



# **Fire Ecology and Fires of the Future**

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**Colorado Wildland Fire Conference:  
The True Cost of Wildfire**

**Glenwood Springs, Colorado**

**April 16, 2014**



# **FIRE IS INEVITABLE.**

**It's not a question of IF;  
It's a question of WHEN it will occur,  
And WHAT KIND of fire it will be.**



Northwest Crown Fire Experiment, Northwest Territories, Canada

Bunk S: *World on Fire*. PLoS Biol 2/2/2004: e54. doi:10.1371/journal.pbio.0020054.g001



Whitewater-Baldy Complex,  
Gila National Forest, New Mexico, May, 2012  
Photo by Kari Greer. Credit USFS Gila National Forest.  
<http://www.flickr.com/photos/gilaforest/7355231410/>

# Fire Severity: As defined by amount of tree mortality during a fire



100

Percent of  
landscape  
canopy  
mortality

0

## Surface fire

Mainly surface  
fuels involved in  
fire spread across  
landscape

## Passive crown fire

Patches of stand torching  
but fire spread mainly  
through surface fuels

## Active crown fire

Mainly aerial fuels  
involved in fire  
spread across  
landscape

# 3 main factors that affect fire behavior:

Crown bulk density

Crown base height

Surface fuels



Photo by Peter Mark Brown



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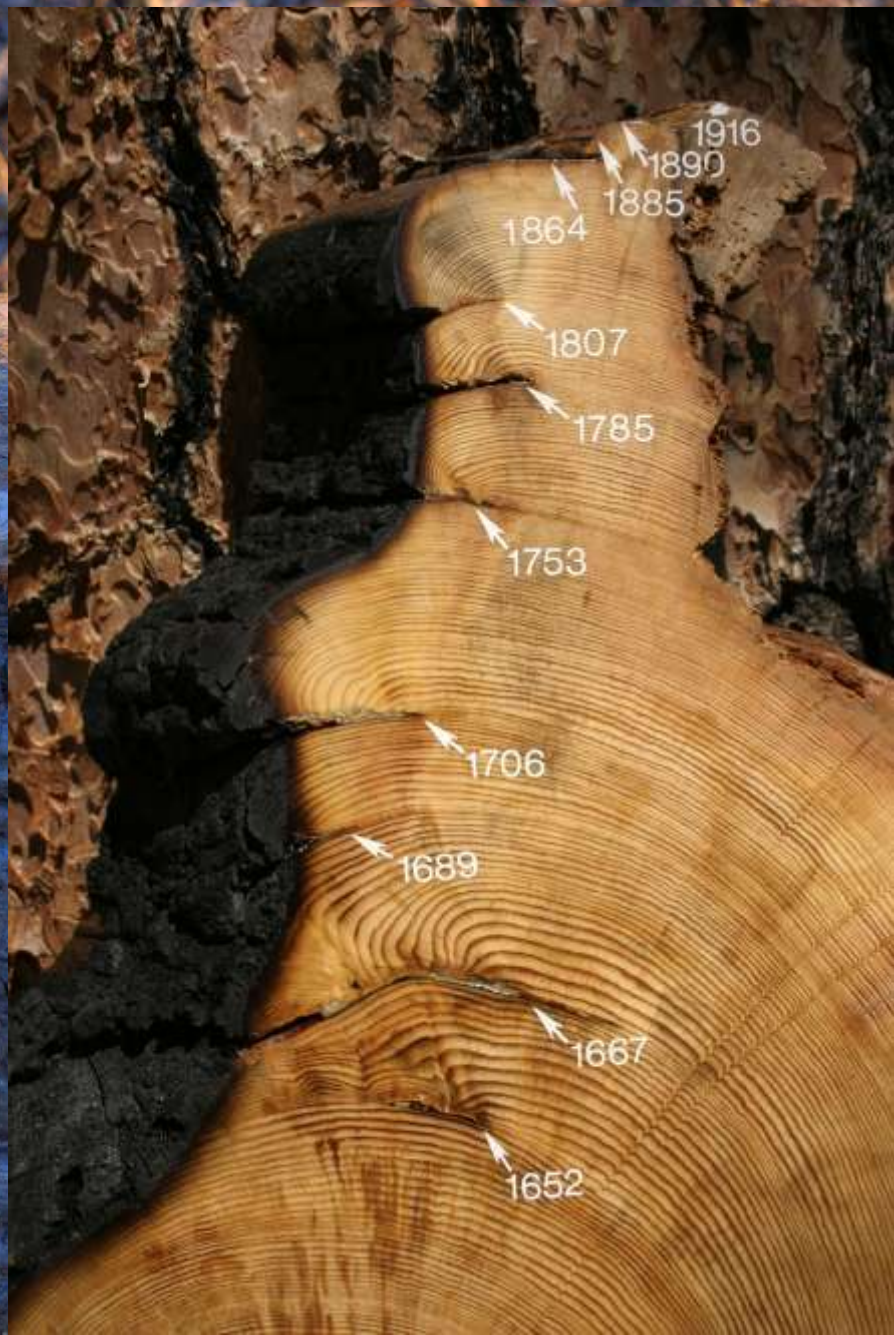




Photo by Peter Mark Brown

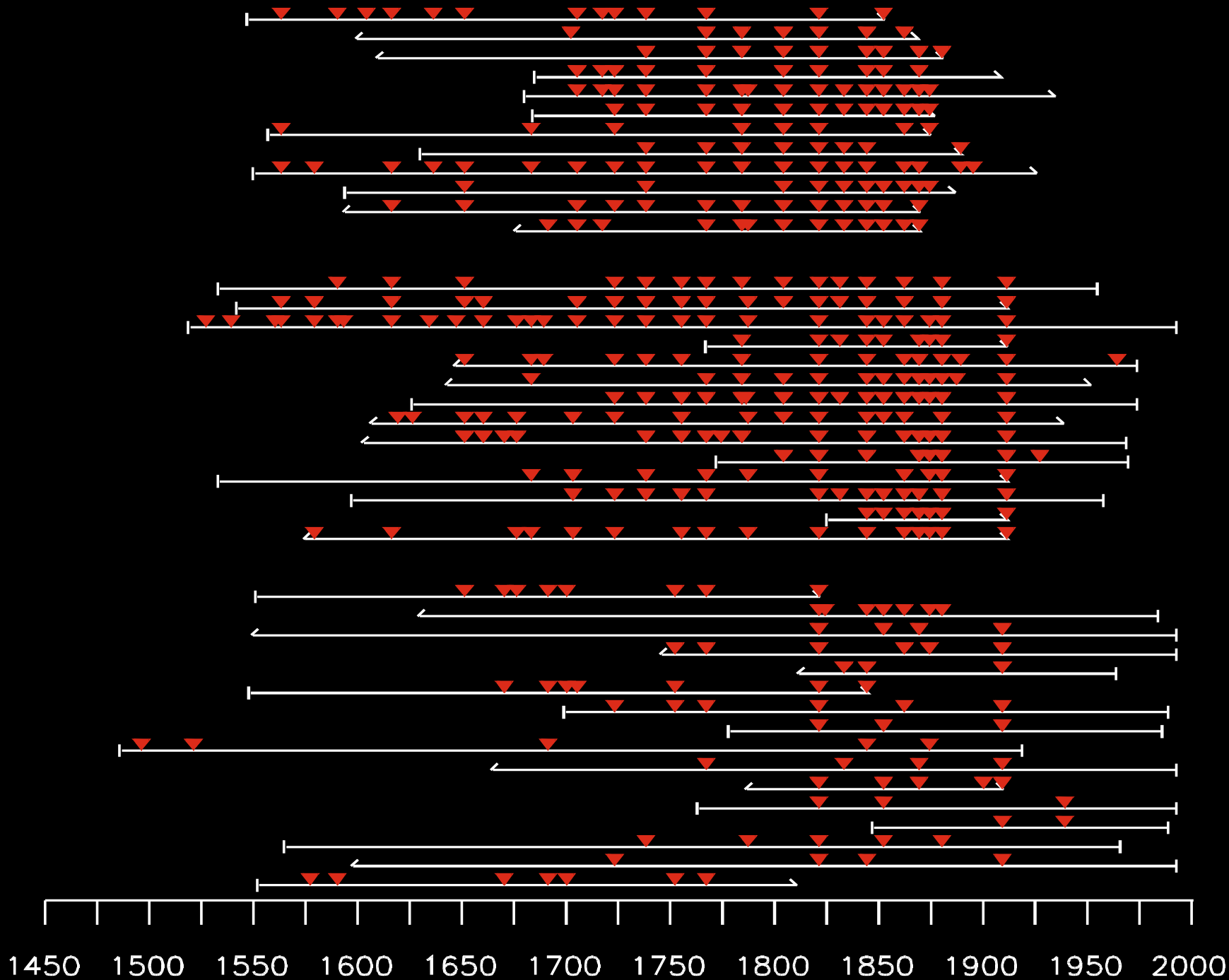


**Dendrochronology:** Rings match between trees because climate controls growth, which yields exact calendar years for tree rings...

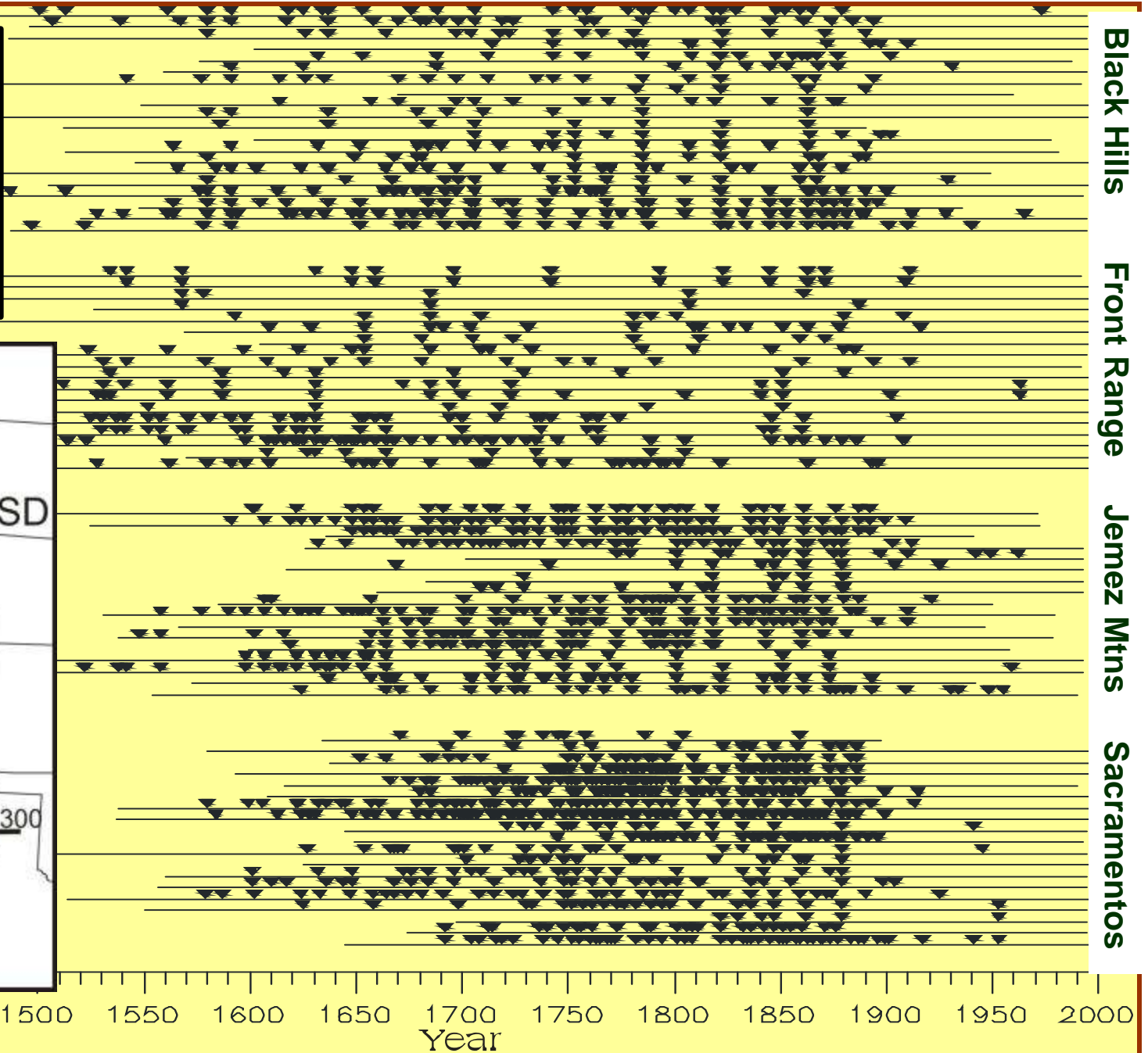
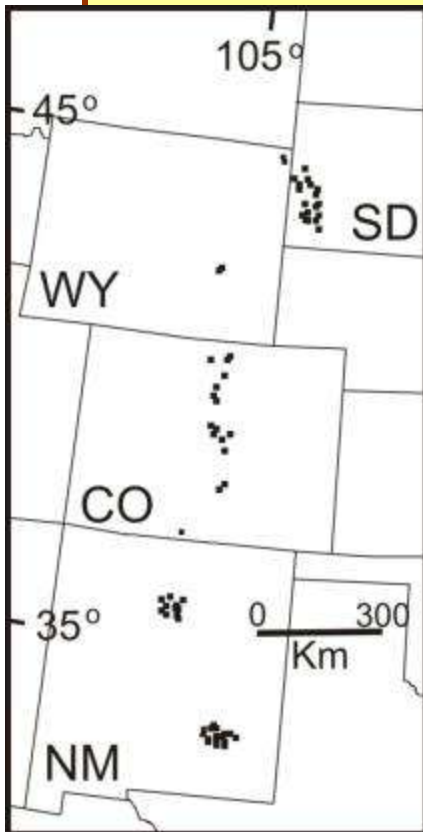


...and allows us to sample remnant trees, especially stumps and logs





These are site  
averages: 10 to  
20 fire-scarred  
trees each (780  
trees total in  
69 sites)



Past

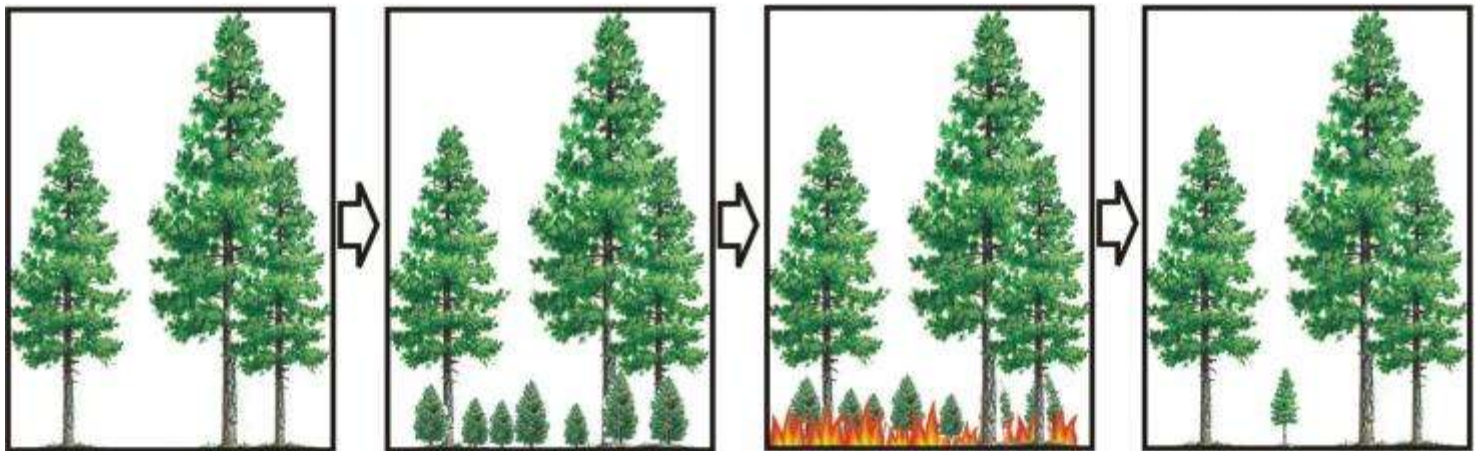
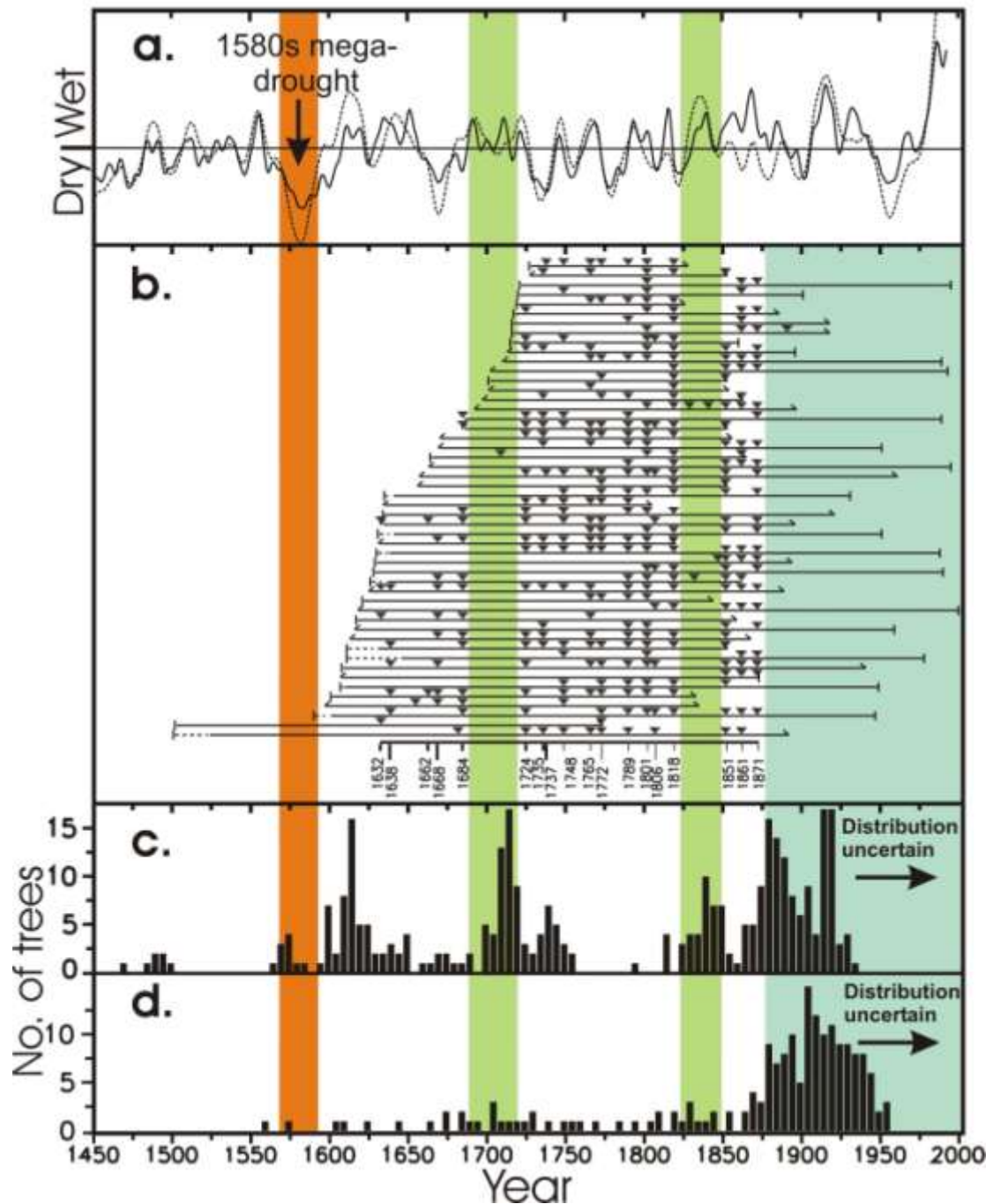




Photo by Peter Mark Brown



a. Tree-ring reconstructions of precipitation and drought (smoothed)

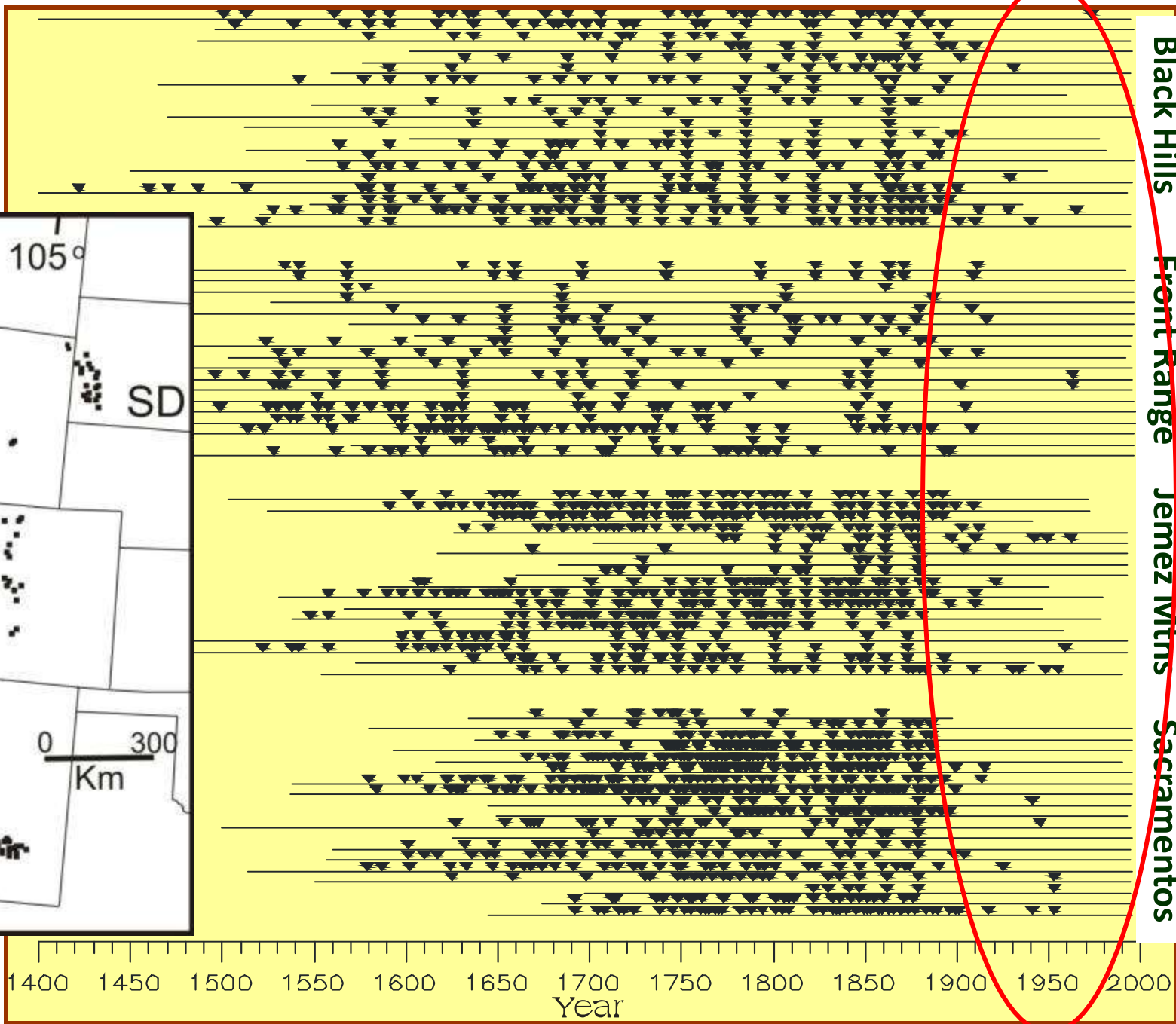
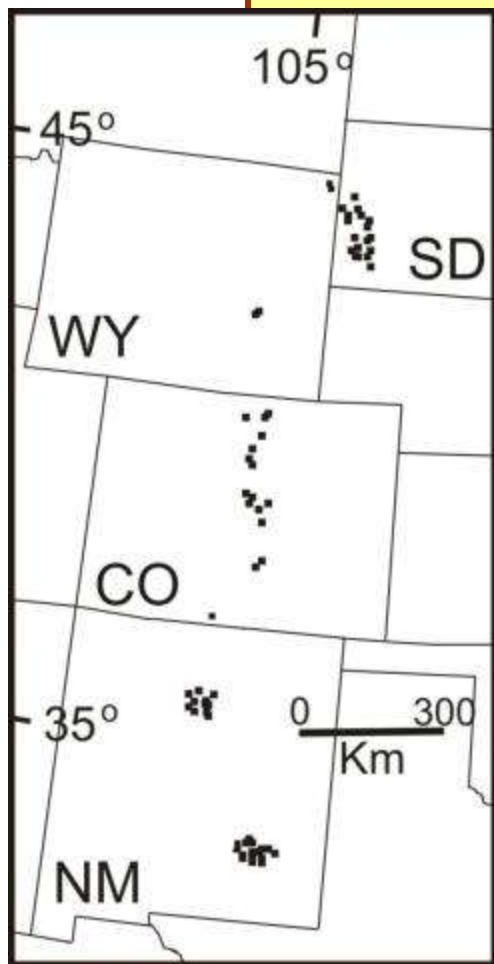
b. Fire-scar history

c. Ponderosa pine establishment

d. Other species (Douglas-fir, juniper, piñon)

(Brown and Wu, 2005)

**Black Hills      Front Range      Jemez Mtns      Sacramentos**

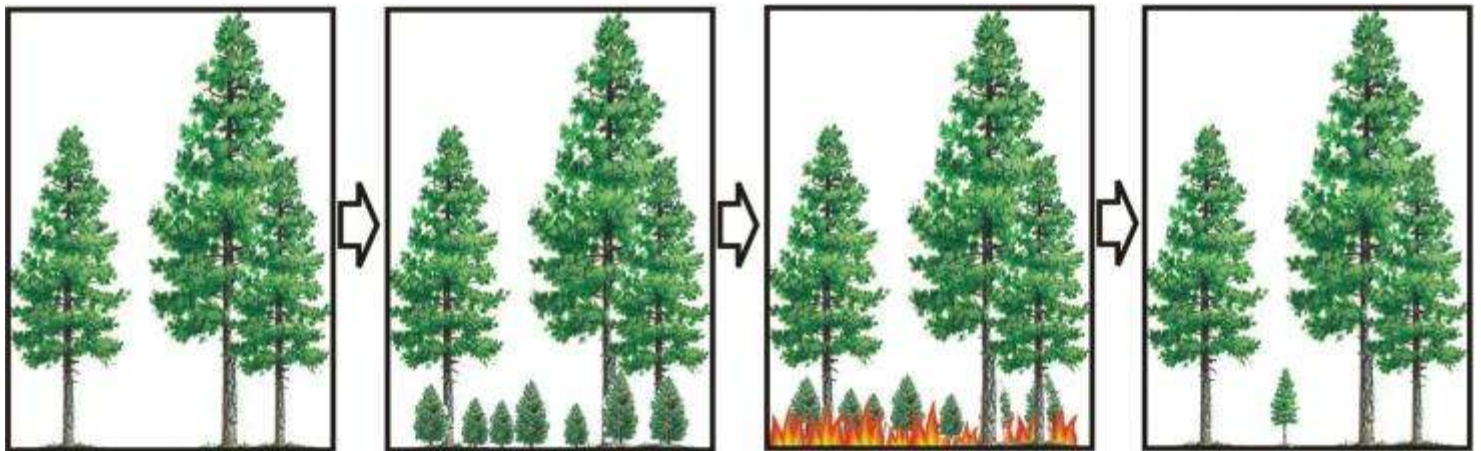






Sheep grazing in a field, 1930s  
KARSON

Past



Current

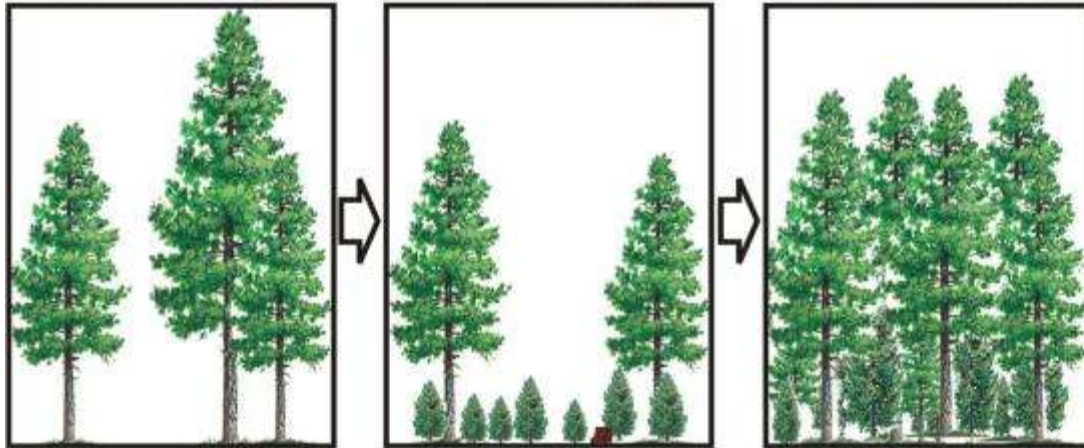
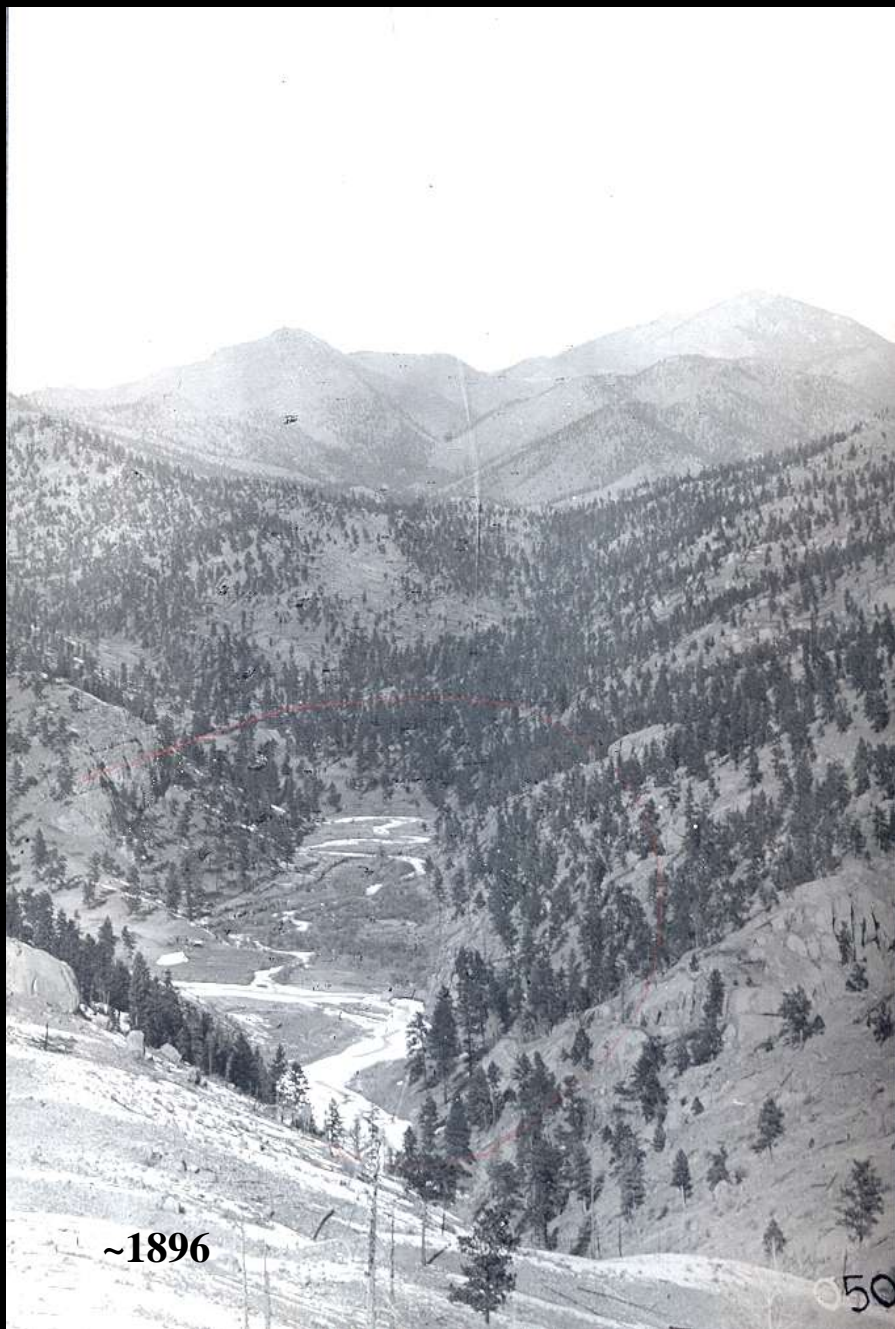






Photo by Peter Mark Brown



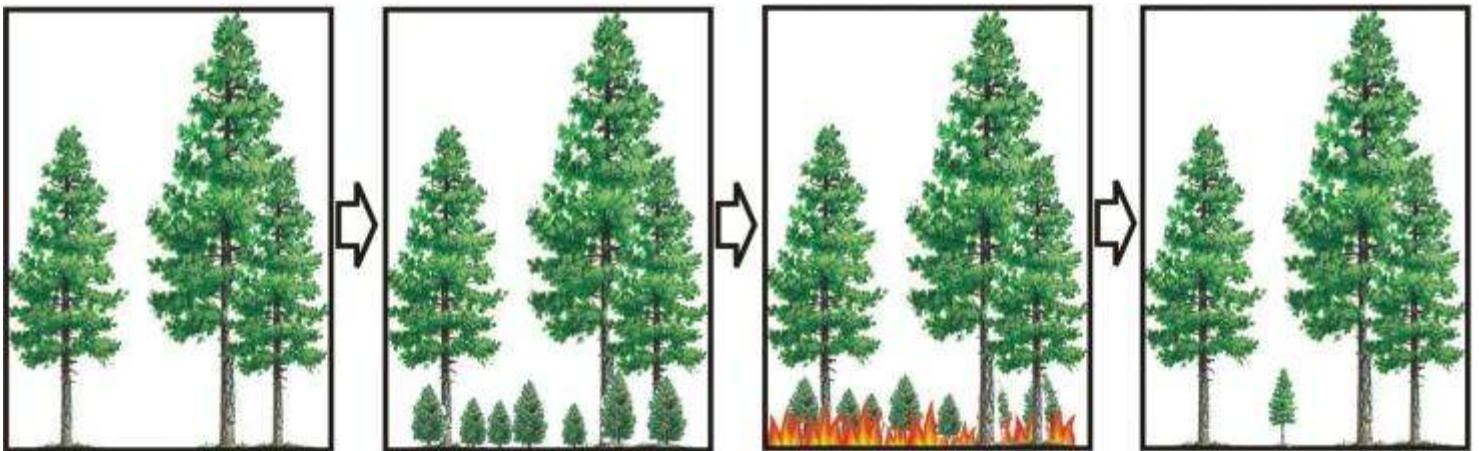
1899



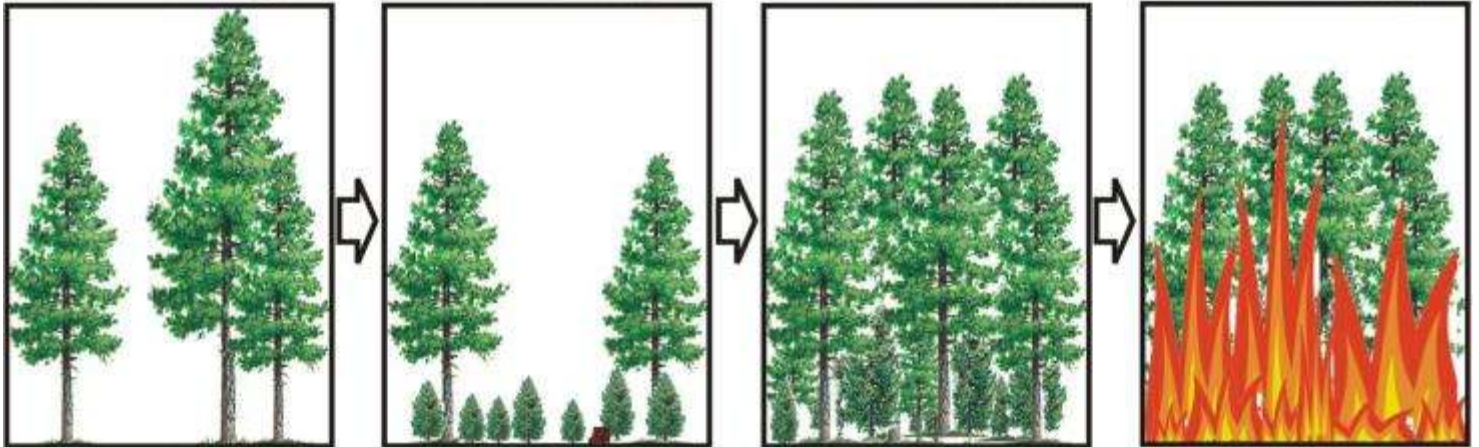
2000



Past



Current













**Photo credit: Dept. of Forest & Rangeland Stewardship, Colorado State University.  
Airplane flight courtesy of LightHawk and Lighthawk Volunteer Pilot Stephanie Wells.**



Photo by Ben Wutdke

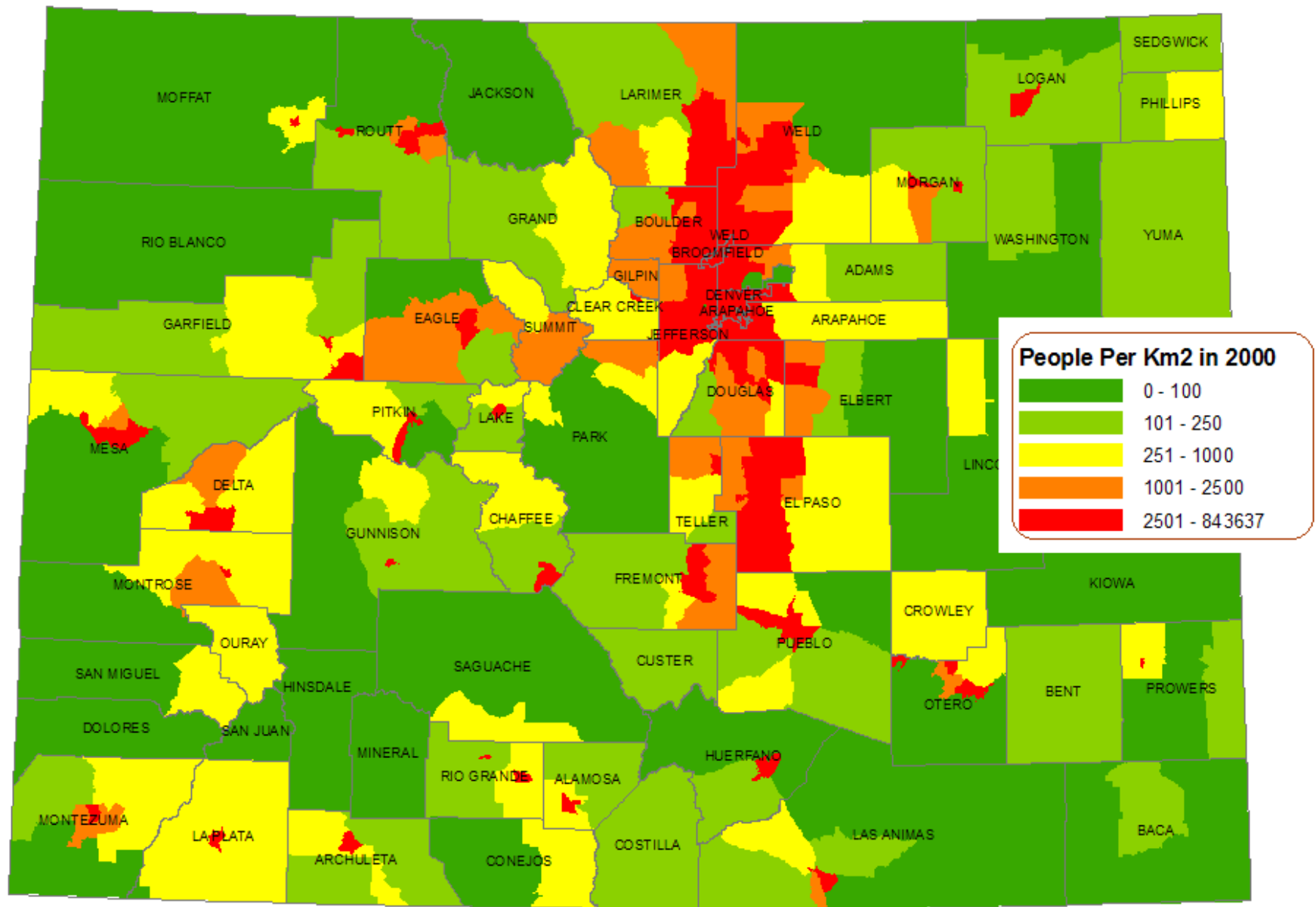


**Photo credit: Dept. of Forest & Rangeland Stewardship, Colorado State University.  
Airplane flight courtesy of LightHawk and Lighthawk Volunteer Pilot Stephanie Wells.**

A map of Colorado with a grayscale background representing elevation. Bright green areas indicate the distribution of Ponderosa pine, primarily along the Front Range and in the western part of the state. Red lines represent major roads or highways. A small cyan arrow points to a specific location in the western part of the state.

# Ponderosa pine in Colorado

# Colorado Population Density, 2000



# Some Recent Fires on the Front Range, 1996-2012

1996	Buffalo Creek	12,000 ac
2000	Bobcat Gulch	10,600 ac
2000	Hi Meadow	10,800 ac
2002	Hayman	138,000 ac

Total estimated cost \$207 mil; 132 homes; 466 others

2004	Picnic Rock	8,900 ac
2010	Fourmile Canyon	6,200 ac

Total estimated cost \$259 mil; 169 homes

2012	Hewlett	7,700 ac
2012	High Park	87,300 ac

One fatality; 259 homes; watershed issues afterward

2012	Waldo Canyon	18,200 ac
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Total estimated cost \$453 mil; 346 homes; 32,000 evacuated

2012	Lower North Fork	4,100 ac
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Three fatalities; 23 homes

2013	Black Forest	14,300 ac
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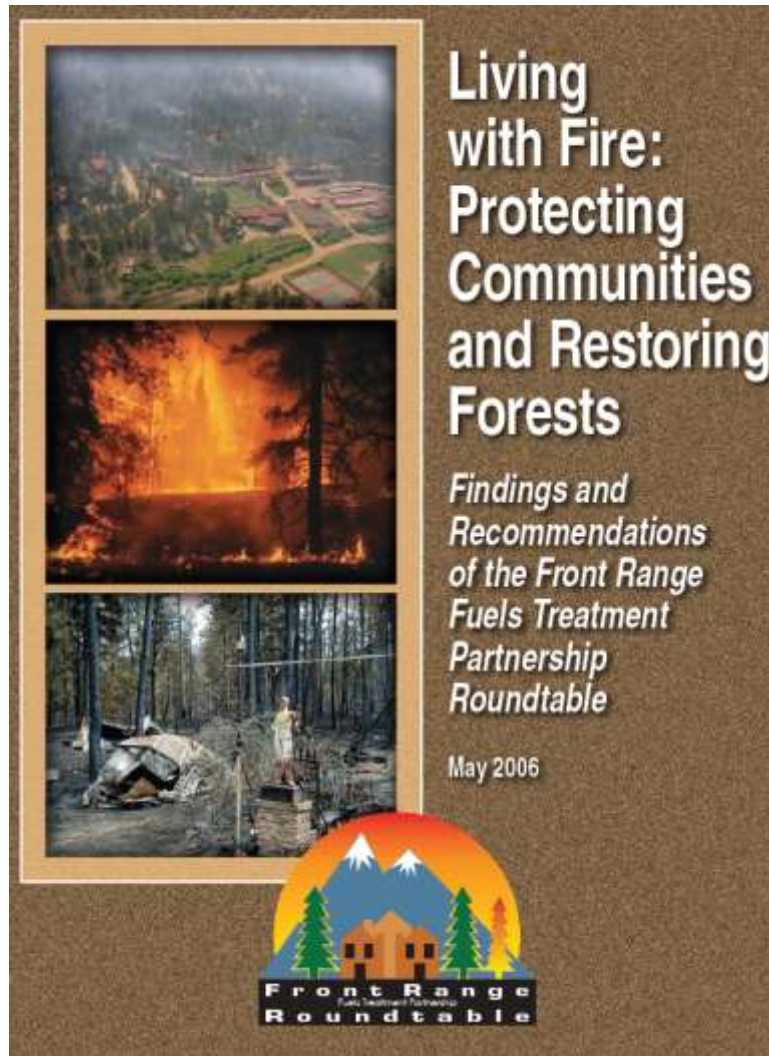
Two fatalities; 511 homes; suppression costs \$9.3 mil



# Colorado Front Range Collaborative Forest Landscape Restoration Project:

Restore the ecological structures and processes associated with lower montane ponderosa pine forests, including fire regimes, to their historical ranges of variability.

Collaboration in conjunction with the Front Range Roundtable



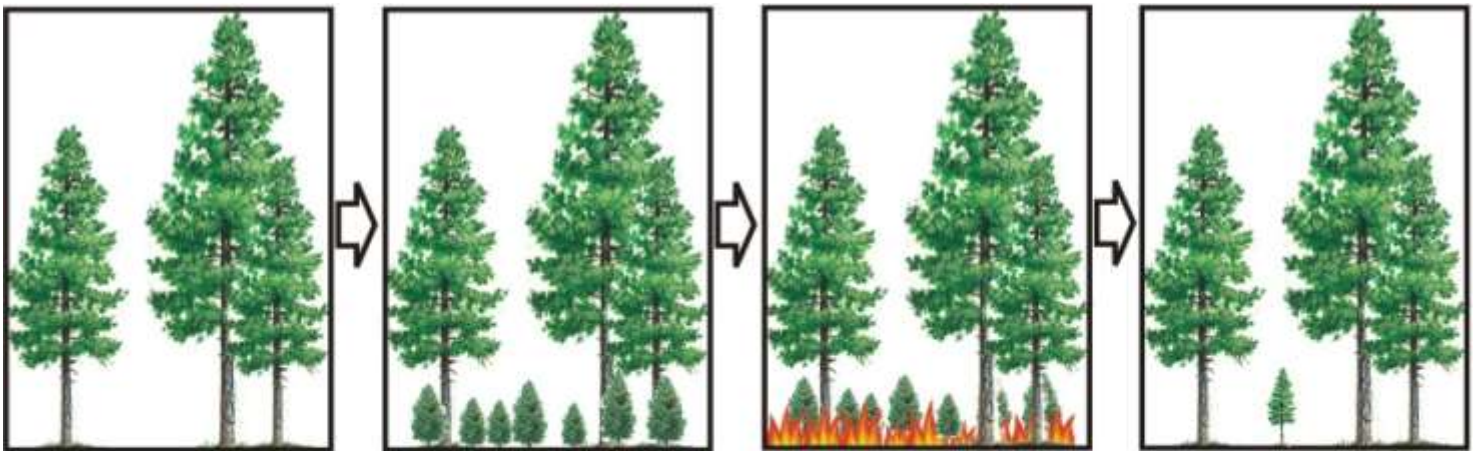
## CFLRP Multi-party Monitoring Plan (2011)

Front Range Roundtable  
Collaborative Forest Landscape Restoration Project  
2011 Ecological, Social and Economic Monitoring Plan  
Written and Compiled by  
Jessica Clement, PhD and Peter Brown, PhD  
Colorado Forest Restoration Institute

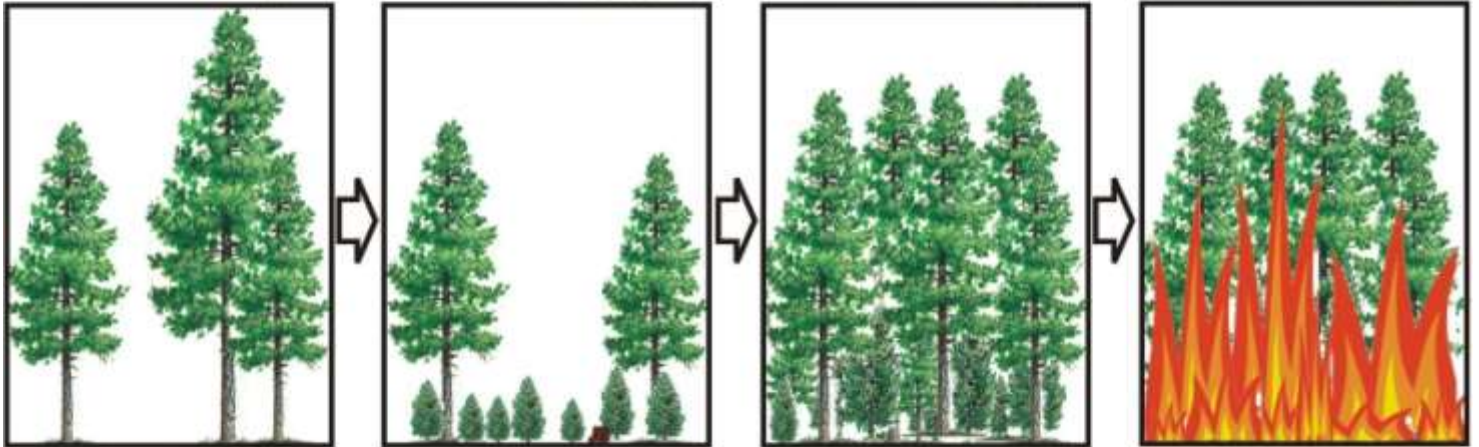




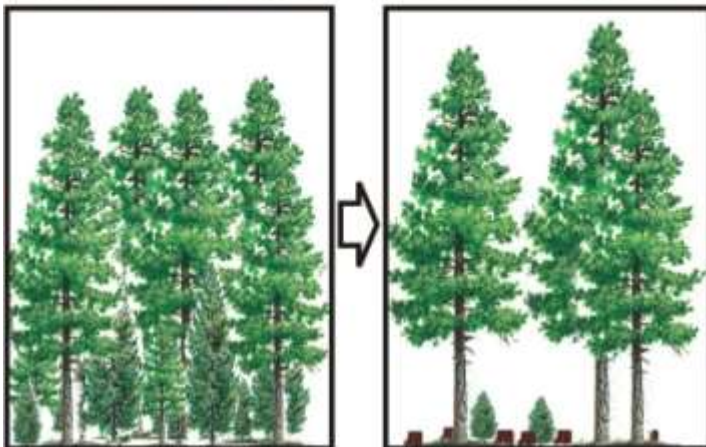
Past



Current



Future





2006

Bald Mtn.  
PA1U1

2009





**Southwest Ponderosa Pine**  
**Group of ponderosa pine with two clumps**  
**Reynolds et al (2013)**





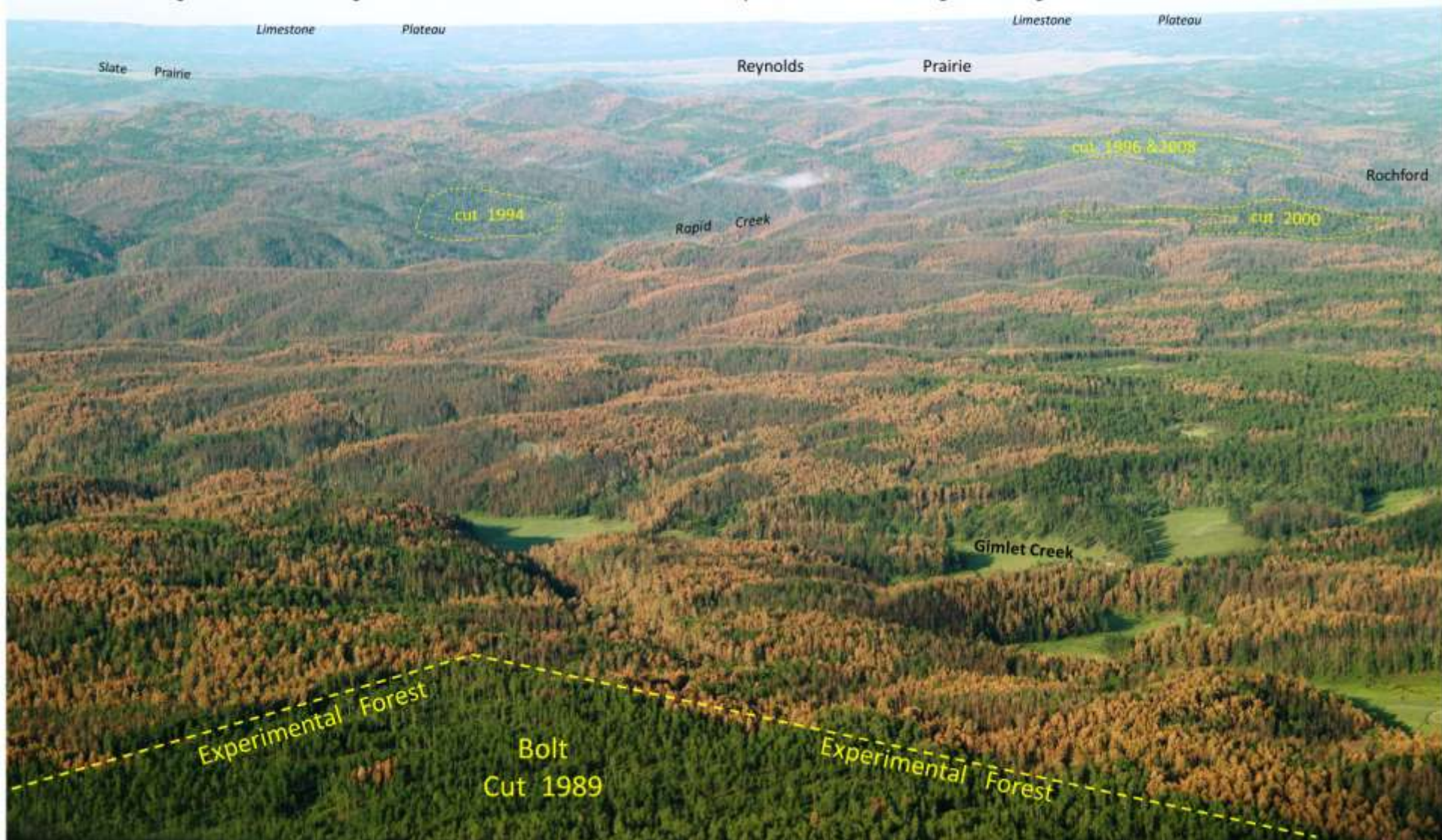
Red Feather, Arapahoe-Roosevelt



Messenger Gulch, Pike

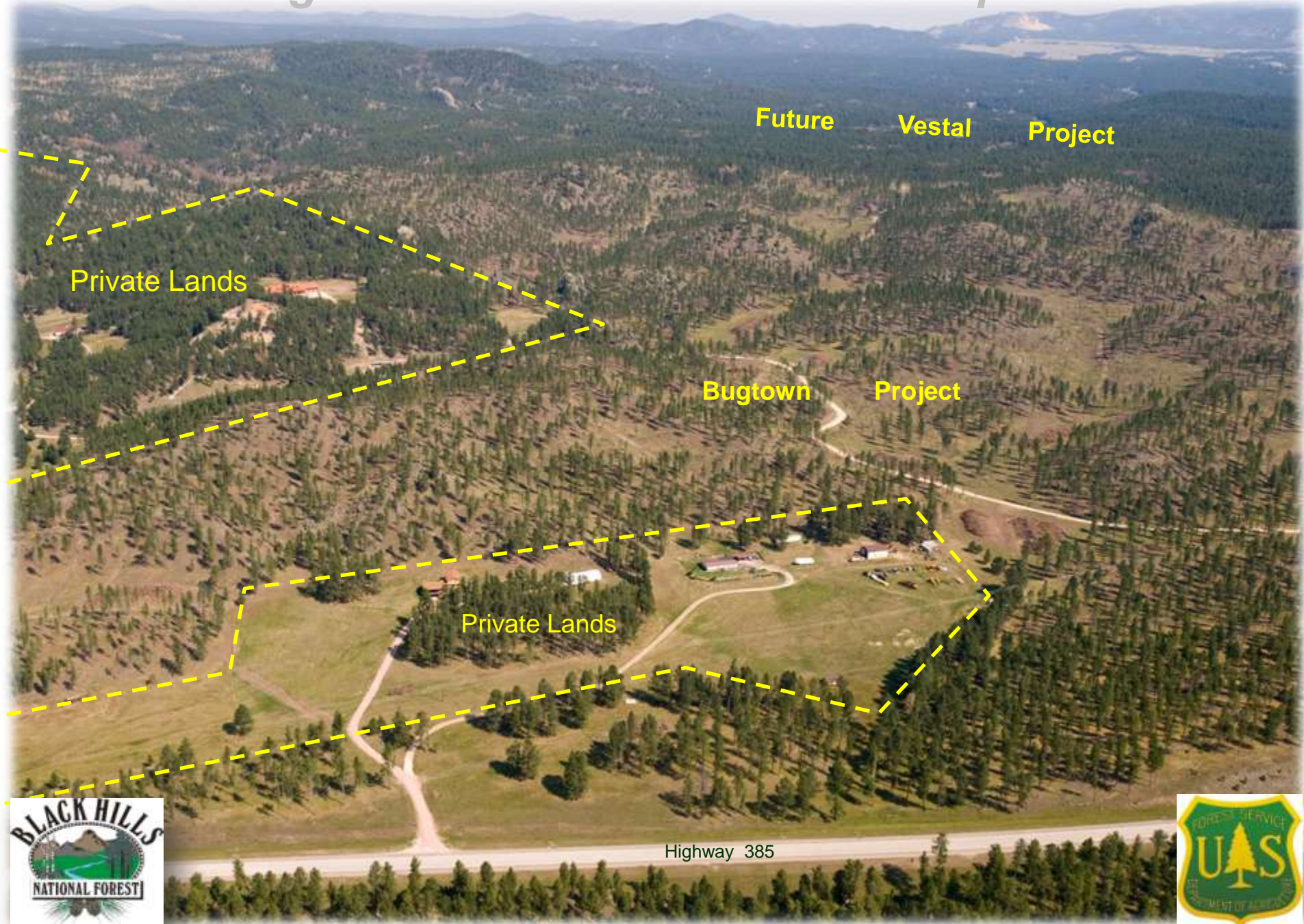
August 2013 Photo looking Southwest

taken by Ben Wudtke Forest Programs Manager Black Hills Forest Resource Association

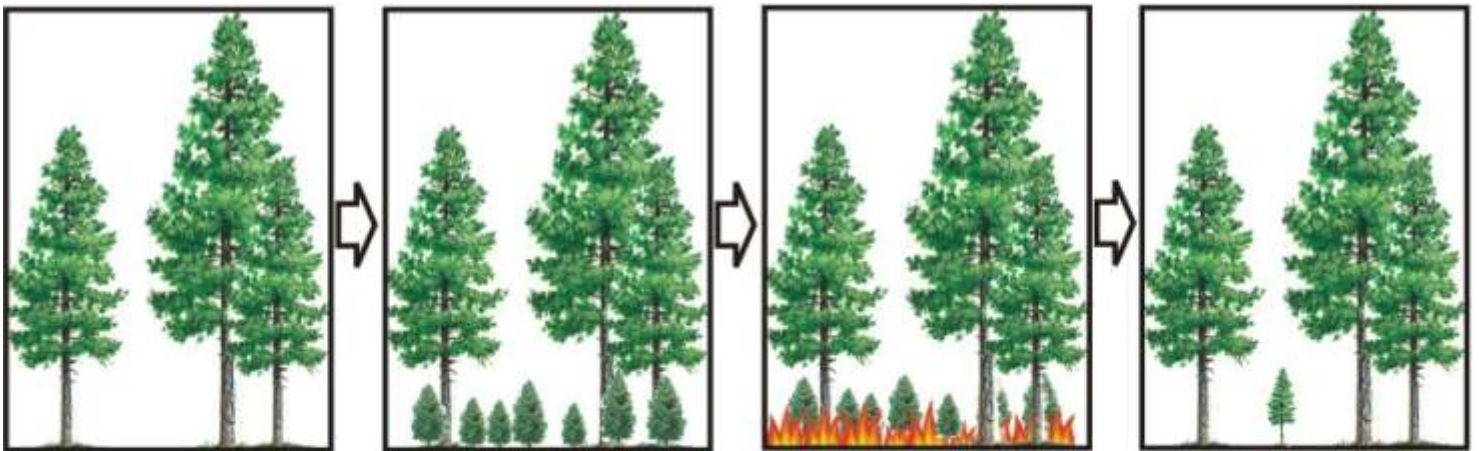


# Thinning the forest across the Landscape

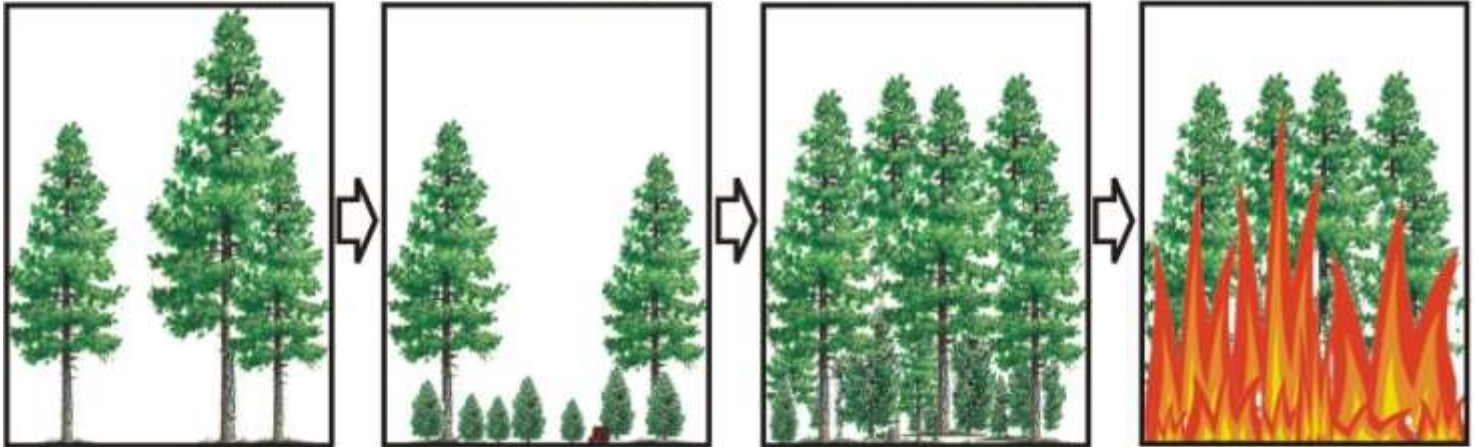
West of Custer SD, photo looking north



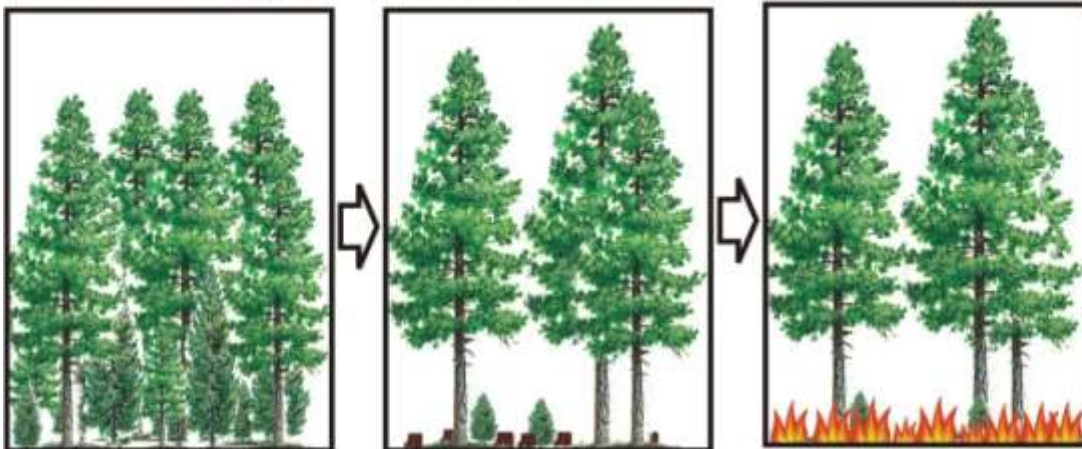
Past



Current



Future









## The National Strategy

The Final Phase in the Development of the  
*National Cohesive Wildland Fire Management Strategy*



April 2014

## National Cohesive Wildland Fire Management Strategy

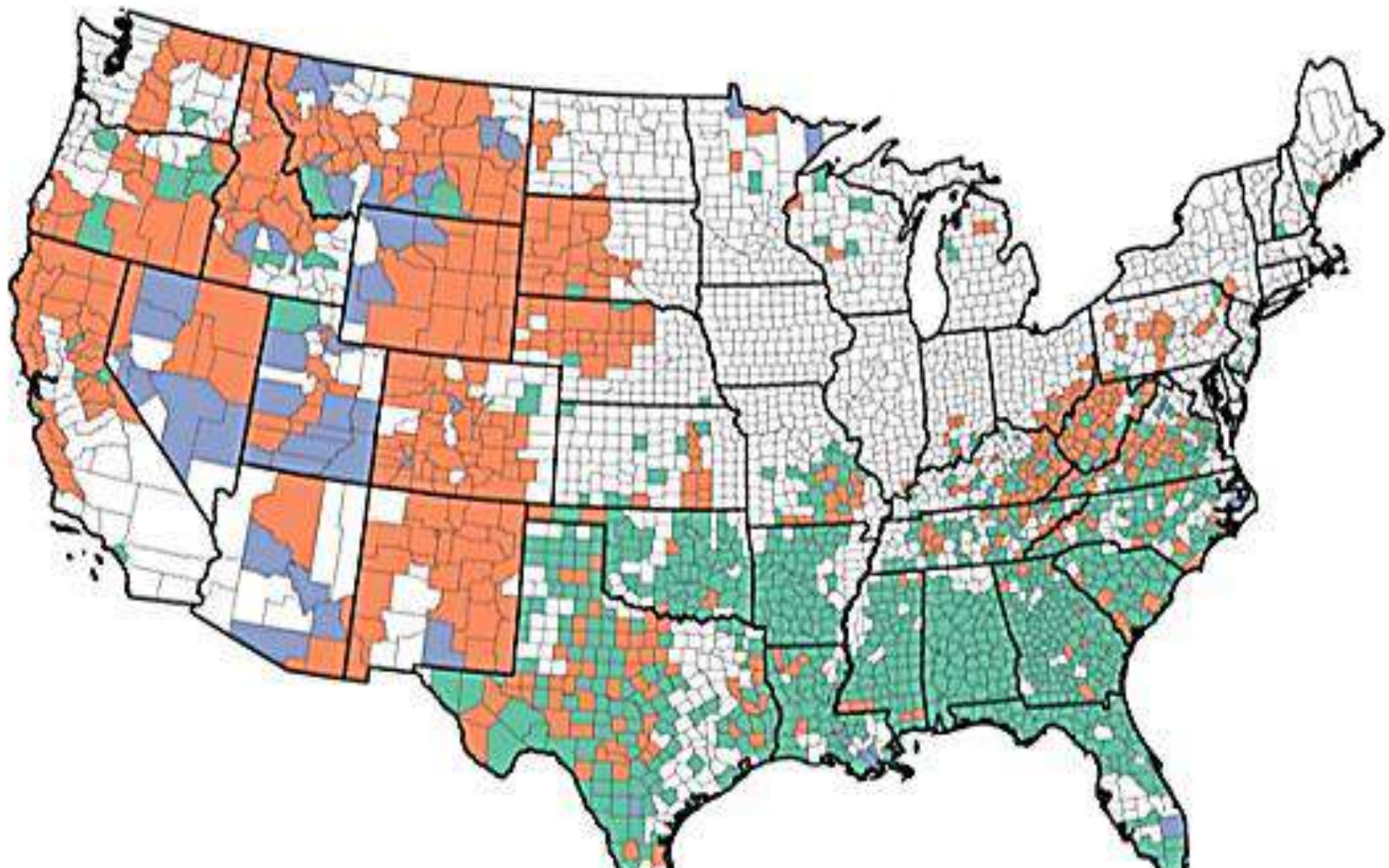
**Priority # 1:** Safe and effective response to wildfires including enhanced wildfire response preparedness with emphasis on both structural protection and wildfire prevention to maximize the effectiveness of initial response.

**Priority # 2:** Vegetation and fuels management through design and prioritization. Including the increased use of wildland fire to meet resource management objectives and expanding methods to improve forest and rangeland resiliency.

**Priority #3:** Homeowner and community engagement to take proactive measures prior to a wildfire event.

**Priority #4:** Utilizing programs tailored to local needs which seek to prevent human-caused ignitions.

<http://www.forestsandrangelands.gov/strategy/>



-  Use prescribed fire to manage fuels where it is already being used
-  Consider expanding use of prescribed fire
-  Consider prescribed fire, but on a limited basis



## The National Strategy

The Final Phase in the Development of the  
*National Cohesive Wildland Fire Management Strategy*



April 2014

## National Cohesive Wildland Fire Management Strategy

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<http://www.forestsandrangelands.gov/strategy/>

**Prescribed fire**

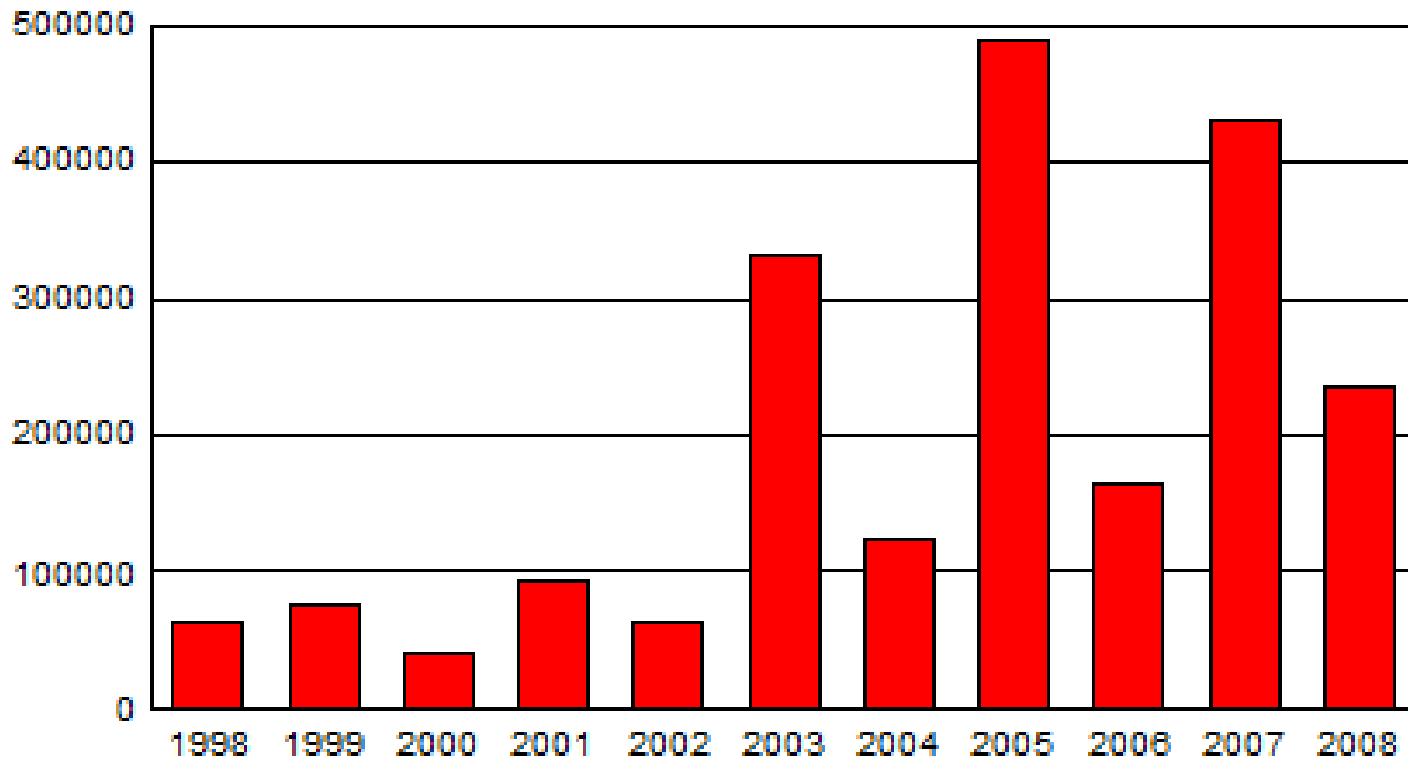
Pile burns  
Broadcast burns

**Wildland Fire Use**


**Full suppression**

Burnouts

**Wildland Fire Use Acres, 1998 to 2008**



[http://www.nifc.gov/fireInfo/fireInfo\\_stats\\_fireUse.html](http://www.nifc.gov/fireInfo/fireInfo_stats_fireUse.html)



**Little Sand Fire, San Juan National Forest**  
**Started: May 13th, 2012**  
**Cause: Lightning**  
**Full containment: July 27, 2012**  
**Acreage: 24,900**

Photo by Peter Mark Brown

# **West Fork Fire, San Juan National Forest**

**Started: June 5, 2013**

**Cause: Lightning**

**Acreage: 58,576 acres**

**Burned into late-July**



Photo by Peter Mark Brown

# Opportunities to work with the outcomes produced by wildfires and beetles

An aerial photograph of a forest landscape. The forest is a mosaic of different colors: vibrant green, brown, and black. The black areas represent charred tree trunks, likely from a wildfire. The brown areas represent dead or dormant trees, possibly from beetle infestations. The green areas represent healthy, living trees. The landscape is rugged and uneven, with varying densities of trees.

**Too often we focus on the 'catastrophic' impacts without considering some of the potential benefits**

A photograph of a dense forest of tall, thin pine trees. The sun is shining from the upper left, creating a warm, golden light that filters through the canopy. The foreground is filled with the lower branches and needles of a pine tree, which are slightly out of focus. The background shows a dense stand of similar trees stretching towards the horizon under a clear blue sky.

**“Restoration is a process, not an event.”**

Photo by Peter Mark Brown



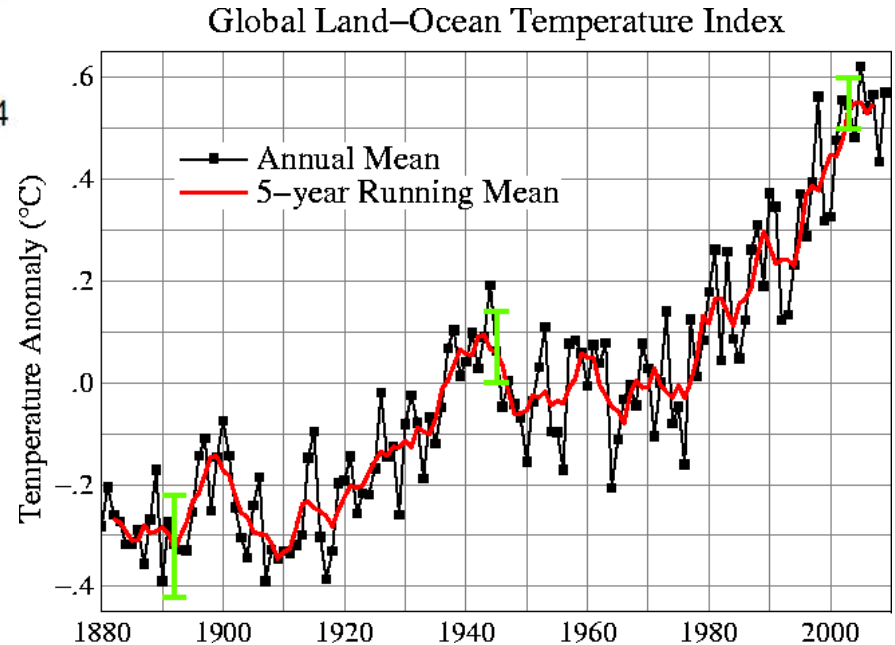
## Warming and Earlier Spring Increase Western U.S. Forest Wildfire Activity

A. L. Westerling, *et al.*  
*Science* **313**, 940 (2006);  
DOI: 10.1126/science.1128834

## Climate Change and Bark Beetles of the Western United States and Canada: Direct and Indirect Effects

BARBARA J. BENTZ, JACQUES RÉGNIÈRE, CHRISTOPHER J. FETTIG, E. MATTHEW HANSEN, JANE L. HAYES, JEFFREY A. HICKE, RICK G. KELSEY, JOSE F. NEGRÓN, AND STEVEN J. SEYBOLD

BioScience • September 2010 / Vol. 60 No. 8



A global overview of drought and heat-induced tree mortality reveals emerging climate change risks for forests

Craig D. Allen<sup>a,\*</sup>, Alison K. Macalady<sup>b</sup>, Haroun Chenchouni<sup>c</sup>, Dominique Bachelet<sup>d</sup>, Nate McDowell<sup>e</sup>, Michel Vennetier<sup>f</sup>, Thomas Kitzberger<sup>g</sup>, Andreas Rigling<sup>h</sup>, David D. Breshears<sup>i</sup>, E.H. (Ted) Hogg<sup>j</sup>, Patrick Gonzalez<sup>k</sup>, Rod Fensham<sup>l</sup>, Zhen Zhang<sup>m</sup>, Jorge Castro<sup>n</sup>, Natalia Demidova<sup>o</sup>, Jong-Hwan Lim<sup>p</sup>, Gillian Allard<sup>q</sup>, Steven W. Running<sup>r</sup>, Akkin Semerci<sup>s</sup>, Neil Cobb<sup>t</sup>

Forest Ecology and Management 259 (2010) 660–684

## Continued warming could transform Greater Yellowstone fire regimes by mid-21st century

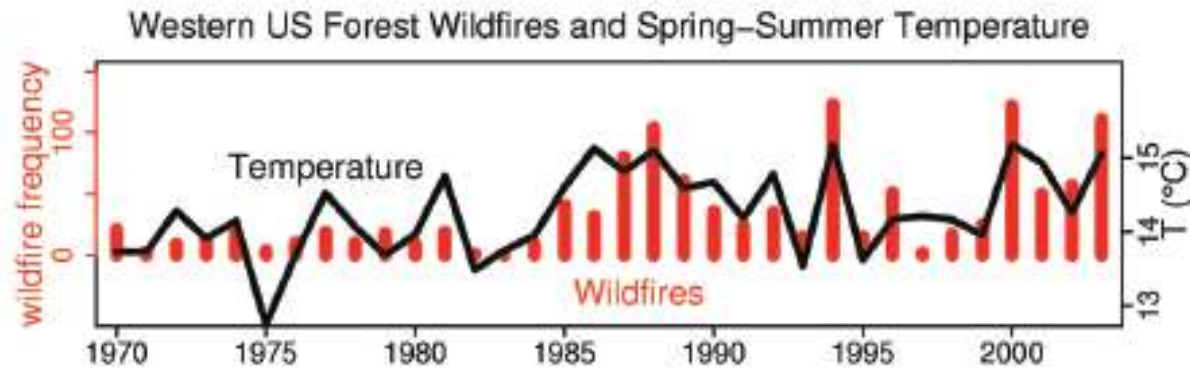
Anthony L. Westerling<sup>a,1</sup>, Monica G. Turner<sup>b,1</sup>, Erica A. H. Smithwick<sup>c</sup>, William H. Romme<sup>d</sup>, and Michael G. Ryan<sup>e</sup>

PNAS | August 9, 2011 | vol. 108 | no. 32 | 13165–13170

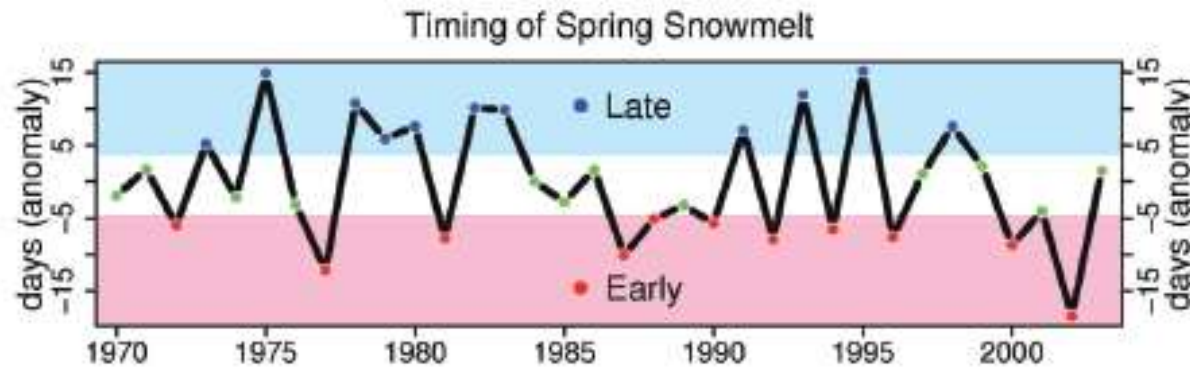
## Linking Increasing Drought Stress to Scots Pine Mortality and Bark Beetle Infestations

Matthias Dobbertin<sup>1,\*</sup>, Beat Wermelinger<sup>1</sup>, Christof Bigler<sup>2</sup>, Matthias Bürgi<sup>1</sup>, Mathias Carron<sup>3</sup>, Beat Forster<sup>1</sup>, Urs Gimmi<sup>1,2</sup>, and Andreas Rigling<sup>1</sup>

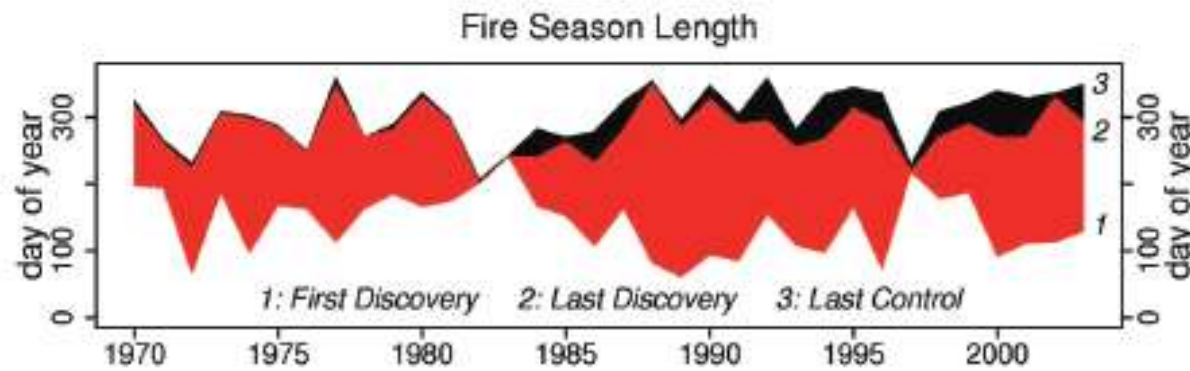
*TheScientificWorldJOURNAL* (2007) 7(S1), 231–239



**Increased wildfires  
in western US  
forests correspond  
to increased  
temperatures...**

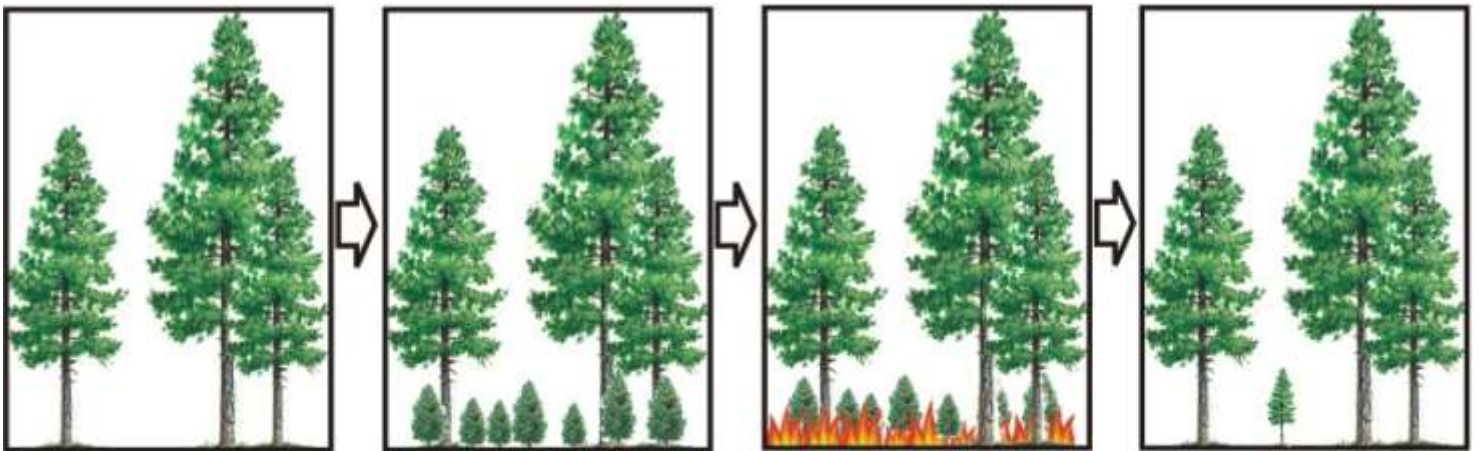


**...earlier  
snowmelt...**

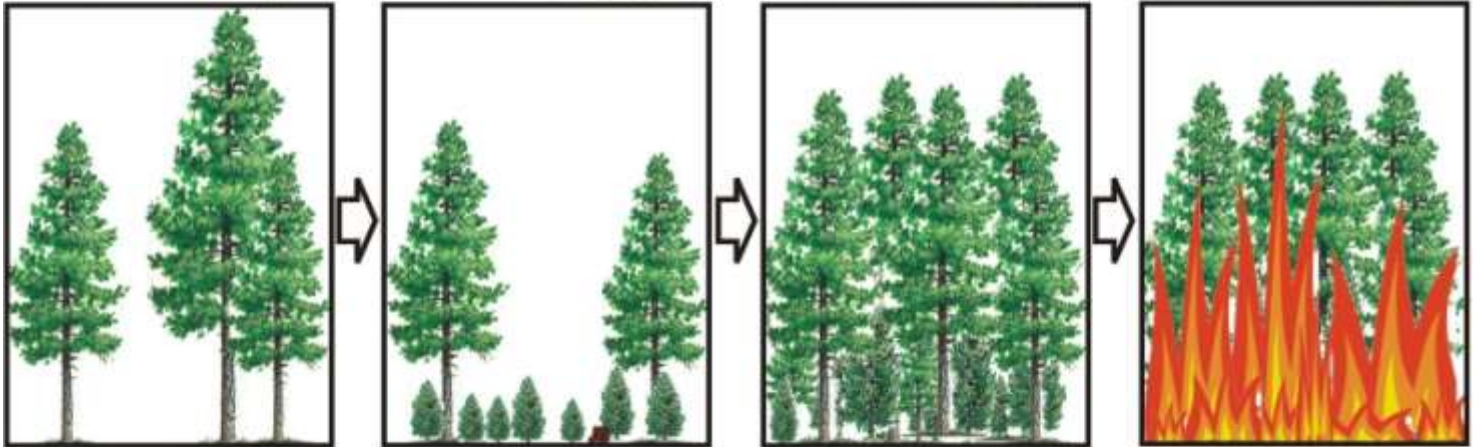


**...and longer fire  
seasons.**

Past



Current



Future

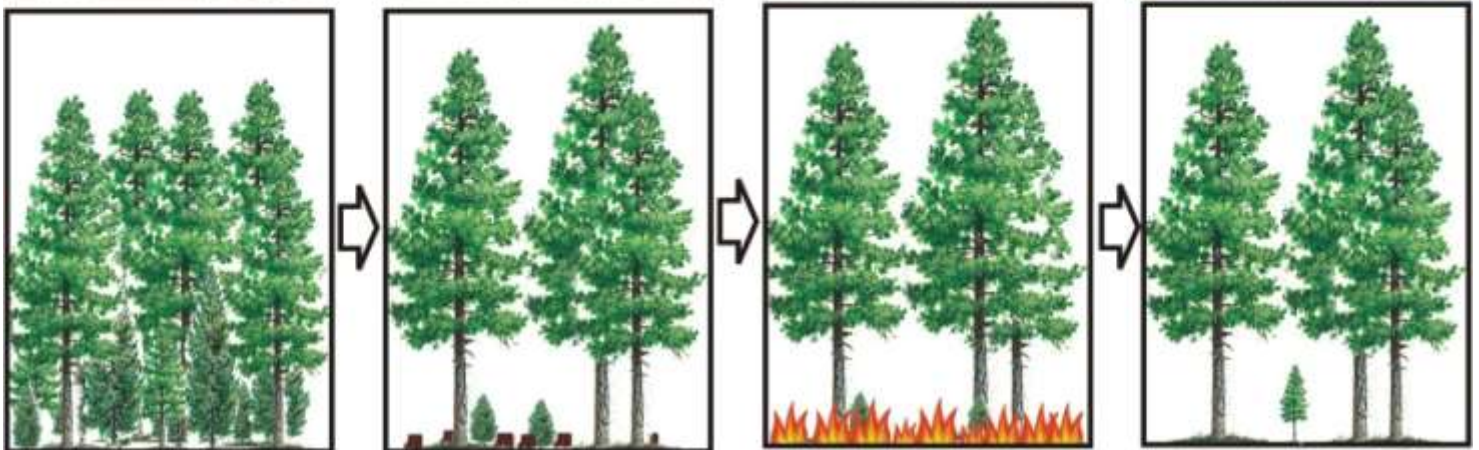




Photo by Peter Mark Brown



# **FIRE IS INEVITABLE.**

**It's not a question of IF;  
It's a question of WHEN it will occur,  
And WHAT KIND of fire it will be.**

A scenic landscape photograph featuring a large, mature pine tree in the foreground on the left. The ground is a grassy field, and in the background, a golf course is visible with several smaller trees and a path. The sky is filled with dramatic, colorful clouds in shades of orange, yellow, and blue, suggesting a sunset or sunrise. The sun is partially visible on the right side of the frame.

**Thank you**  
**[pmb@rmtrr.org](mailto:pmb@rmtrr.org)**