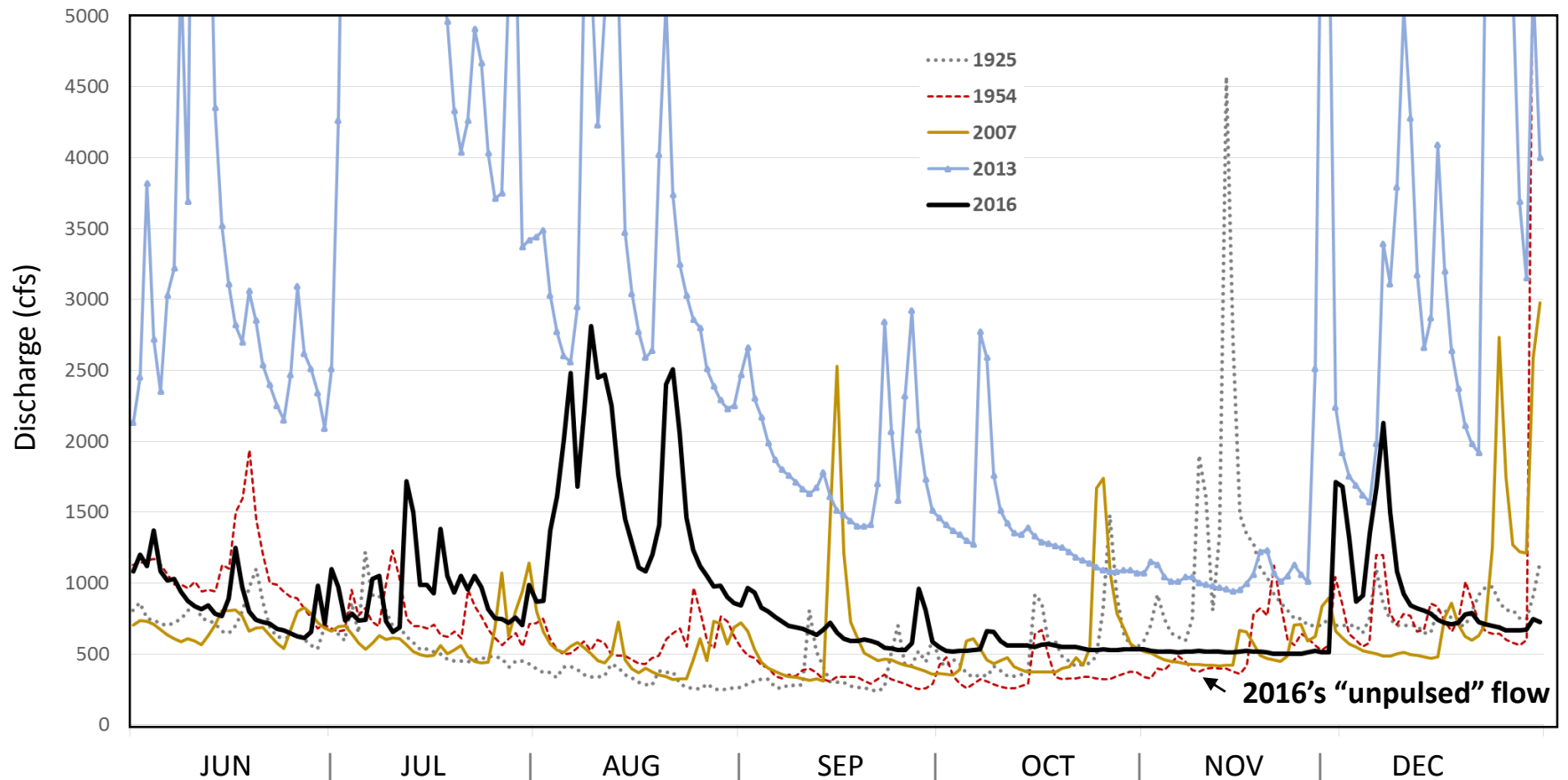


\*Z-Score of Oct-Nov mean discharge



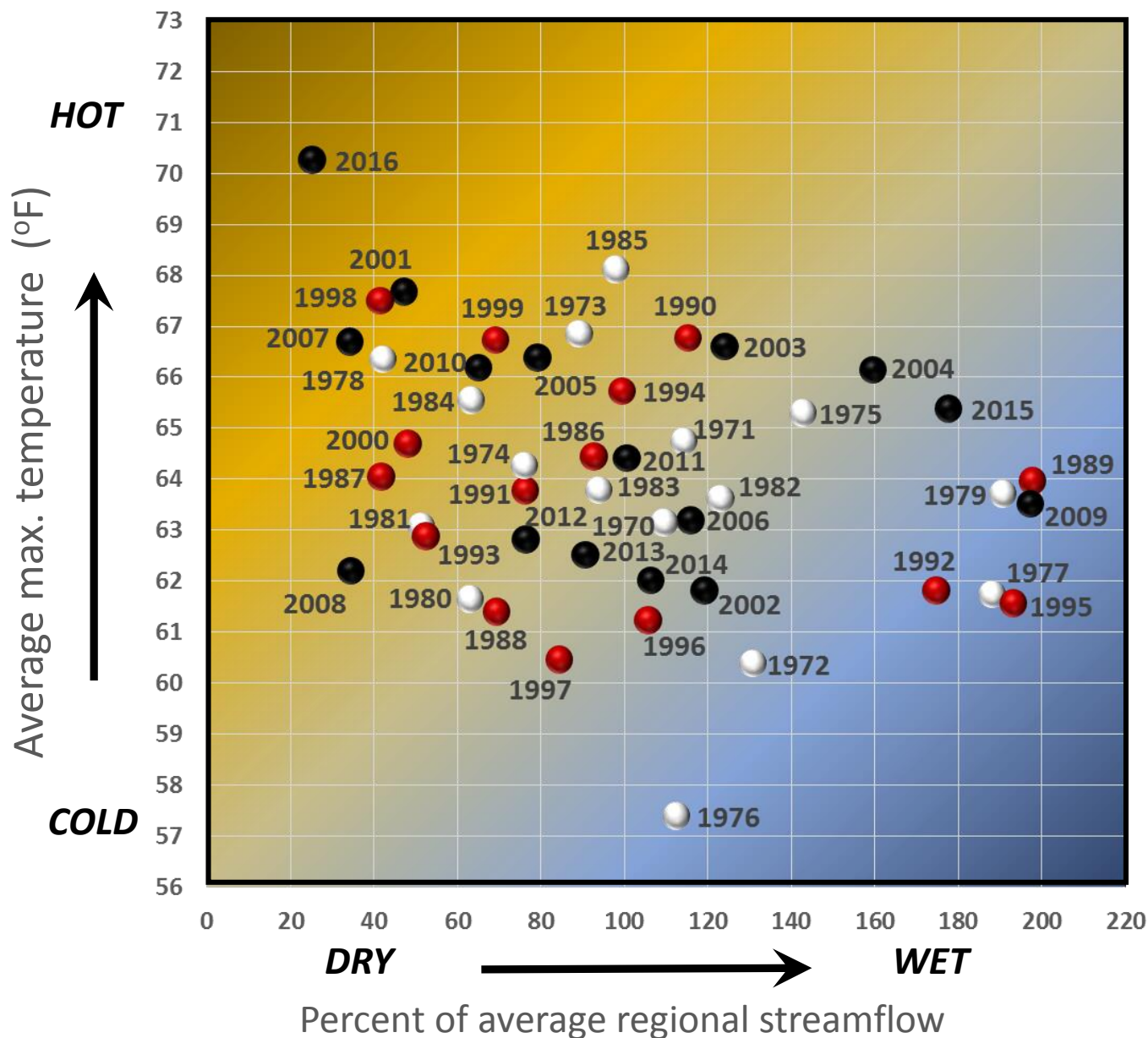
# Late-year daily flow of the French Broad River at Asheville

(USGS Hydrological Station #03451500)



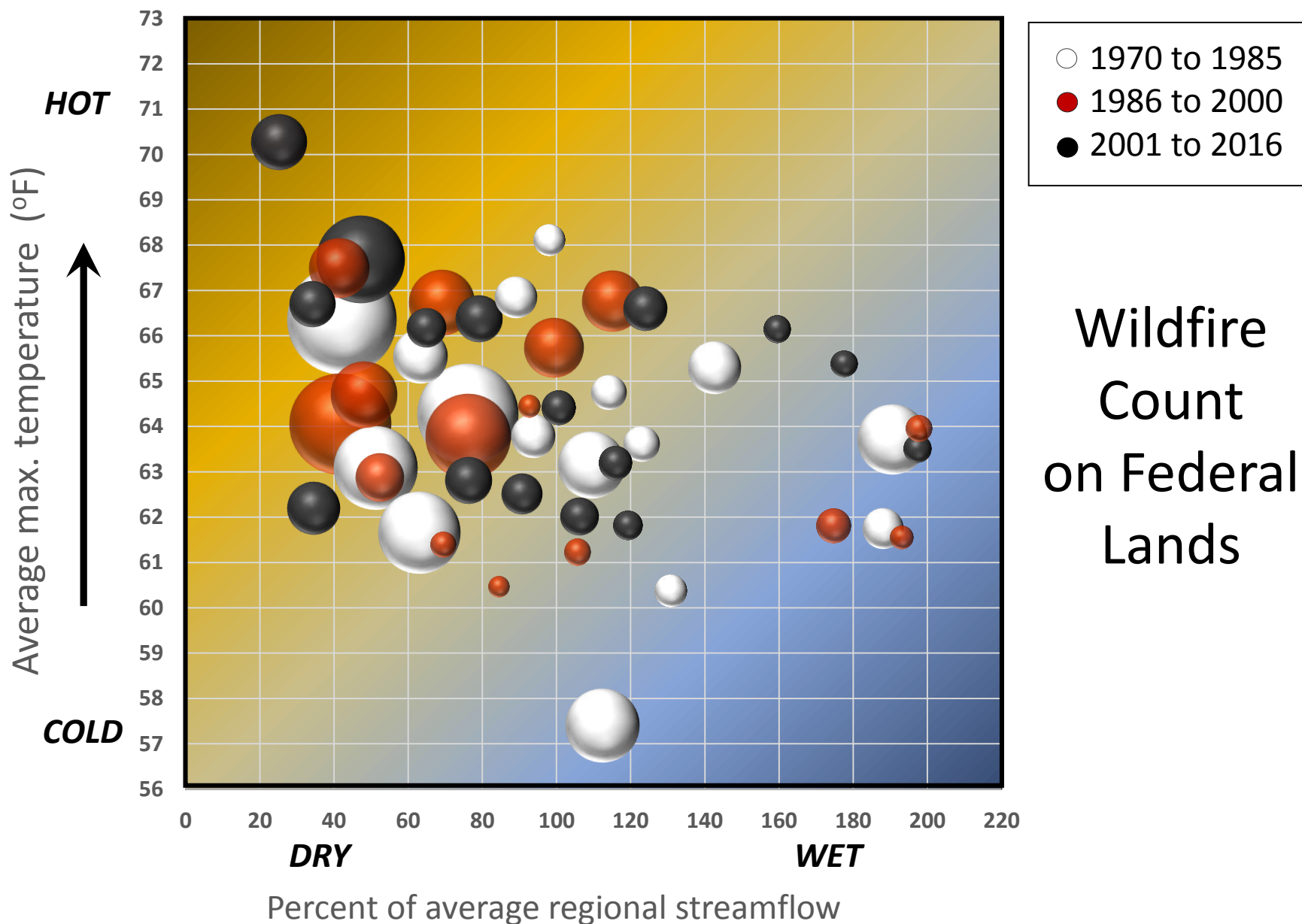


# The fall fire climate of the Southern Appalachians



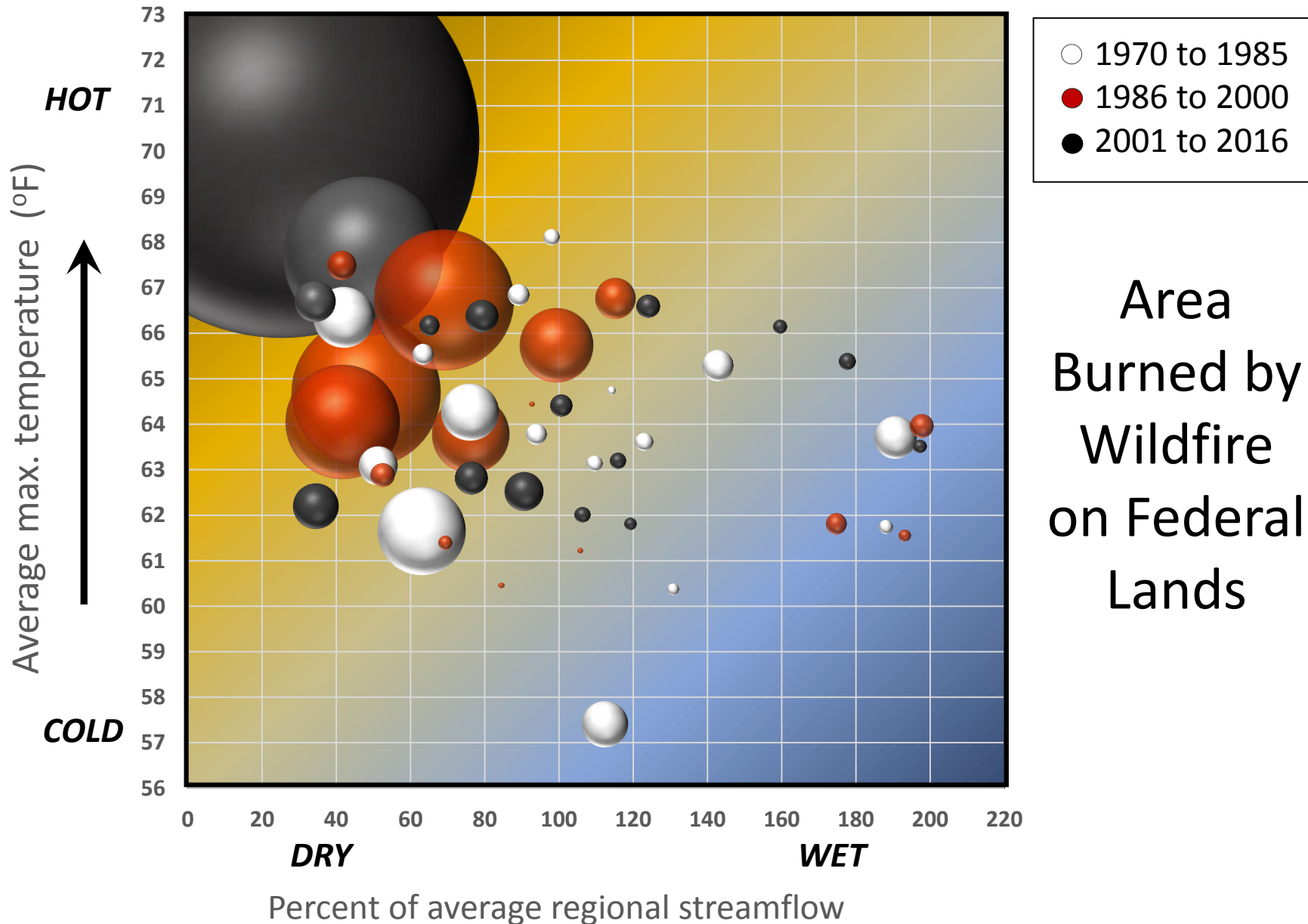


# The fall fire climate of the Southern Appalachians





# The fall fire climate of the Southern Appalachians





# IMPACTS





# Impacts to high value forest elements

## Loss of veteran legacy trees





# Impacts to vegetation and fuels

## Fire-adapted communities





# Impacts to vegetation and fuels

## Non-fire-adapted rich coves





# Impacts from novelty

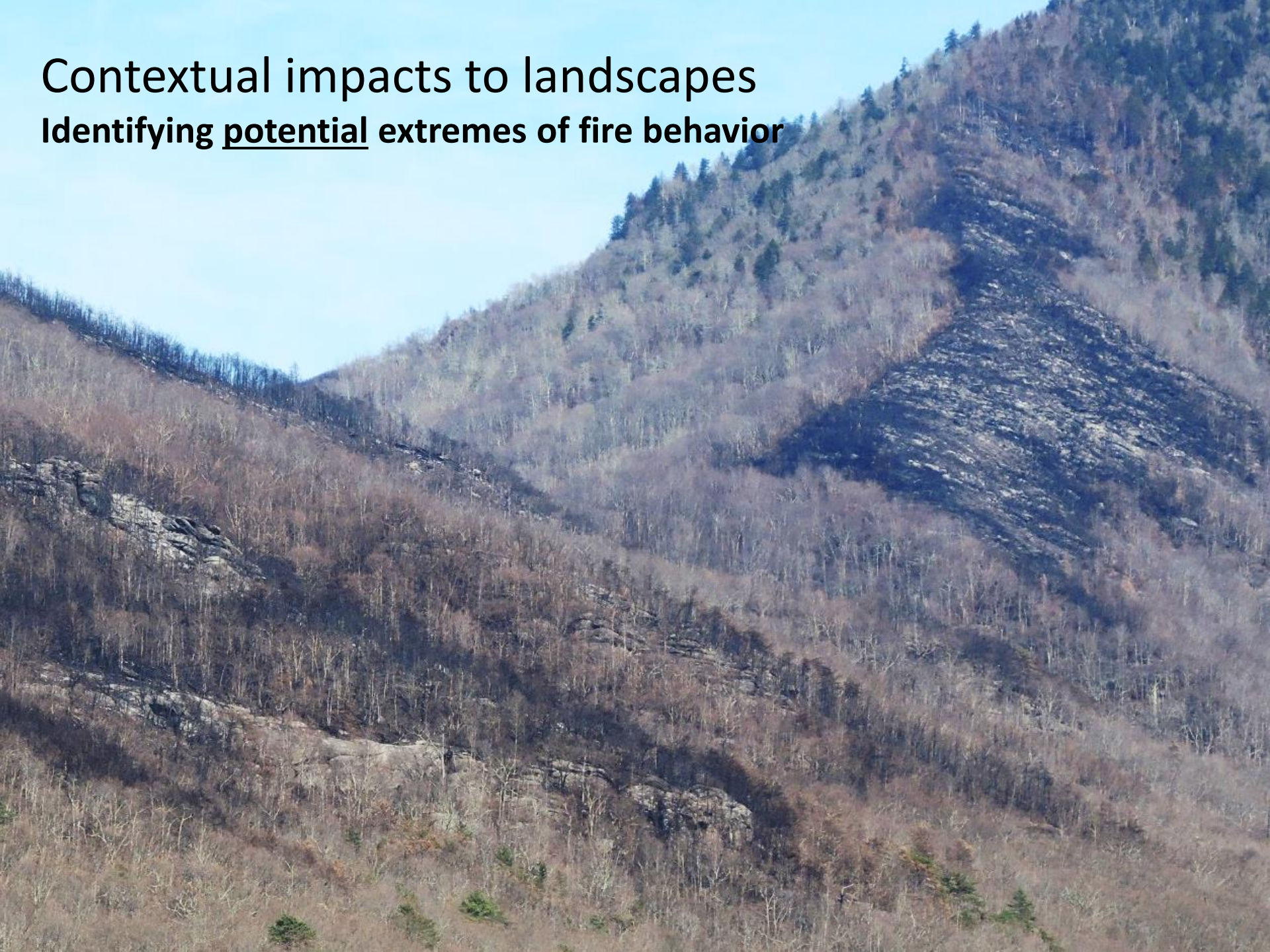
## Invasive paulownia in the Boteler Fire





# Contextual impacts to landscapes

## Identifying potential extremes of fire behavior





# Contextual impacts to landscapes

Identifying likely patterns of fire behavior based on inherent properties

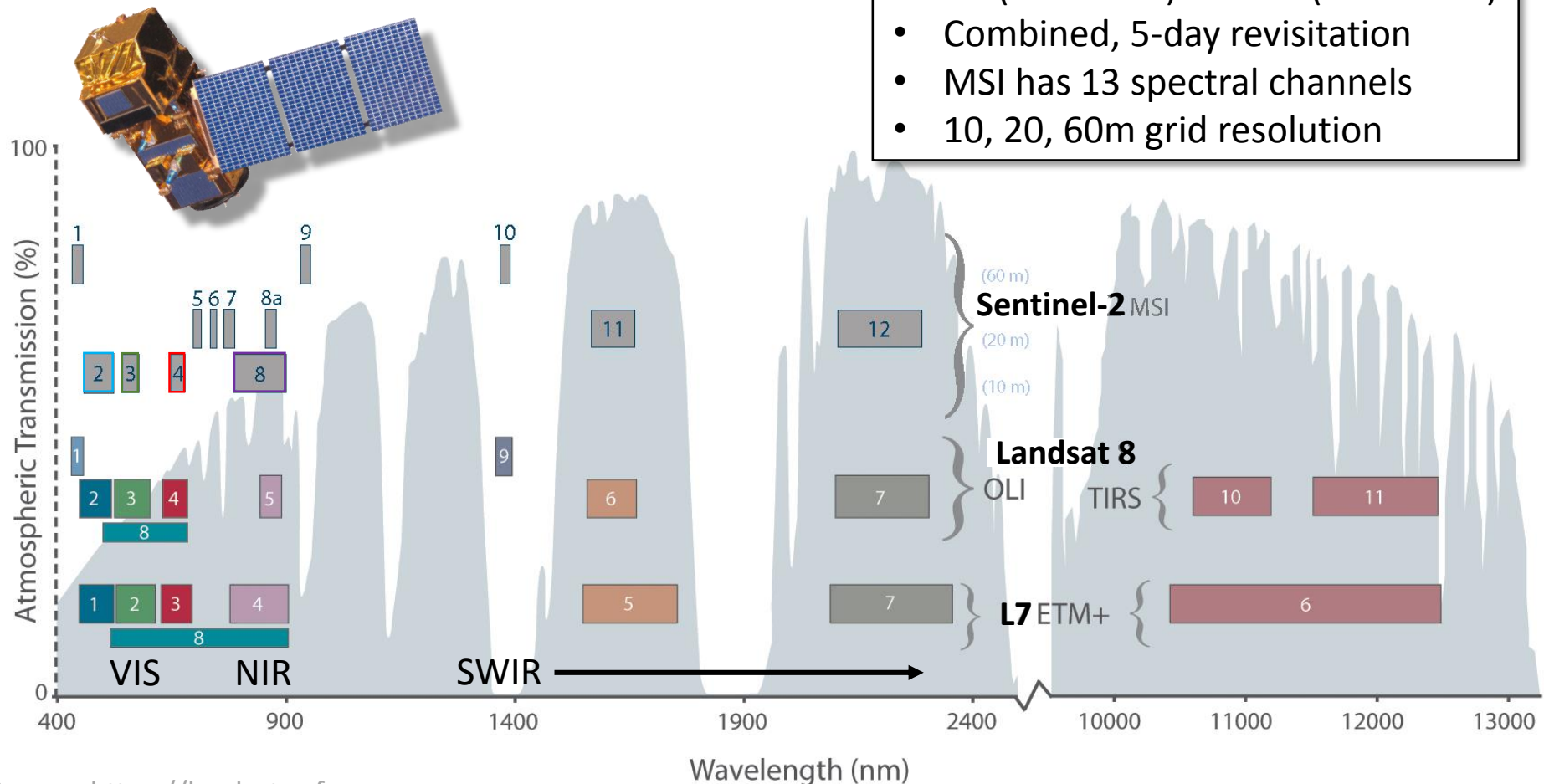




# Systematic all-lands, high resolution, cross-seasonal monitoring of landscape disturbance and recovery

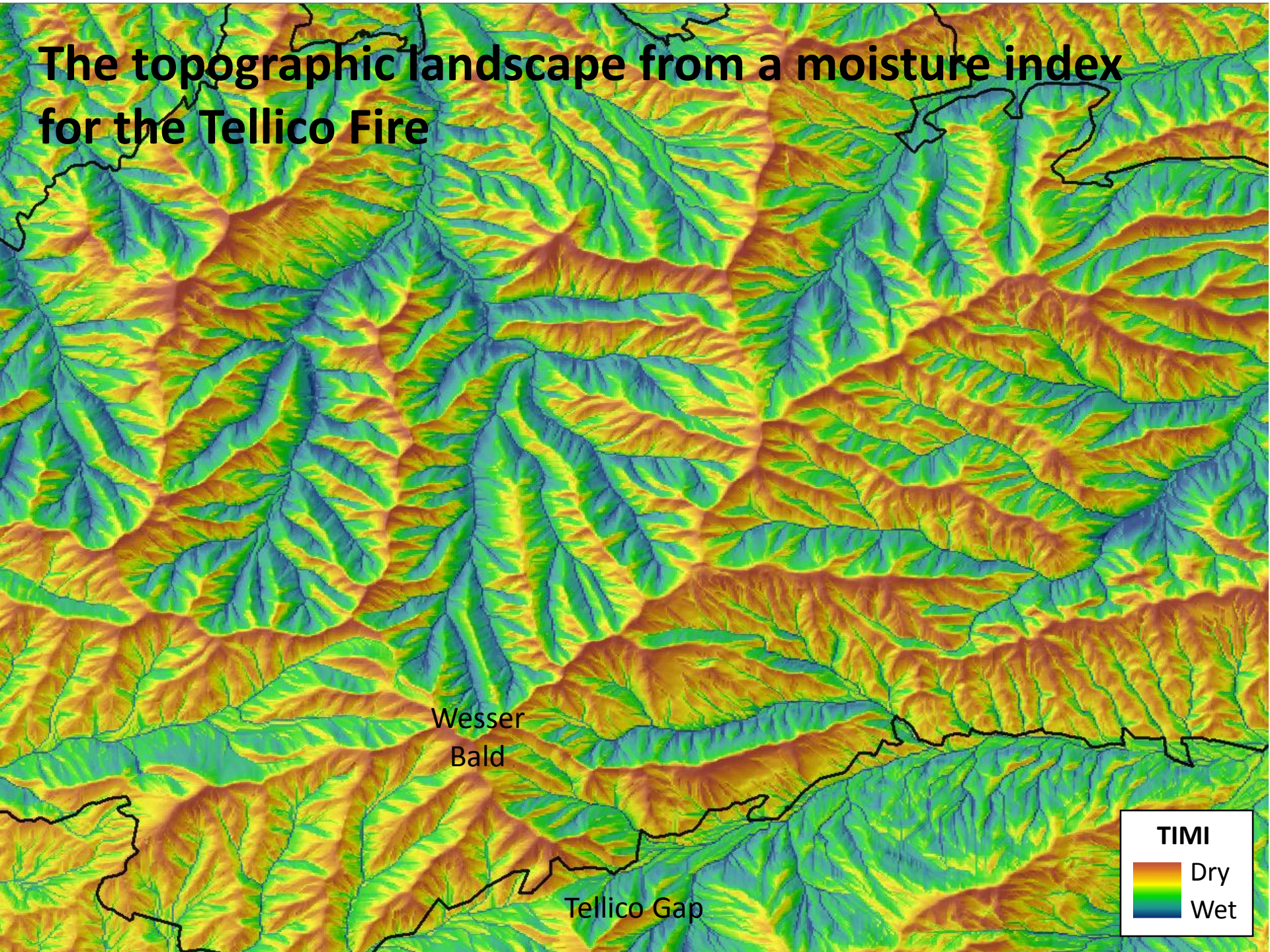
## Sentinel 2

- European Space Agency
- Global coverage
- Free and open data policy
- **2A** (Jun. 2015) and **2B** (Mar. 2017)
- Combined, 5-day revisitation
- MSI has 13 spectral channels
- 10, 20, 60m grid resolution



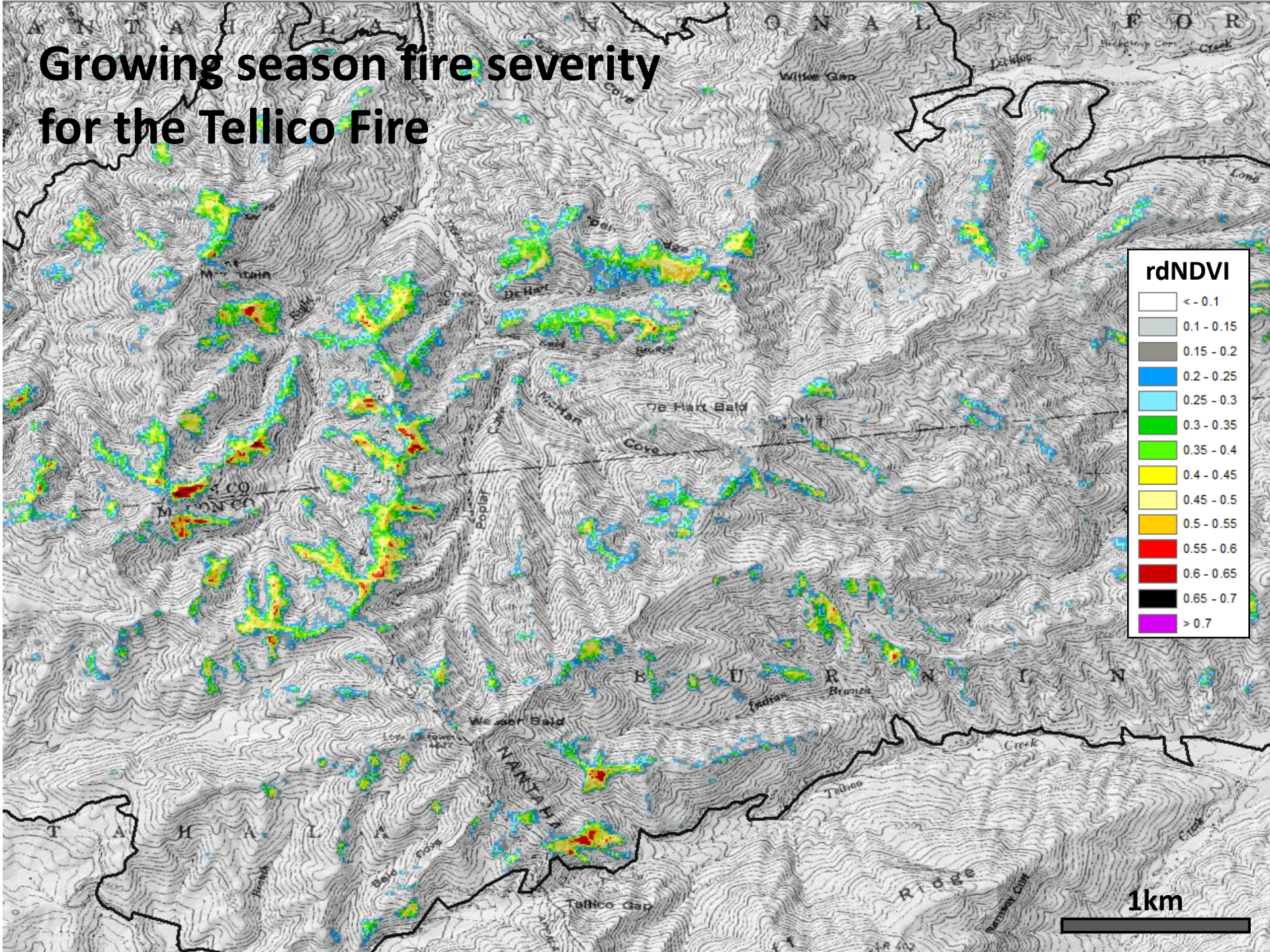


# The topographic landscape from a moisture index for the Tellico Fire



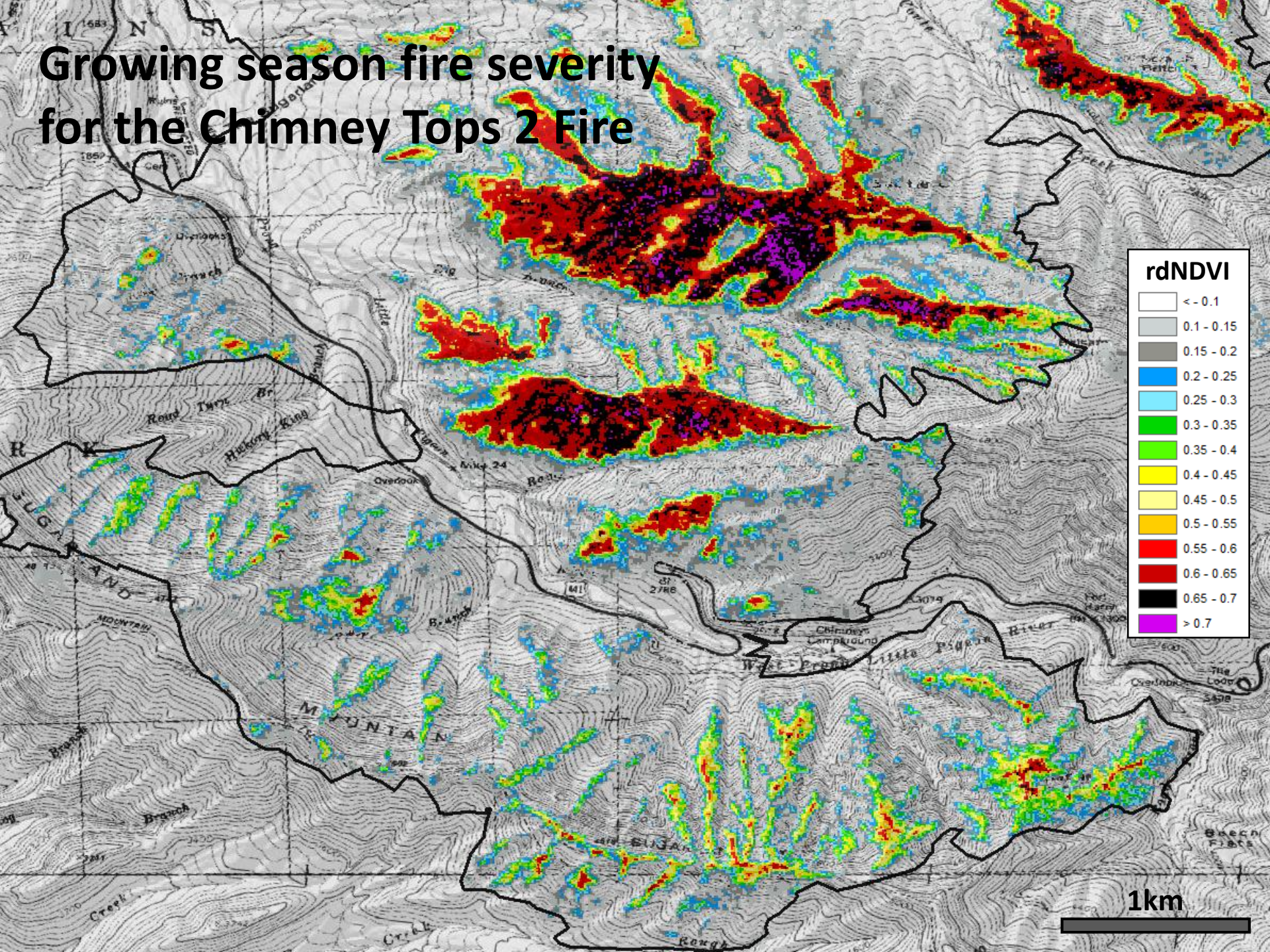


# Growing season fire severity for the Tellico Fire



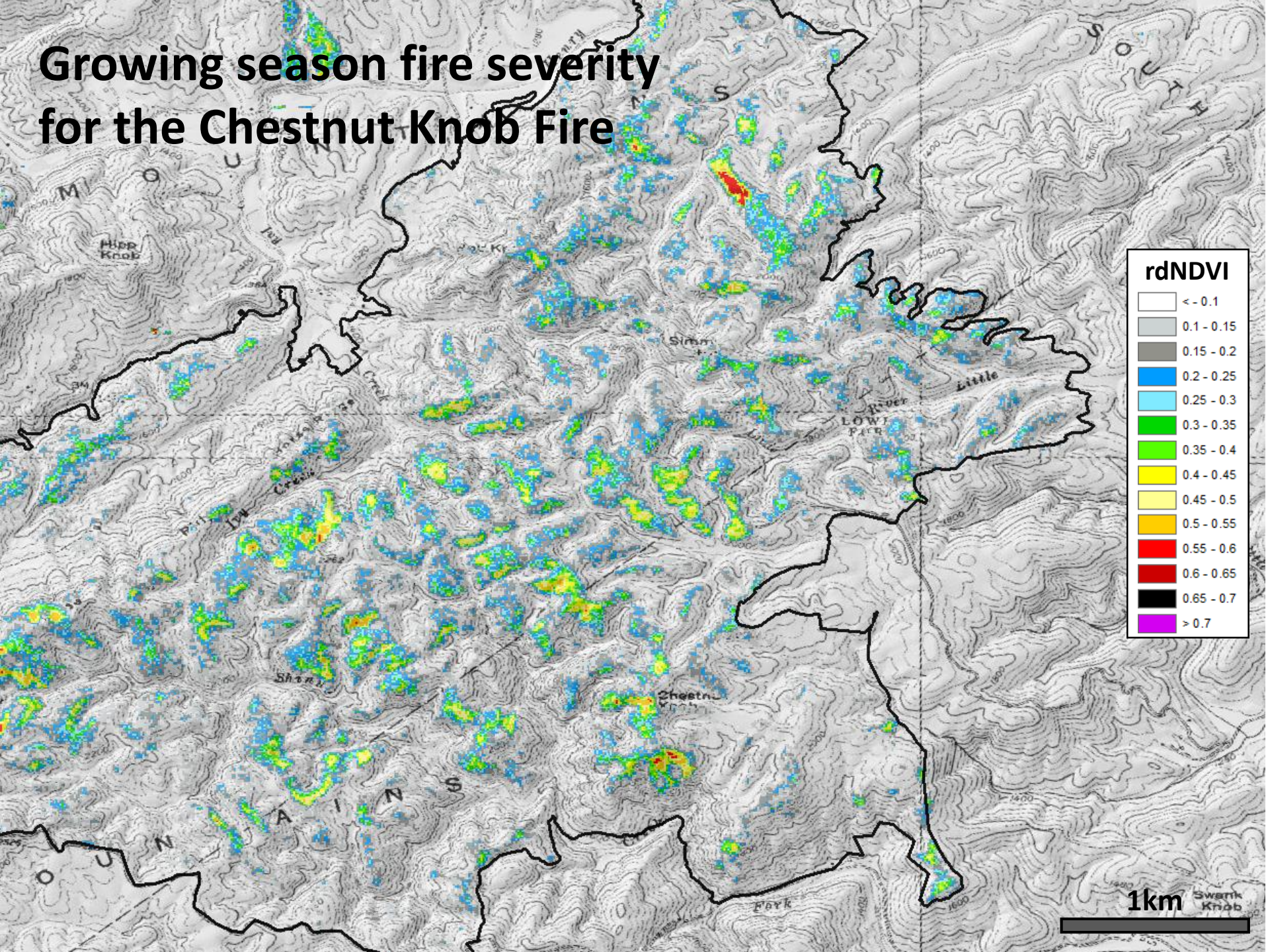


# Growing season fire severity for the Chimney Tops 2 Fire



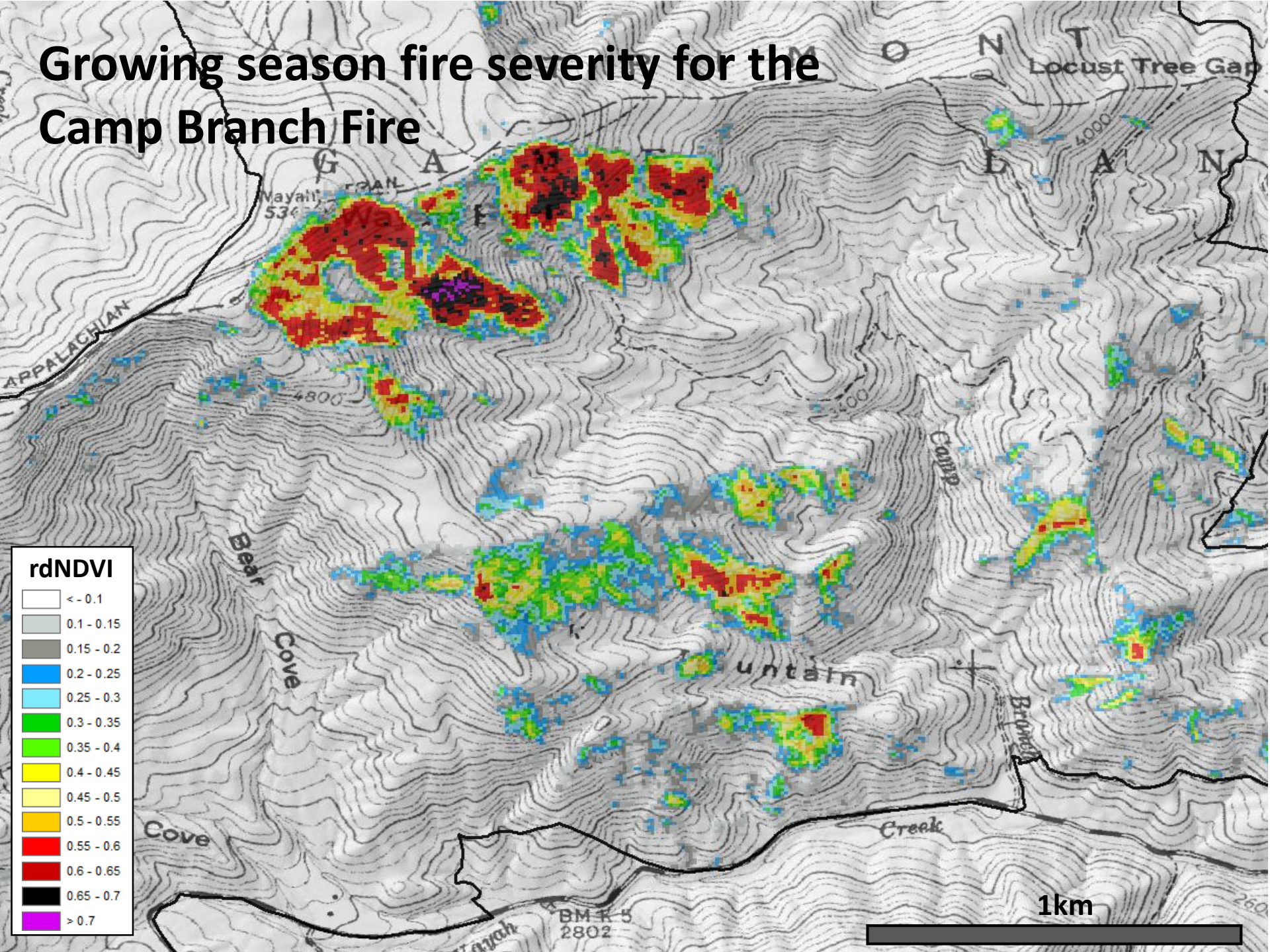


# Growing season fire severity for the Chestnut Knob Fire



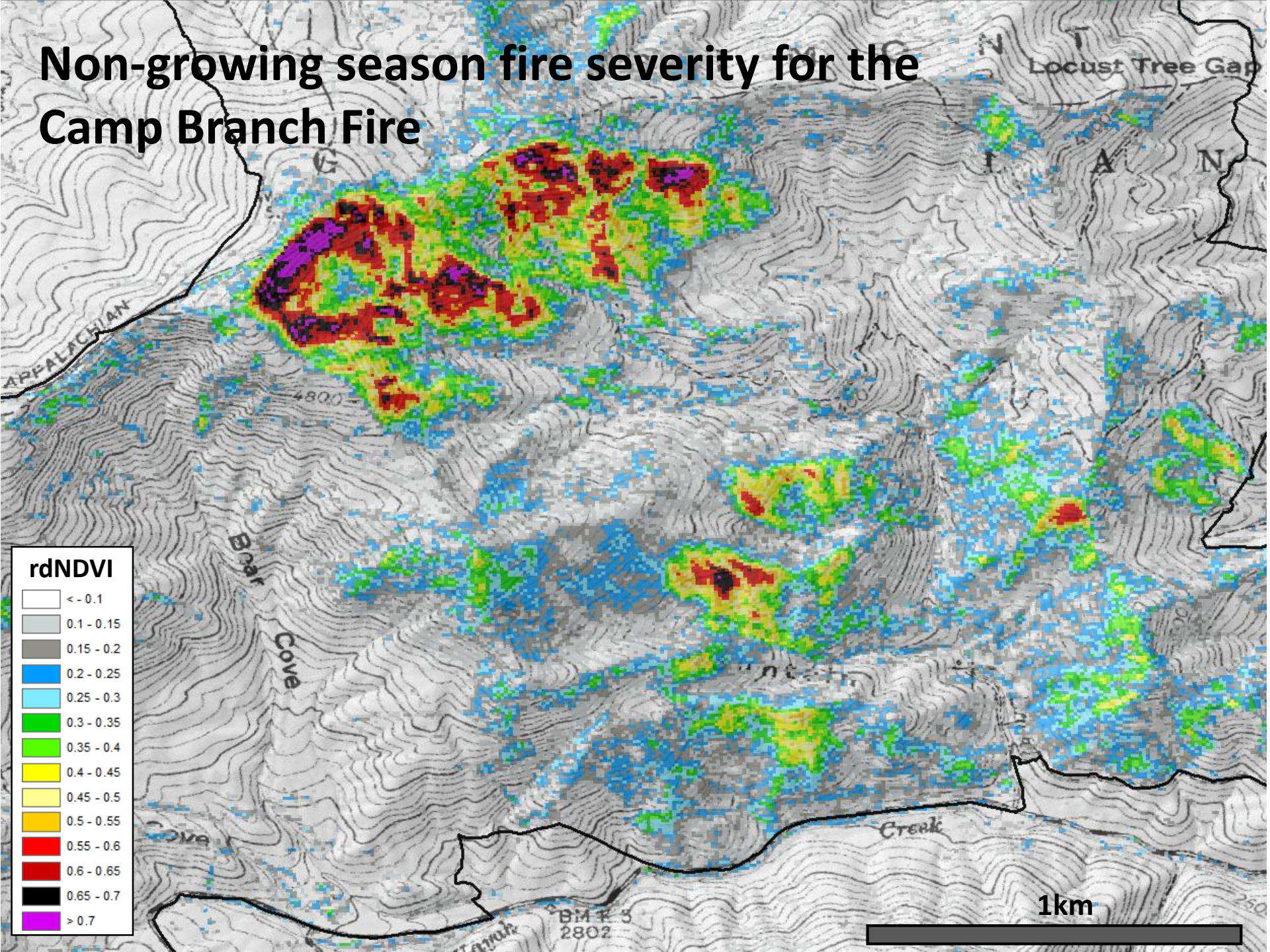


# Growing season fire severity for the Camp Branch Fire





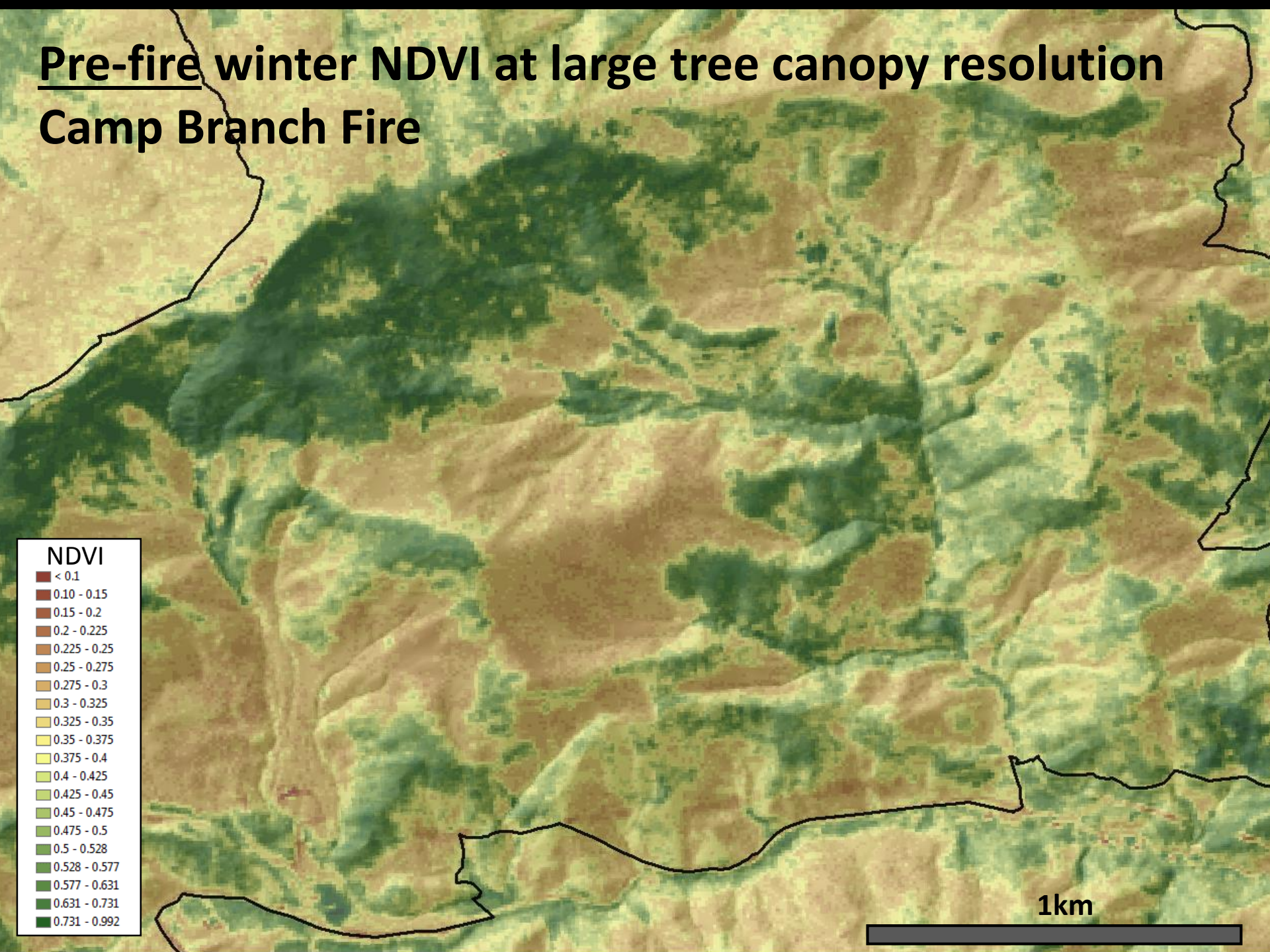
# Non-growing season fire severity for the Camp Branch Fire





# Pre-fire winter NDVI at large tree canopy resolution

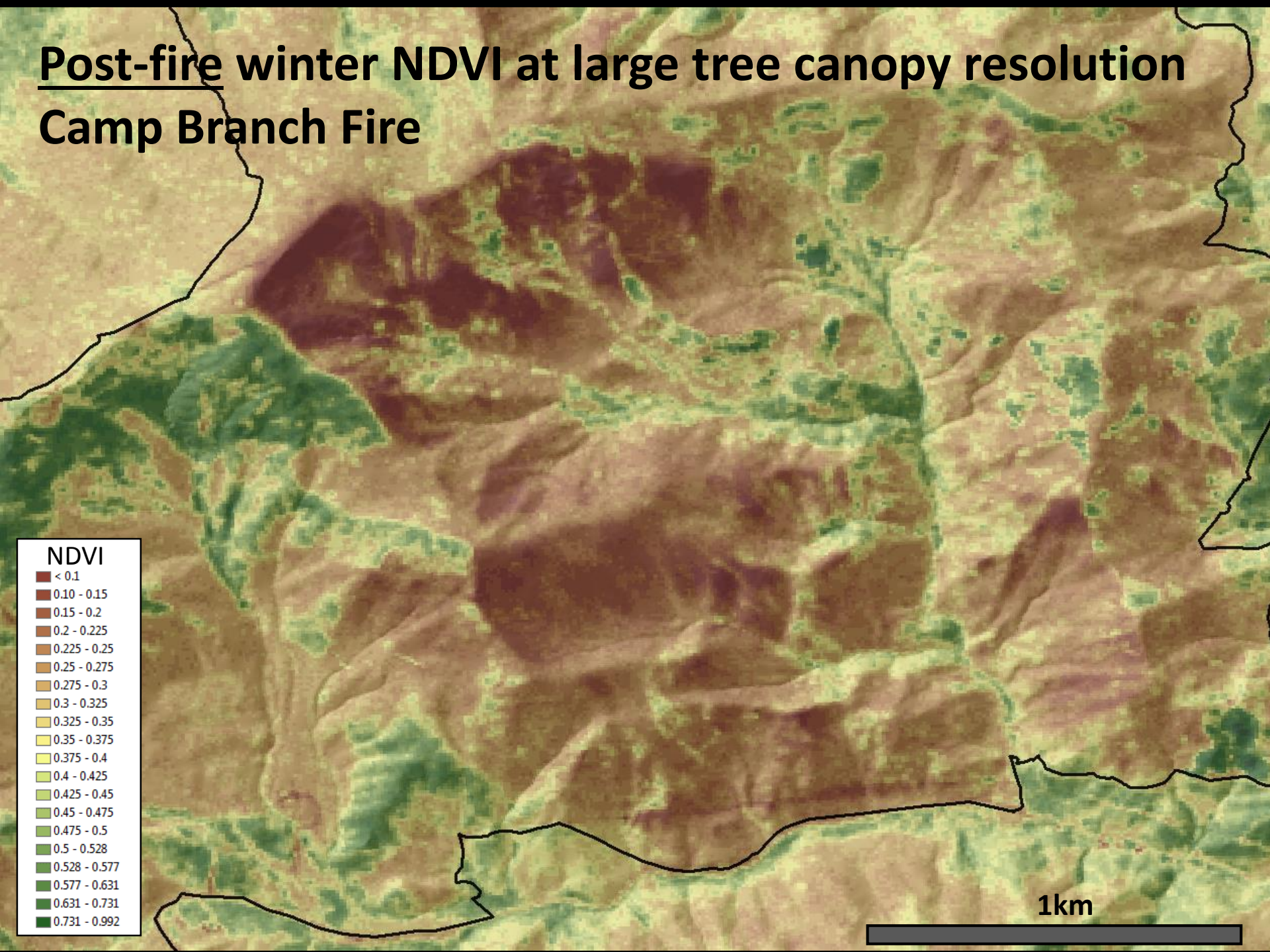
## Camp Branch Fire





# Post-fire winter NDVI at large tree canopy resolution

## Camp Branch Fire





# Summary: So where are we headed?

**Fire seasonality** has fixed and variable drivers. Spring fires are routine, but strong fall fire seasons, like 2016, are hot-drought dependent, raising concerns about future seasonal climate vulnerabilities.

Most **wildfire ignitions** are human caused (as are prescribed fires) which underscores our ability to manage landscapes and prevent undesired ignitions.

Topographically, **core wildfire effects** are generally predictable across fires and likely over time. The occasional fire generally reinforces existing vegetation patterns in a way that contributes to ecological resilience, but not without caveats.



**Thank you.**

