ALASKA FIRE SCIENCE CONSORTIUM

A JFSP KNOWLEDGE EXCHANGE CONSORTIUM

*Photo by Rob Allen*

# The Alaska Fire Science Consortium

**Mission: Better Collaboration**
**Between Fire Science and Fire Management**


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http://akfireconsortium.uaf.edu

# Fire Ecology Under the Midnight Sun

Randi Jandt

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Photo by Tony Chapman, 2005 Boundary Ck Fire

# Forest Fires in Alaska?! You Betcha.


**Jun-Aug Average:**

- ✓ 60° F
- ✓ 5.4" rainfall

# The Green Desert

- Frozen ground limits run-off and root growth to near the surface
- Moss & Duff insulates the ground
- Permafrost governs soil temperature and moisture regime
- Without permafrost, AK soils have high infiltration, yielding dry surface

# Fire is the primary disturbance factor in boreal forest uplands

| YEAR | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
|---|---|---|---|---|---|---|---|---|---|---|
| # FIRES | 701 | 624 | 307 | 509 | 367 | 527 | 688 | 515 | 416 | 612 |
| ACRES BURNED | 6,590,140 | 4,663,880 | 266,268 | 649,411 | 103,649 | 2,951,593 | 1,125,419 | 293,018 | 286,888 | 1,320,752 |

*Data from Alaska Fire Service:* http://fire.ak.blm.gov

Air quality in interior was considered unhealthy or hazardous for 52 days in 2004. Fairbanksans were exposed to extreme levels of CO (> 10 ppm) and smoke particulates (PM2.5) > 1000 mcg/$m^3$, over 8X the previously recorded high from wildfire.

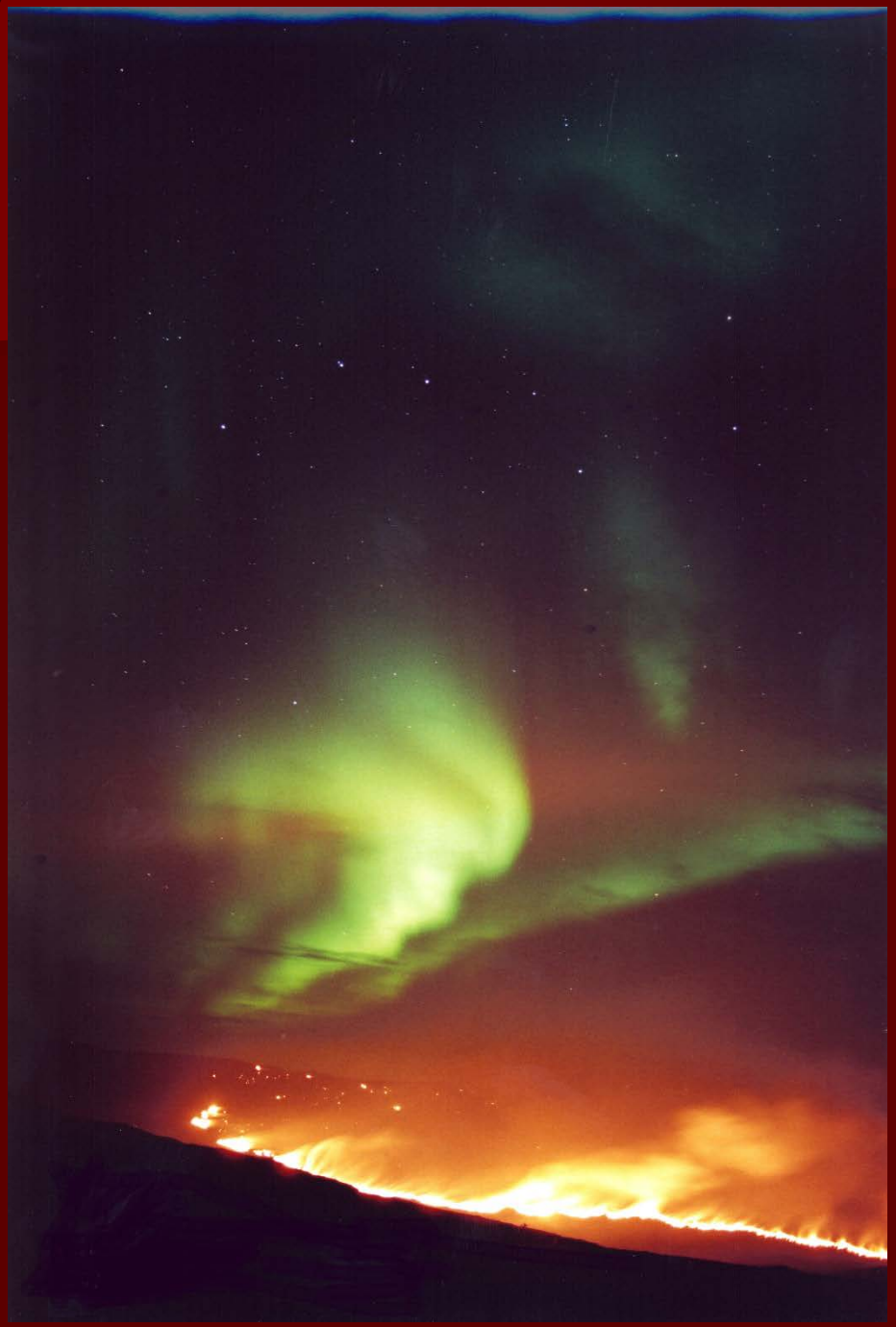

Photo by Dale Haggstrom


U.S. Wildfire Statistics average:
✓ 2,800 homes lost a year
✓ 16 firefighters lost a year
Photo by Adam Kohley, 2006 Parks Highway Fire

# What role does fire play in the boreal forest?

- Fire regime
- Fire behavior
- Fire effects

Photo by Adam Kohley, 2006 Parks Hwy Fire



# Average Annual Acres Burned:

## AK ~ 1.7 million
## L48 ~ 5 million

**> 90% of burned acres result from lightning-caused fires**

*2005 Central Fire and Northern lights*

*Photo by Jeff Schrader, Central, AK*

# Burned ≠ Destroyed

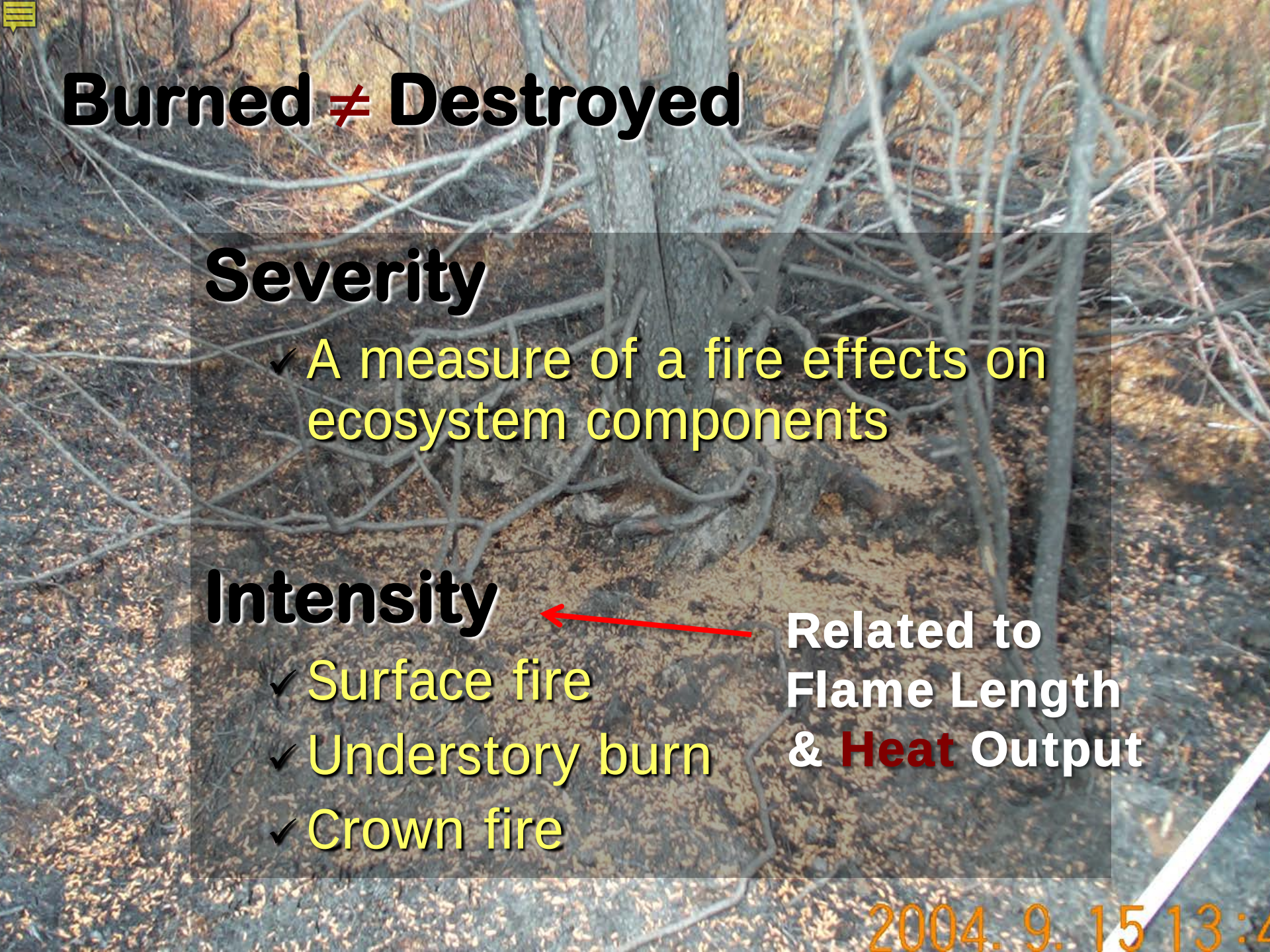
## Severity

- ✓ A measure of a fire effects on ecosystem components

## Intensity

- ✓ Surface fire
- ✓ Understory burn
- ✓ Crown fire

**Related to Flame Length & Heat Output**



# Light burn severity


Alphabet Hills Rx Burn 9/2004

# High burn severity

Note: Low or Moderate burn severity comprises most of every fire mapped (even in 2004)

Alphabet Hills Rx Burn 9/2004

# Fire Intensity

Can be high while severity is low!


Fire severity linked to smoldering combustion:which is linked to moisture, therefore drought!
2007 Anaktuvuk River Fire
Photo by R. Jandt

# Fire Effects depend on Severity

# Fire usually kills the trees

# Black Spruce


*Jim River Fire, Kanuti NWR, Photo by R. Jandt*

# Black Spruce Seedlings

# Labrador Tea resprouting

# Response of Deciduous Trees

*Photo by Dave Jandt*

# “Floristic Relay” Model of Succession


*2004 Photo by R. Jandt*

Photo just north of Taylor creek, showing spruce regeneration 1-1.5m high:
(Fire Y-34, 1966; photo taken 6/4/00, 34 years post-fire)

**Self Replacement** typical for regenerating burns. Severe burns (creating a mineral seed bed) or burning a young stand may induce a *type conversion*.

Johnstone & Chapin, 2006

# Response of Grasses

*Alphabet Hills 2004 RX in 2006, R. Jandt*

# Shrubs

*BENE, Alphabet Hitlls RX, 2 yr post-fire, R. Jandt*

# Response of Lichen

Photo by Ann Claerbout, 2006

# Response of Lichen

*Seward Peninsula, 36 yrs post-fire, R. Jandt*

# Fire Effects on Soil

# Response of a Forest Community

# Fires leave a mosaic of effects

- Topography
- Day-to-day burning conditions
- Permafrost
- Fuel type & density

Photo by R Jandt

# Key to Forest Succession

Burn Severity →

Low

High

Site Moisture →

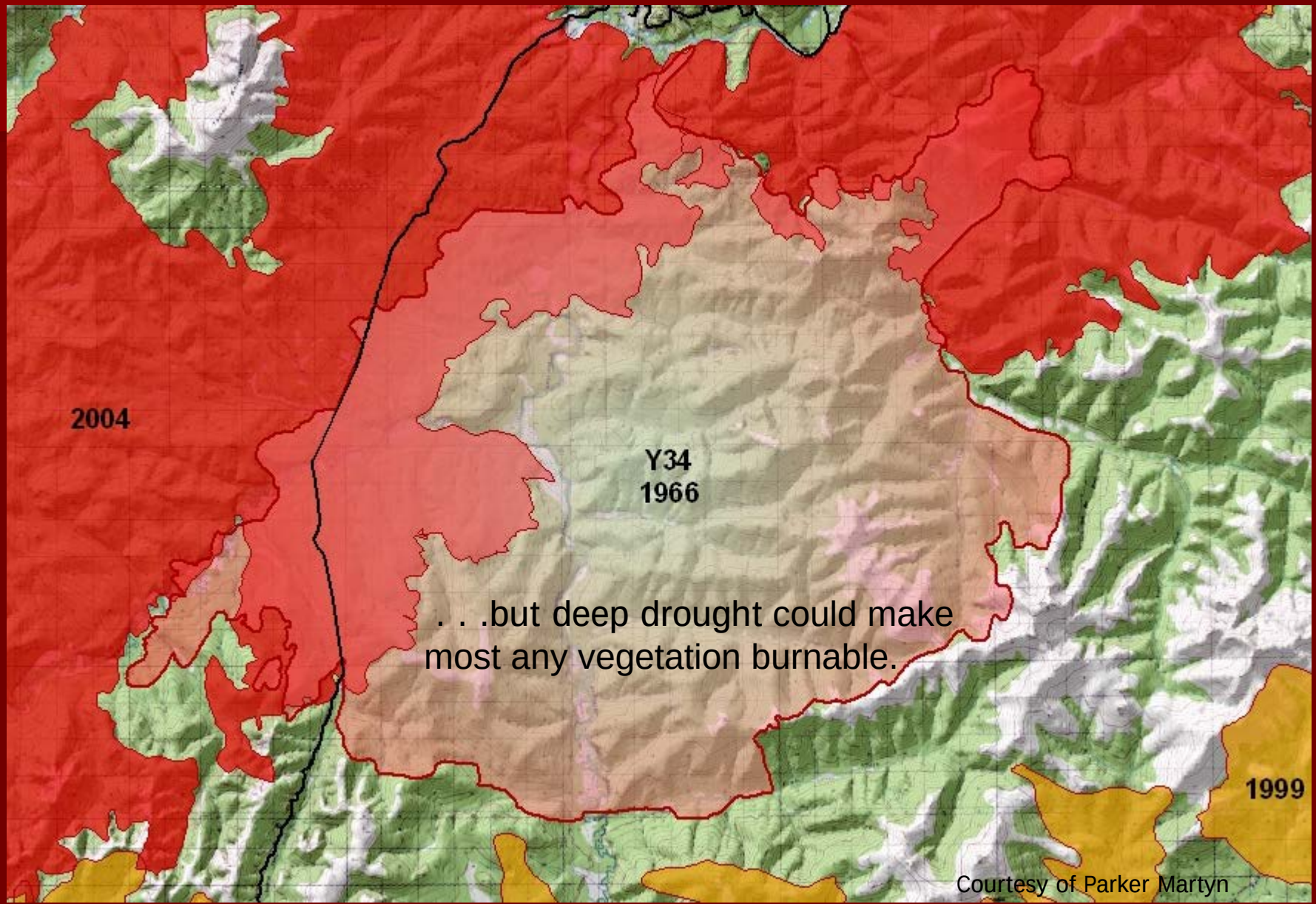
Dry

Wet

Johnstone, JF, Hollingsworth, TN, Chapin, FS. 2008. Gen. Tech. Rep. USFS-PNW-GTR-767

# What if it burns twice?

# Old burns can slow down fires




Courtesy of Parker Martyn

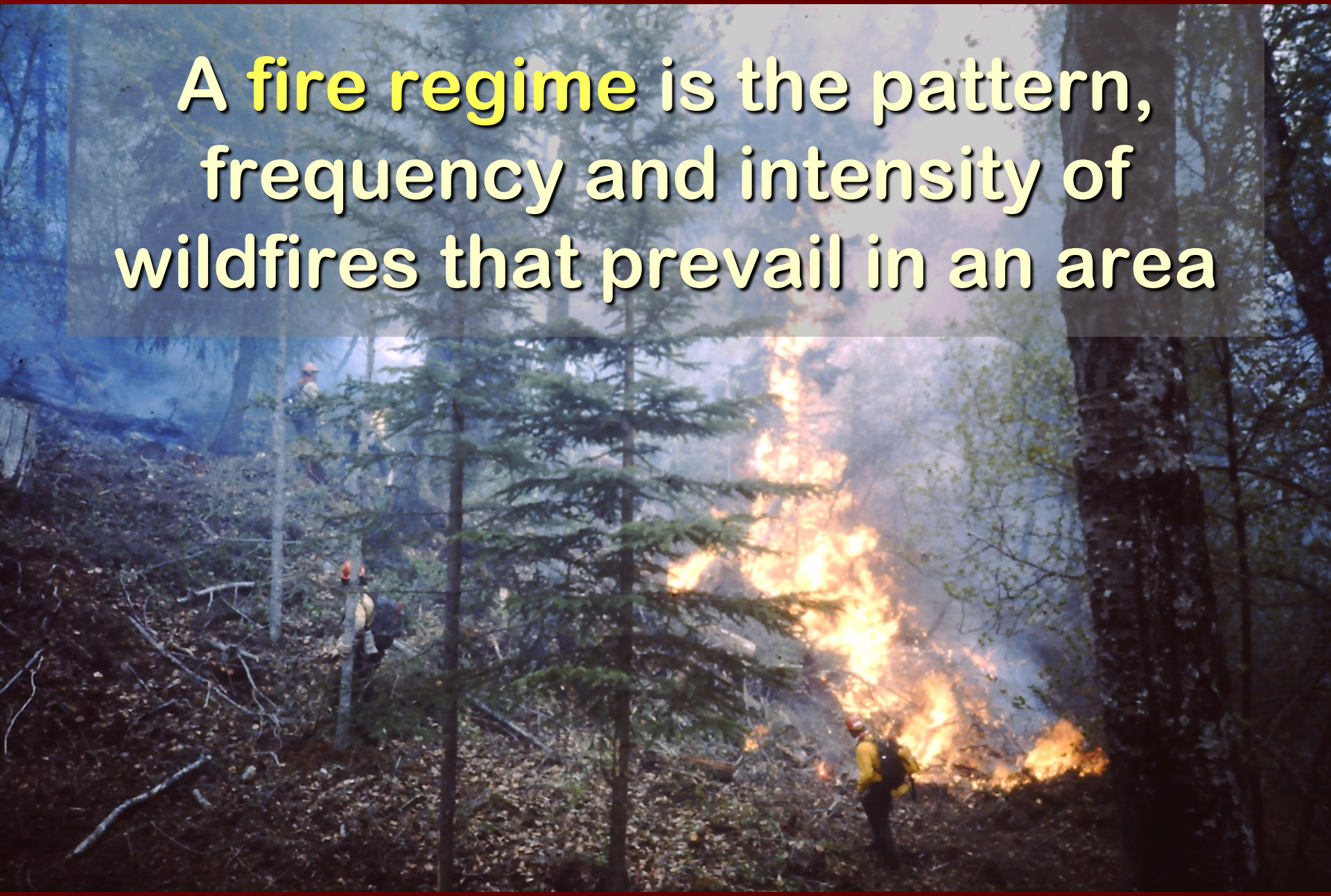



*Photo by Dave Jandt*

# Birth of the Present-Day Forest

- The boreal forest we know developed in the mid-Holocene (~6,000 years ago)
- Over time, black spruce replaced white spruce as the dominant tree species
- Since black spruce became dominant, fire frequencies have averaged 134 years (range 36-301 yrs) *Lynch et al. 2002*

*2008 Blind Luck Fire, R. Jandt*

# Fire Regime of AK Boreal Forest

- Long fire return interval
- Episodic fire history
- High intensity stand replacing fire, usually 90% tree mortality
- Frequency of large fire years may be increasing

Photo by Tony Chapman, 2005 Boundary Ck Fire

# Human Impacts on Fire Regime

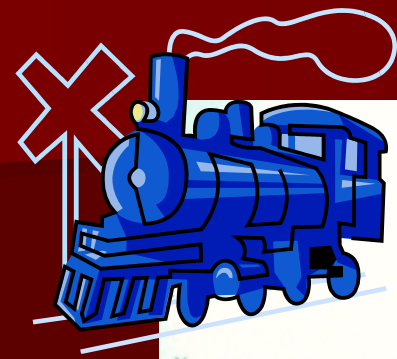
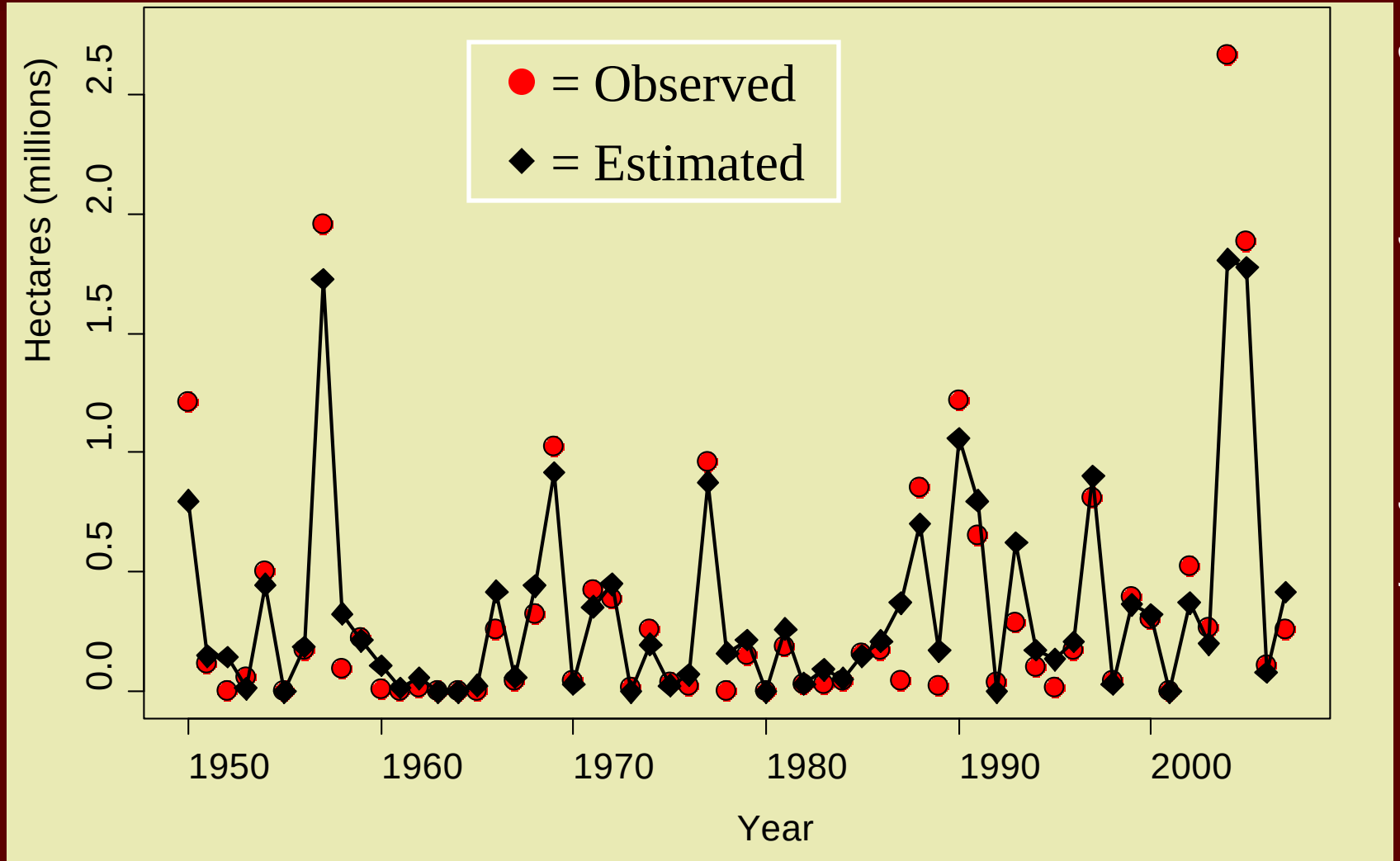



*Photo by KT Pyne: 1988 Fire A119*

# Changes in Fire Severity Result from Exclusion of Fire in Frequent Fire Return Interval Fire Regimes

# AK Fire Seasons Driven by Weather

- Annual area burned highly correlated to weather patterns since 1950.

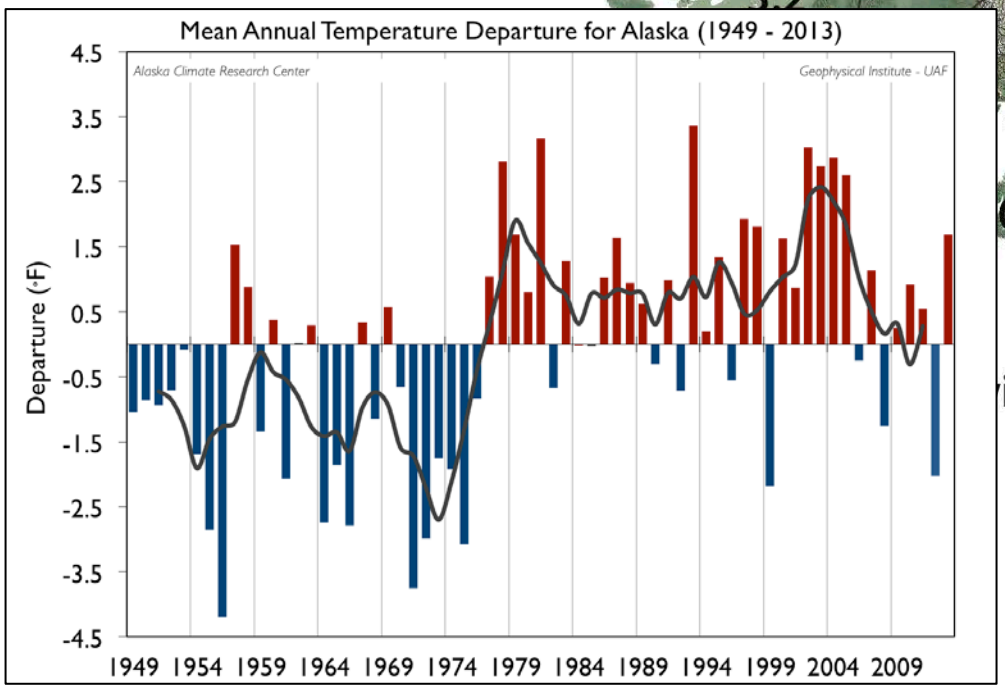


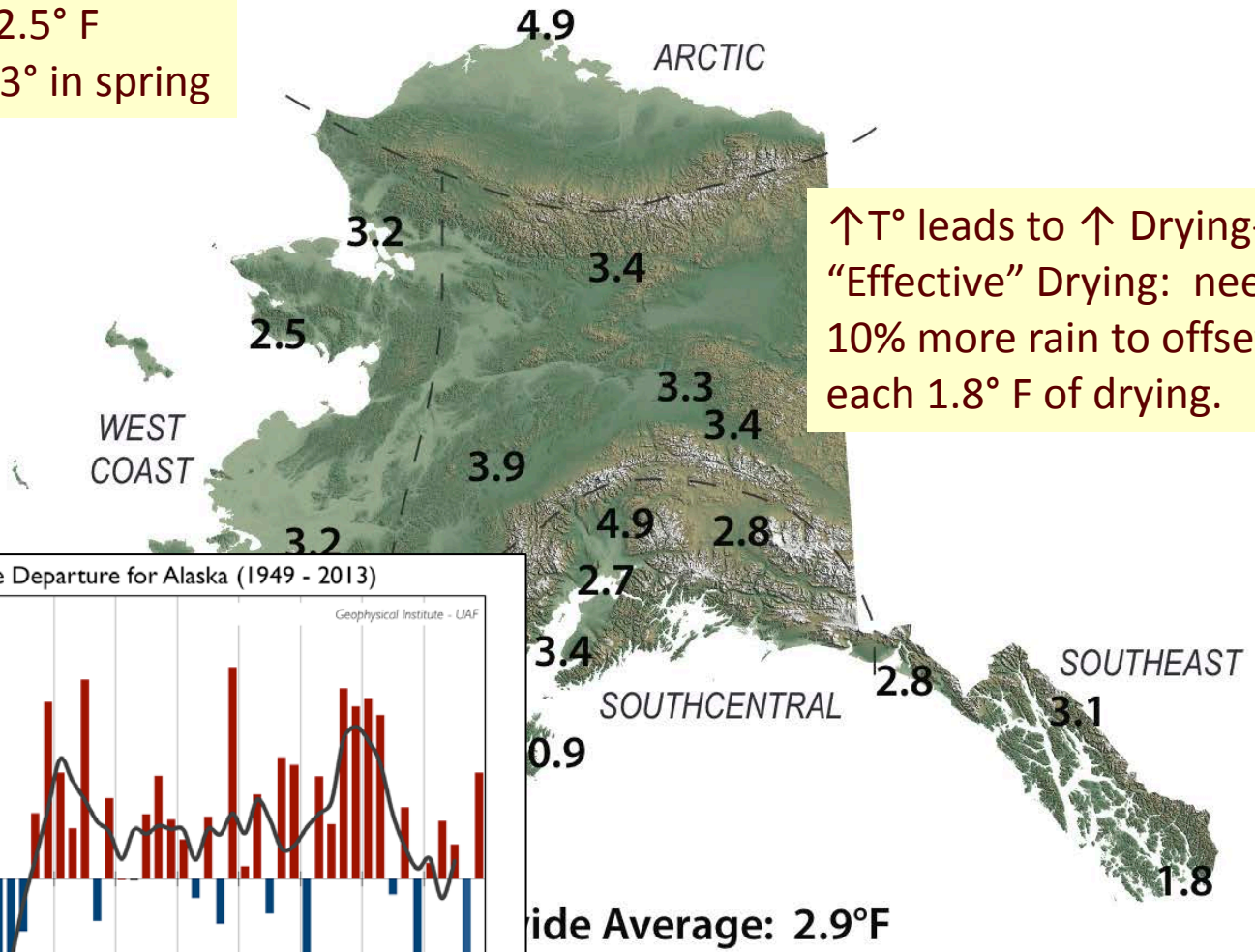

Observed vs. GBM-estimated Area Burned in Alaska

*Figure courtesy of Dr. Paul Duffy, Neptune, Inc.*

# Total Change in Mean Annual Temperature (°F), 1949 - 2012

Fairbanks & Homer 2.5° F warmer in summer, 3° in spring




↑T° leads to ↑ Drying-- "Effective" Drying: need 10% more rain to offset each 1.8° F of drying.

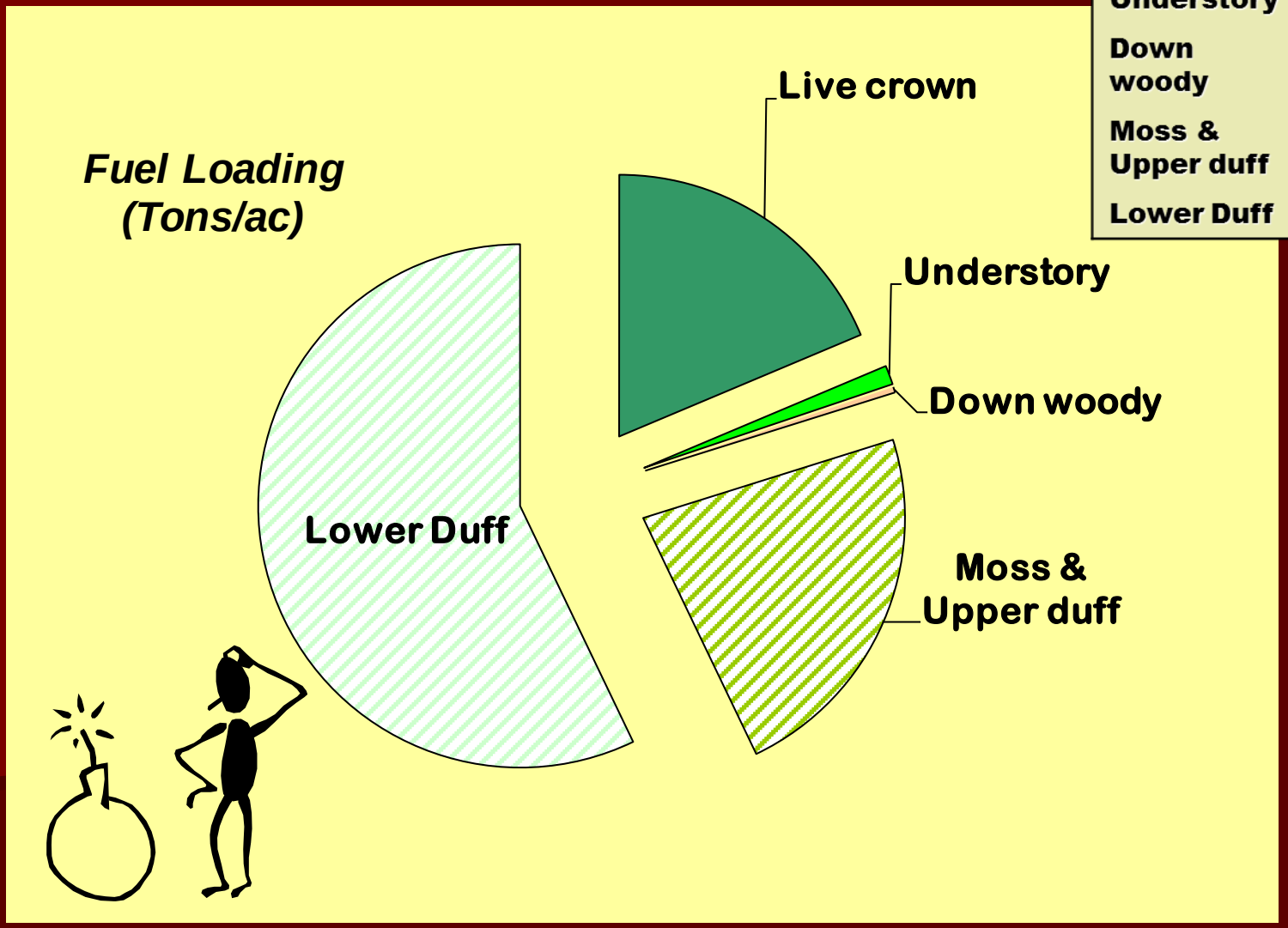
ide Average: 2.9°F

Geophysical Institute, University of Alaska Fairbanks

- ✓ Fuel is abundant and more or less continuous in the boreal forest.
- ✓ Warmer summers dry out vegetation, especially forest floor.
- ✓ Dry forest floor means deeper burning

# Fuel Loading by Category

| | Tons/ac |
|---|---|
| Live crown | 32 |
| Understory | 2 |
| Down woody | 0.6 |
| Moss & Upper duff | 39 |
| Lower Duff | 98 |




Total = 137 T/ac

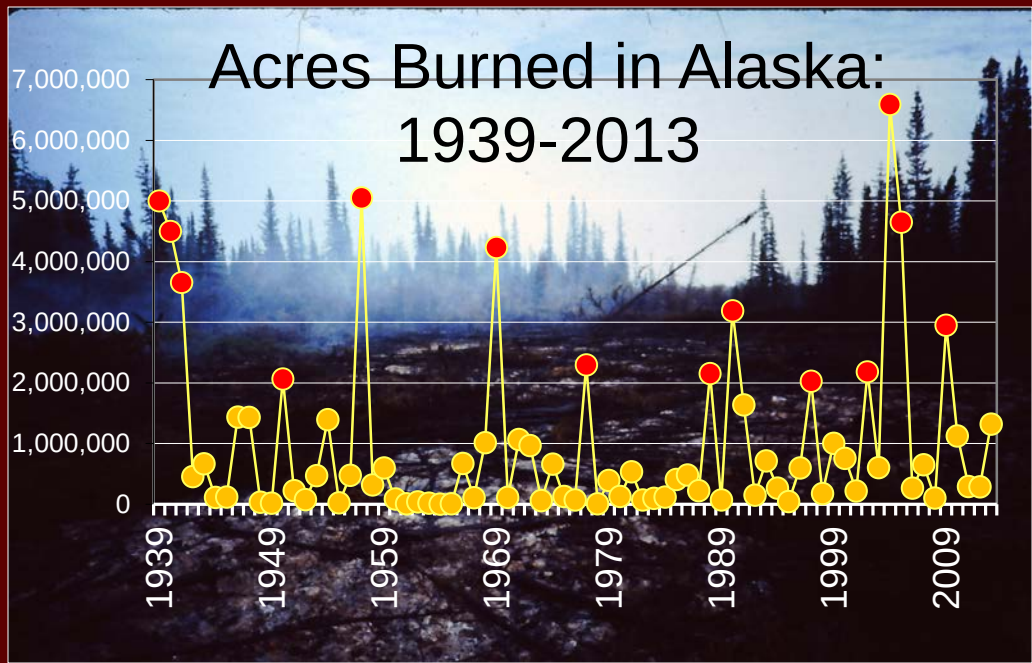
Grand Fir Forest = 15 T/ac

# Is our fire regime in transition?

*Photo by Dave Jandt: 1988 Top of World Hwy Fire*

Warmer summers may lead to:

- drier fuels
- longer fire seasons
- more extreme fire behavior
- higher burn severity
- more burnable biomass in tundra



# More Fire in Recent Decades?

*Photo by Dave Jandt: 1988 Top of World Hwy Fire*

Scientific evidence:

- Most burning in 10,000 yrs in Yukon Flats *(Kelly et al 2013)*
- Increased area burned in Canada in last 30 yrs *(Gillett & Weaver 2004)*
- Shift from spruce to hardwood forest dominance in Alaska *(Mann et al 2012)*
- Doubling of boreal forest burning *(Kasischke & Turetsky 2006)*
- More arctic tundra burning *(Hu et al 2010)*

# To be continued:  Come back tomorrow!

# The End

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