Wildfires in the Southern Great Plains and Novel Approaches to Fuels Management

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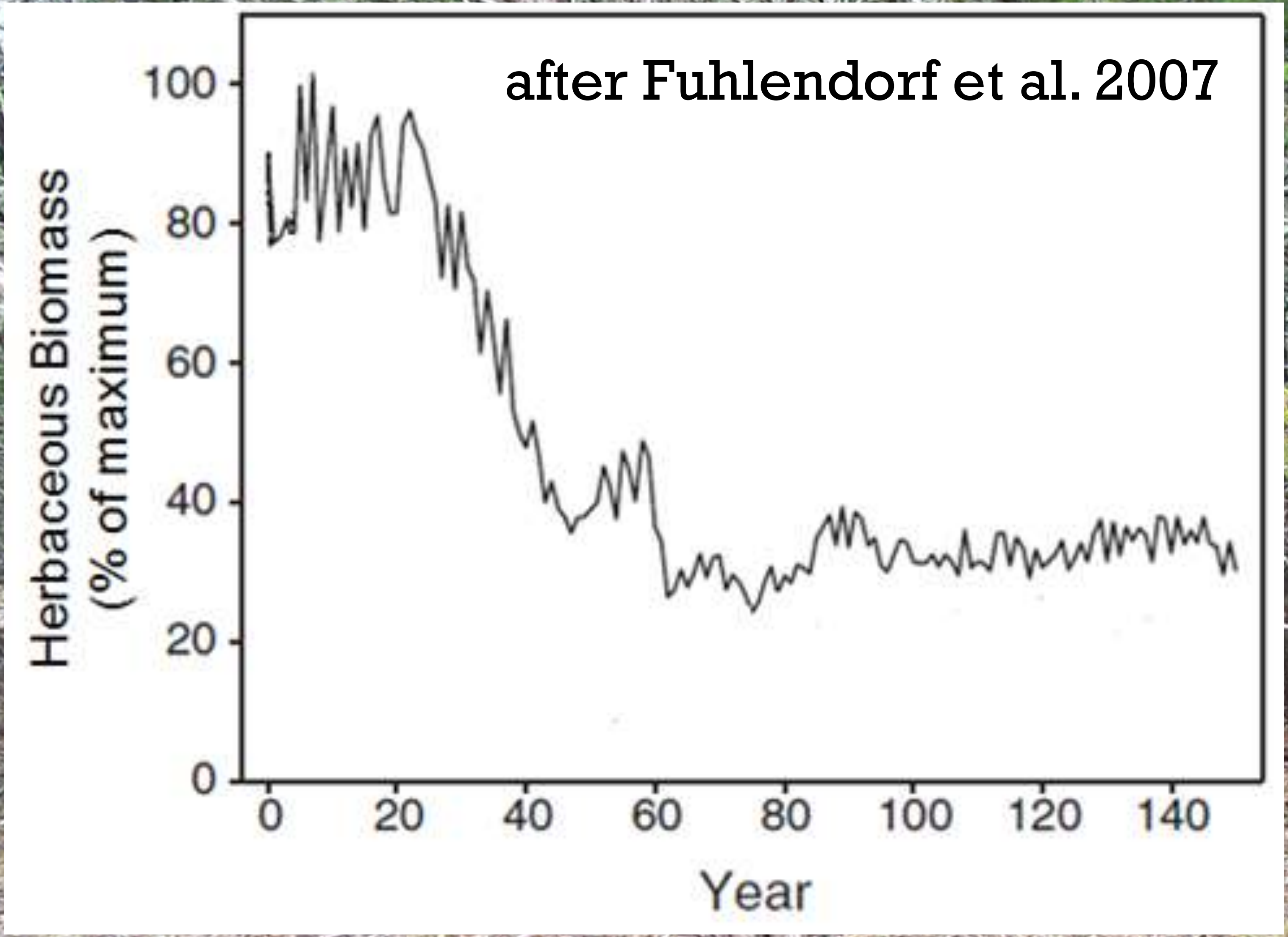

Long-term changes in Great Plains rangelands:
Alteration of fire behavior

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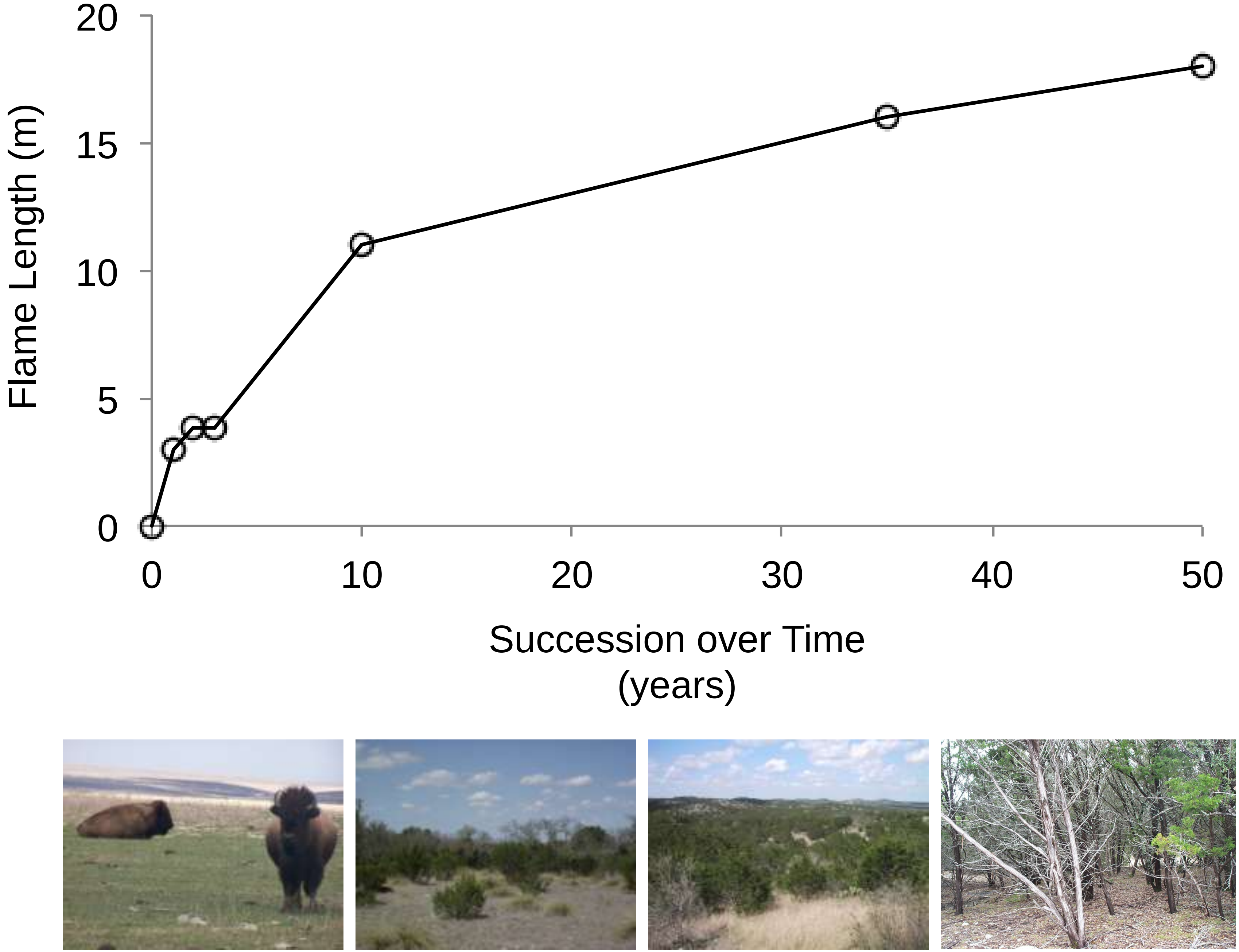
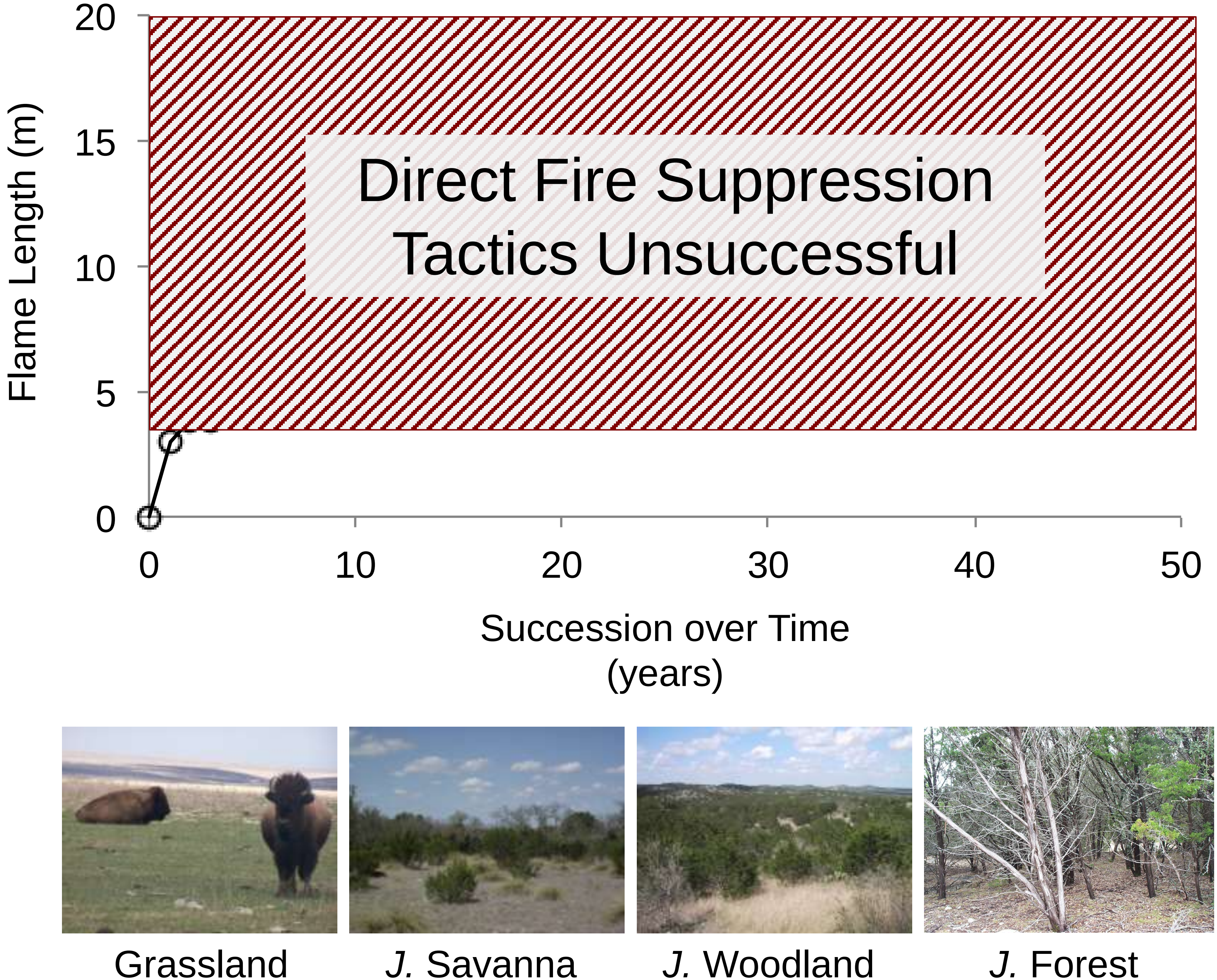
Fire Suppression Guidelines

Flame Length (feet)	Fireline Intensity (BTU ft^{-1} s^{-1})	Fire Suppression Interpretation
< 4	< 100	Fire can be attacked at head and flanks with hand tools; hand line should hold fire
4 – 8	100 – 500	Fires too intense for direct attack on head; hand line unreliable; mechanized equipment can be effective (plows, dozers, pumpers)
8 – 11	500 – 1,000	Fires present serious control problems (crowning, torching and spotting)
> 11	> 1,000	Crowning, spotting, and major fire runs probable; control at head of fire ineffective

Andrews and Rothermel 1986



Grassland | *J.* Savanna | *J.* Woodland | *J.* Forest


Direct Fire Suppression
Tactics Unsuccessful
Flame Length (m)
20
15
10
5
0
0
10
20
30
40
50
Succession over Time
(years)
Grassland
J. Savanna
J. Woodland
J. Forest

- Wildfires in 2011 burned more area in south-central U.S. than the rest of the country combined (NIFC 2012)
  - In Texas alone:
    - 2900 homes destroyed
    - 10 human lives lost
    - $333,000,000+ in firefighting expenses (TX Insurance Council)
    - $500,000,000+ in insurance claims (TX Insurance Council)
- Wildfires in OK & TX in 2005-2006
  - 2.2 million acres burned
  - 1100 homes destroyed
  - 25 human lives lost
  - Largest wildfire in continental U.S. over the last 15 years (East Amarillo Complex Wildfire - 907,245 acres)

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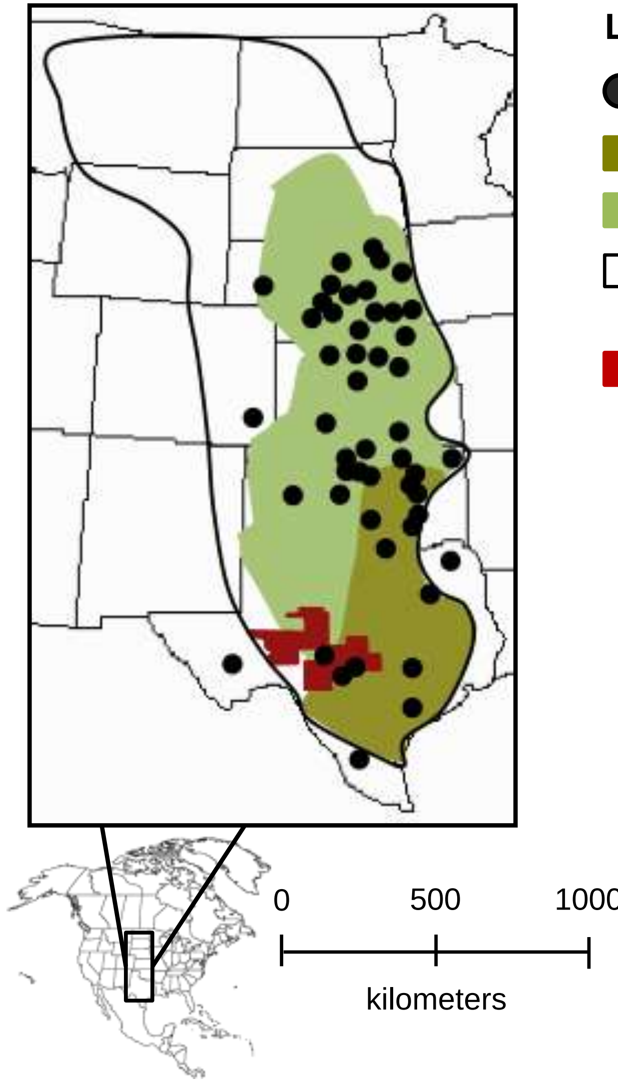
Novel Solution to Address Wildfire Problem and Reduce Fuels while Restoring Ecosystems



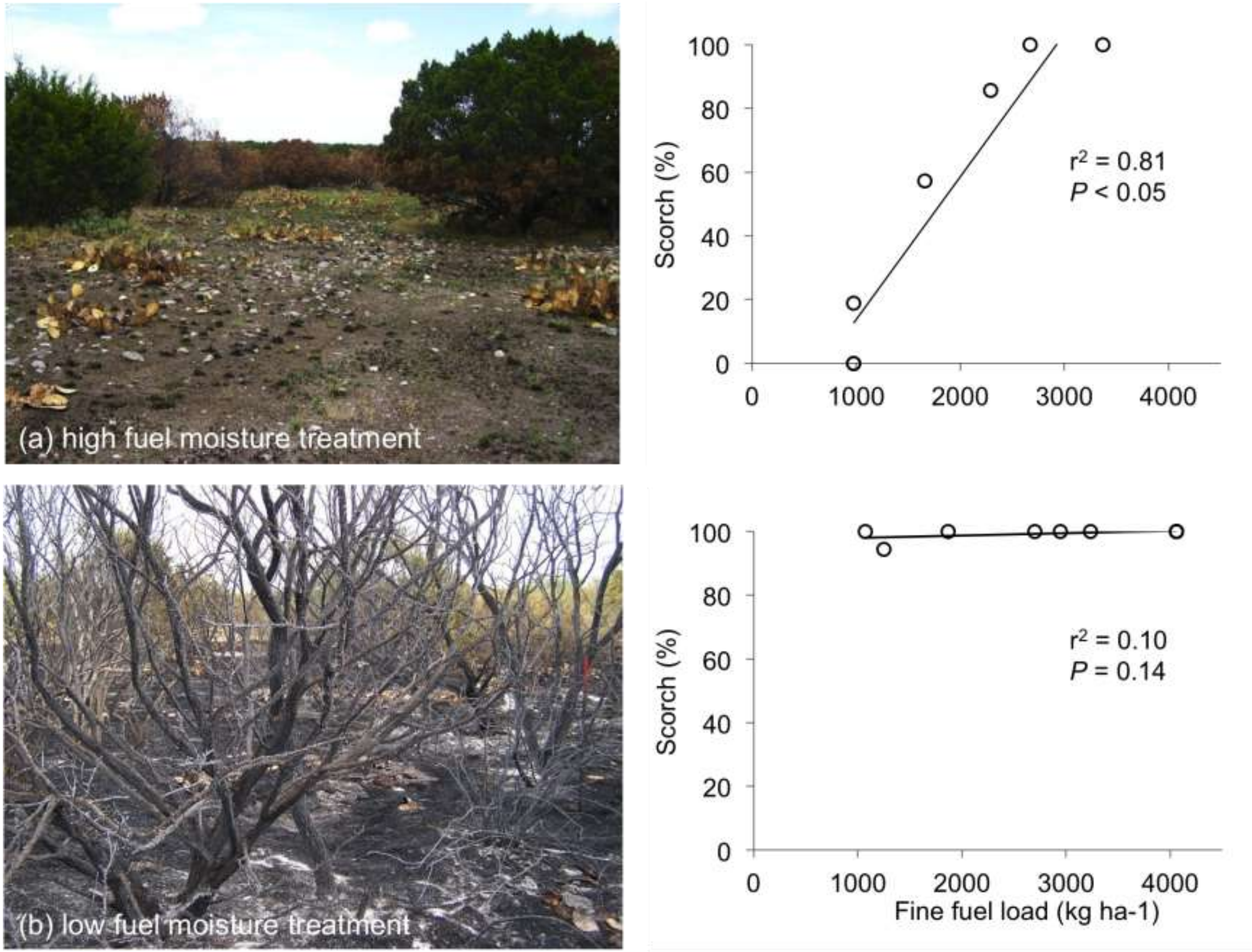
Legend

- Locations of known burn cooperatives
- Converted to juniper woodland†
- Transitioning to juniper woodland†
- Areas with minimal encroachment in Great Plains†
- Areas where cooperatives are known to have special exemptions to burn during periods when government mandates cease outdoor burning activities

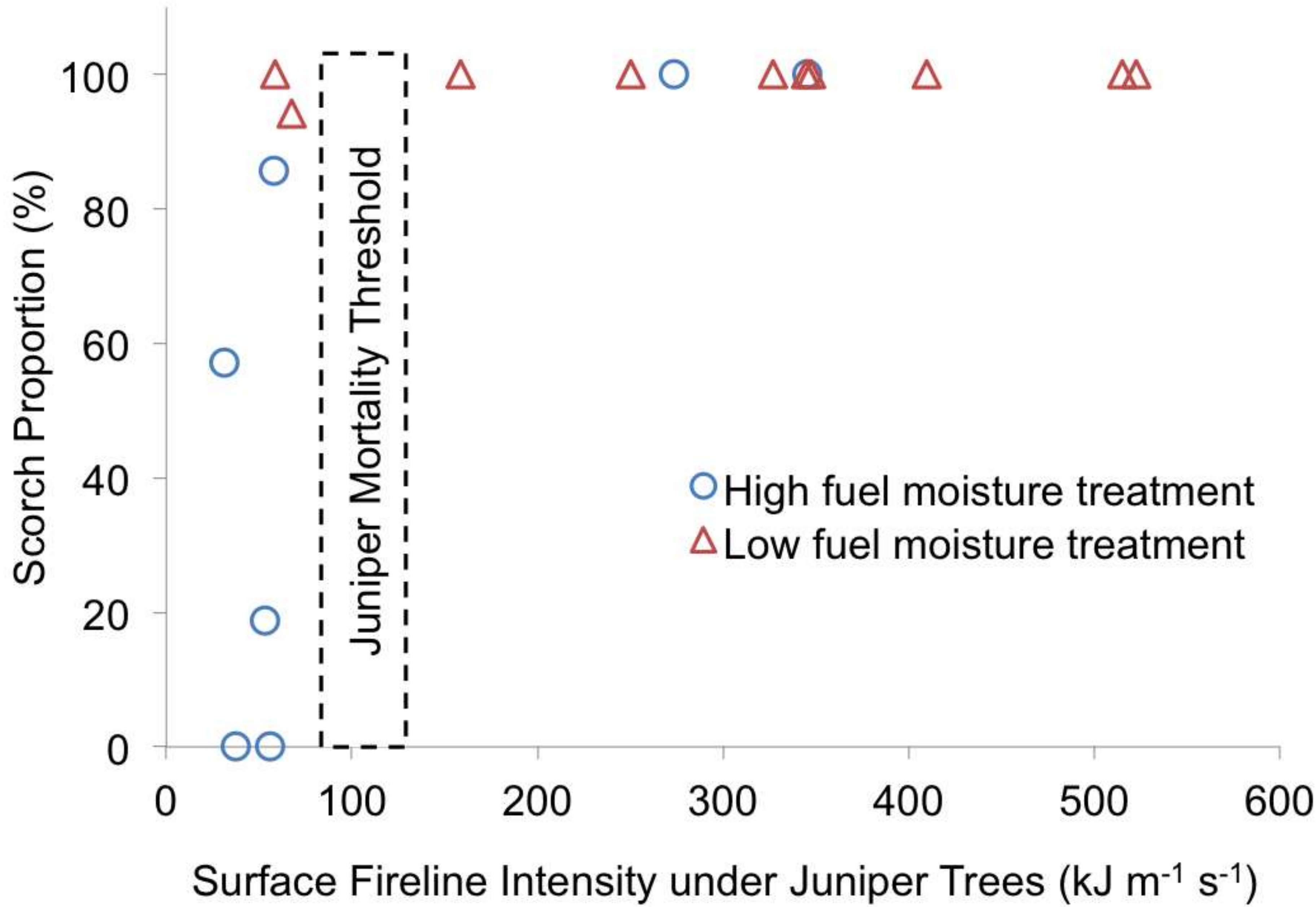
†Adapted from Engle et al. 2008

Twidwell et al. *in review*

Using Prescribed Fire in Wildfire Conditions:
A Radical Shift in Prescribed Fire and Fuels Management Philosophy



Twidwell et al. *in press* J. Applied Ecology



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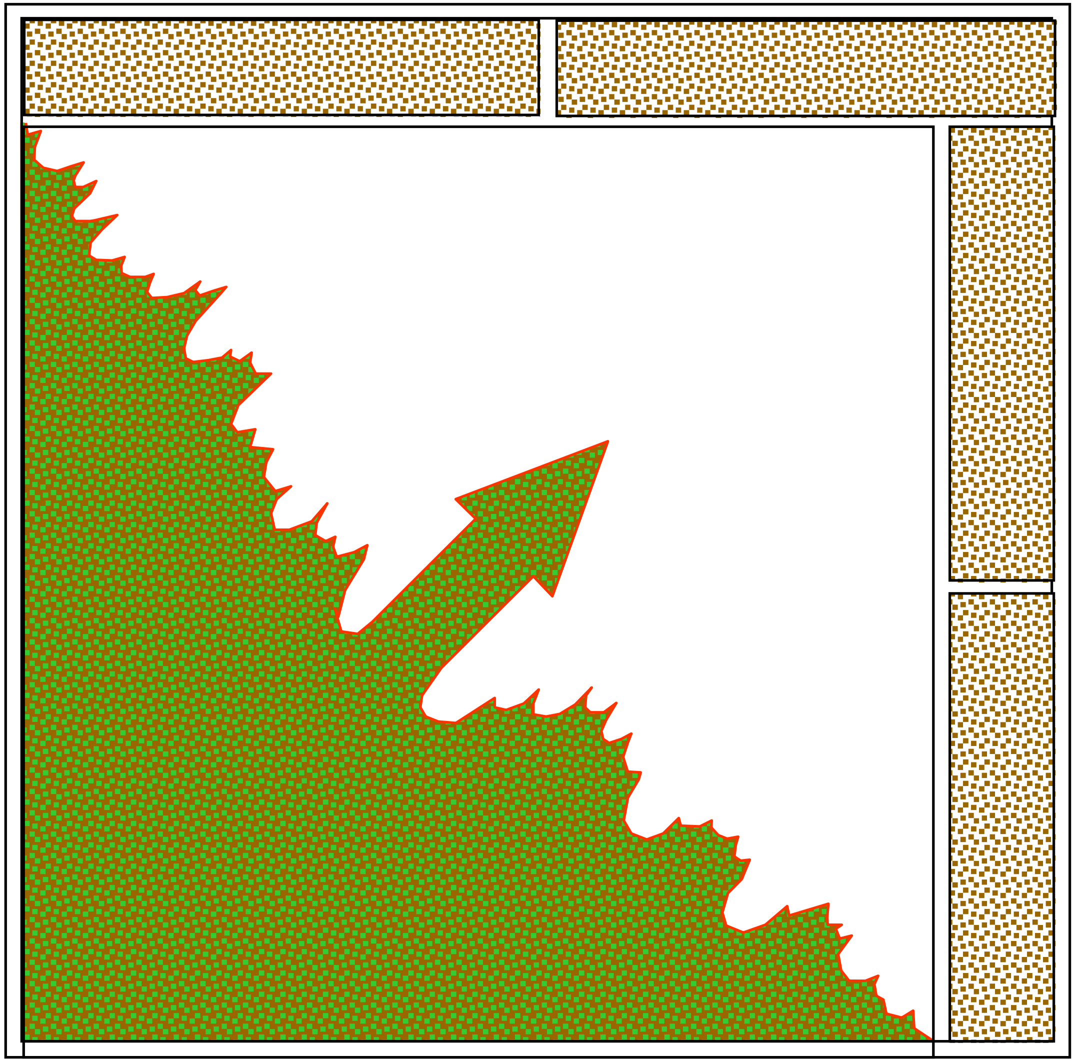
Using Prescribed Fire in Wildfire Conditions:
Designing Landscapes to Control Them



Rules-of-Thumbs
in Rangelands

Spot-fire distance in
non-volatile,
rangeland fuels

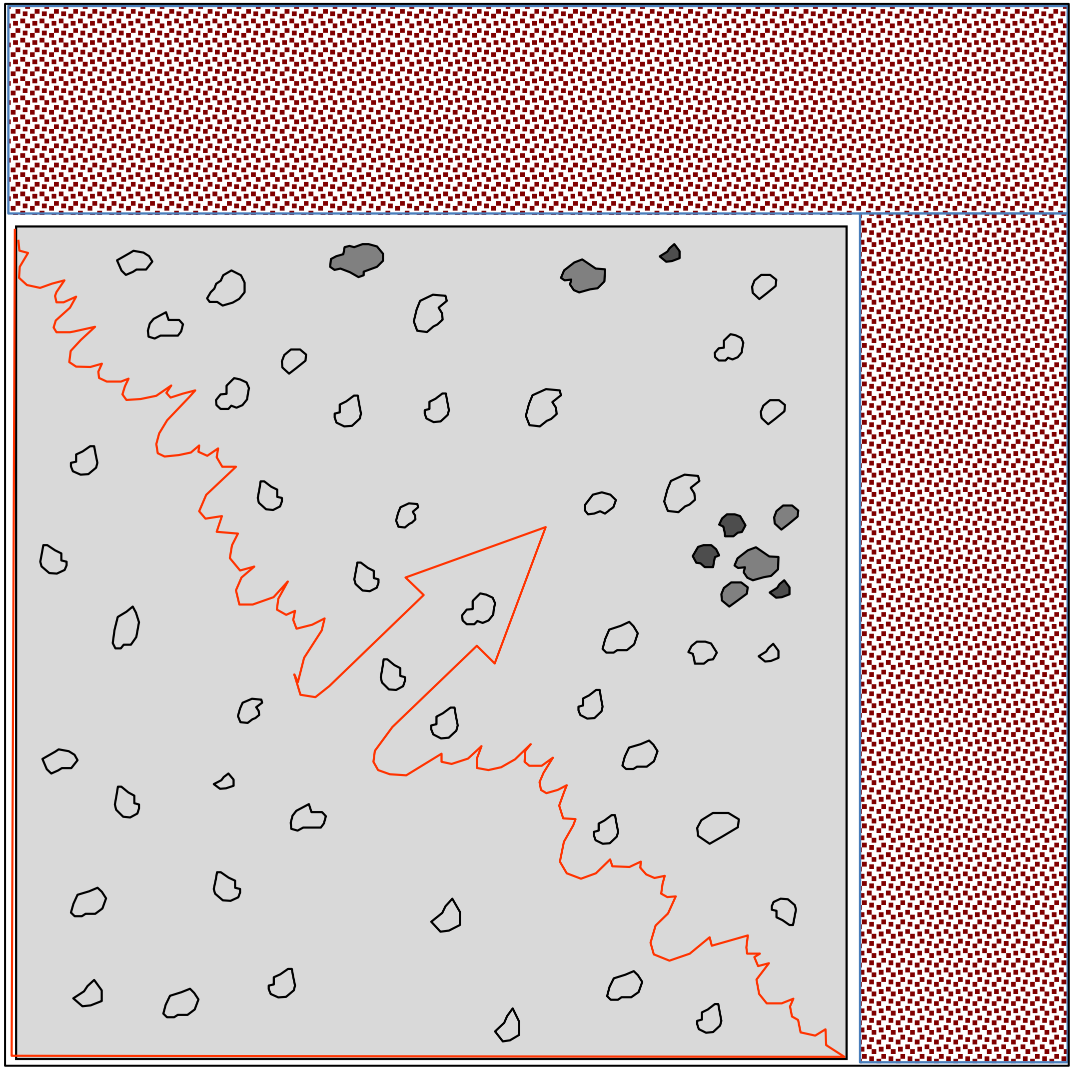
100 ft. perimeter buffer

Use when winds are
less than 20 mph
(but recommend not
exceeding 15 mph)

- Wright 1974

Using Prescribed Fire in Wildfire Conditions:

Designing Landscapes to Control Them



Rules-of-Thumbs
in Rangelands

Spot-fire distance in volatile, rangeland fuels

400 ft. perimeter buffer

Use when winds are less than 20 mph (but recommend not exceeding 15 mph)

- Wright 1974

Rules-of-Thumbs in Rangelands Oversimplify Physical Models of Spot-Fire Transport and Occurrence

The maximum distance between a source of firebrands (e.g., a burning tree) and a potential spot fire is dependent on 6 phenomena.

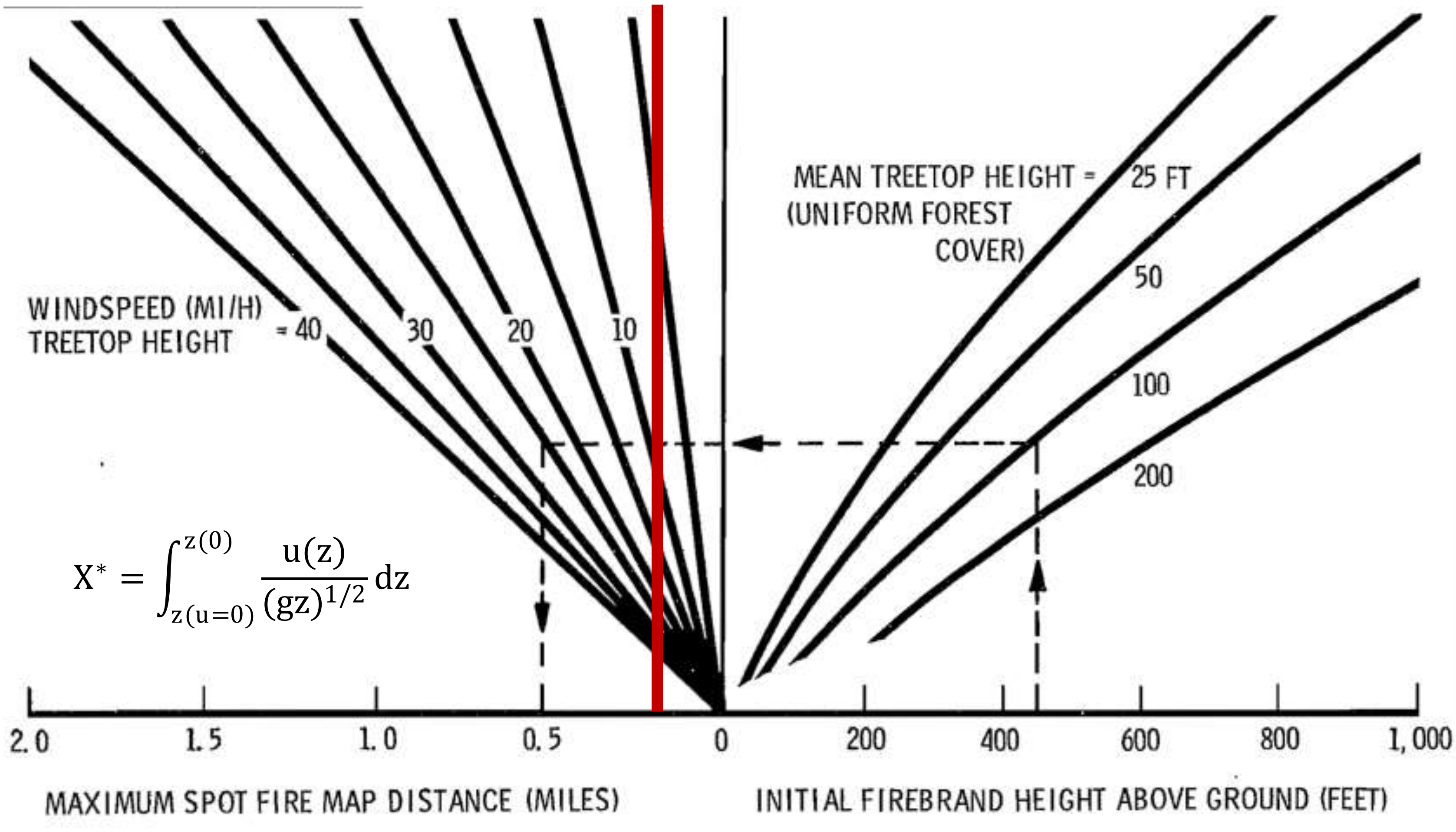
1. The structure of the flame that provides the initial lofting of a firebrand particle.
2. The structure of the buoyant plume established by the flame – this determines the height of the airborne particle.
3. The rate at which the firebrand particle burns as it moves through the atmosphere.
4. The trajectory of the firebrand as it moves through the flame and plume.
5. The structure of the surface winds over variable terrain.
6. The trajectory of the firebrand as it moves through the surface winds.

$$X^* = \int_{z(u=0)}^{z(0)} \frac{u(z)}{(gz)^{1/2}}\,dz$$

Albini 1979, 1981, & 1983

Spot-Fire Distance in Wildland Fuels

Predicting maximum spot fire distance in flat terrain



$$X^* = \int_{z(u=0)}^{z(0)} \frac{u(z)}{(gz)^{1/2}} dz$$

Albini 1979

Landscape Design Using Fire Physics for Fuels Management

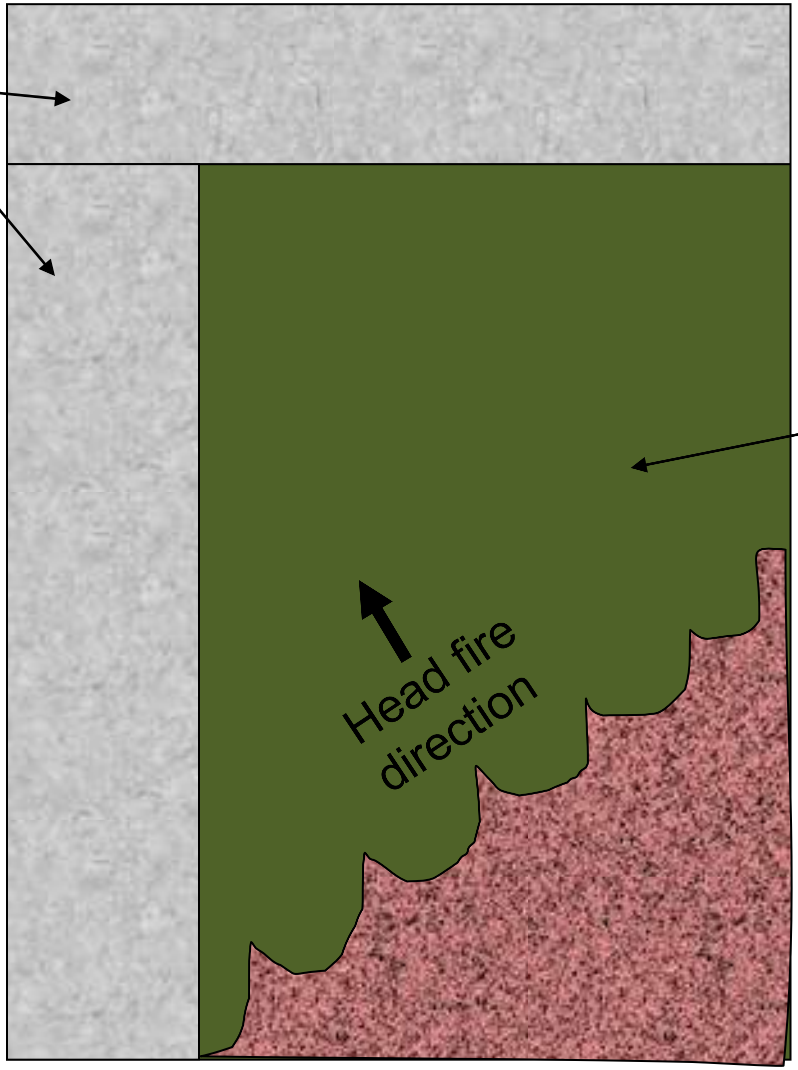
Perimeter buffer:

Burned under moderate conditions.

Livestock are used to maintain low fuel load.

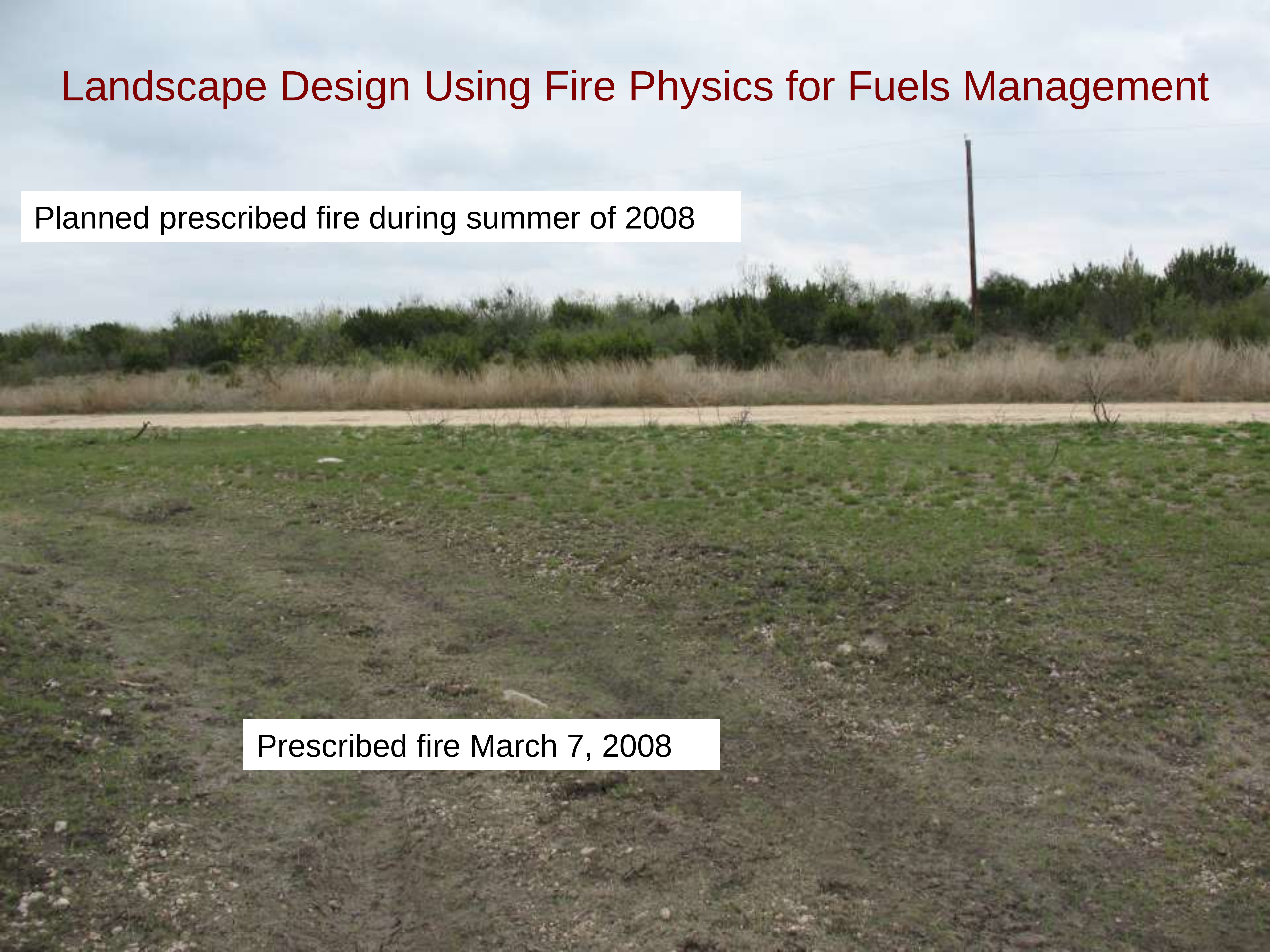
Distance determined by (no slope):

$$X^* = \int_{z(u=0)}^{z(0)} \frac{u(z)}{(gz)^{1/2}} dz$$



Burned in extreme fire conditions to reduce volatile fuels while also meeting restoration objectives

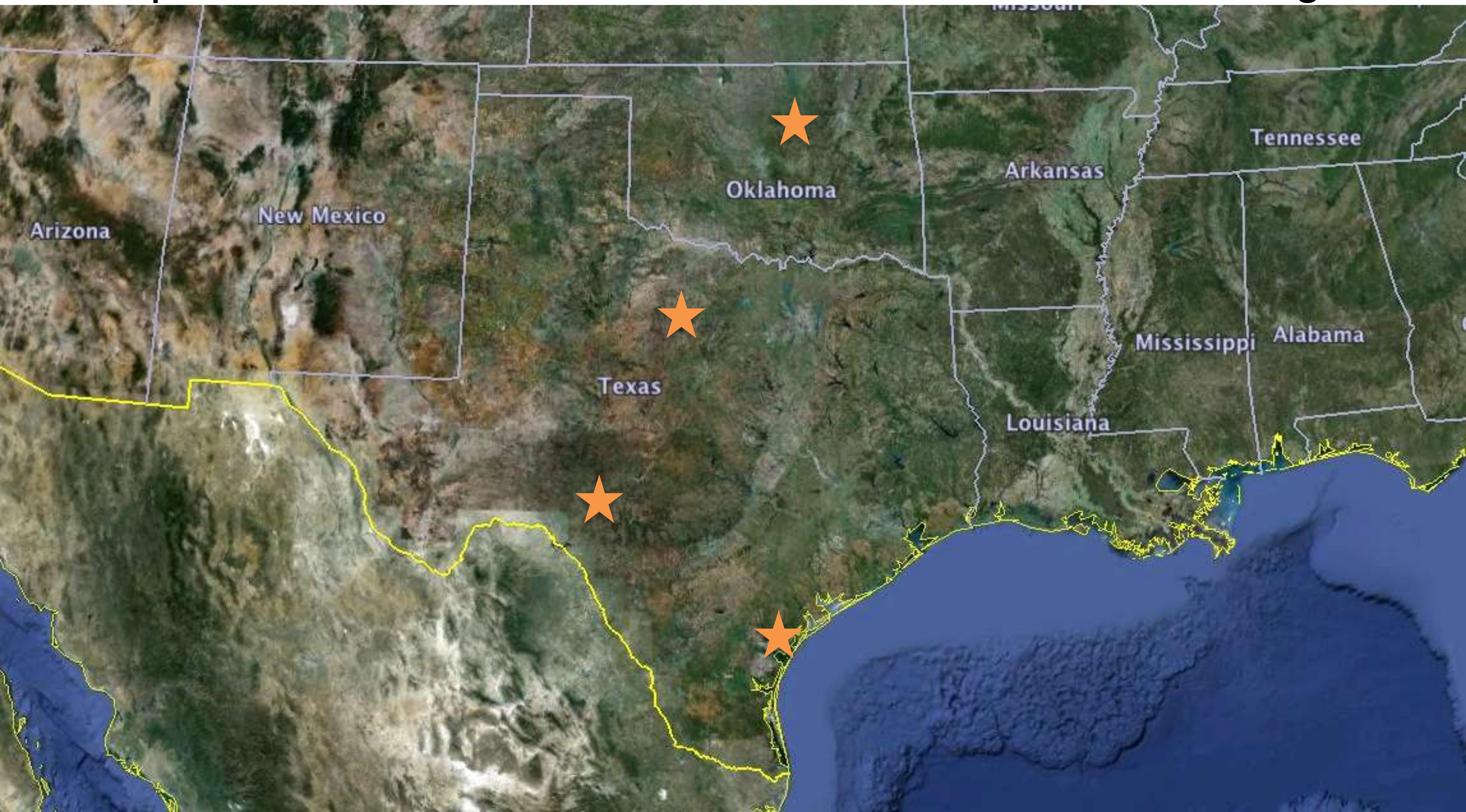
Landscape Design Using Fire Physics for Fuels Management



Potential for EPPBA's Approach to be Applied Elsewhere?

Experimental Evaluation:

75 experimental fires in extreme conditions across 4 ecoregions



Potential for EPPBA's Approach to be Applied Elsewhere?

Experimental Evaluation:

75 experimental fires in extreme conditions across 4 ecoregions

- Maintains native species richness

  (Twidwell et al. 2012)
- No long-term change in grass community composition

  (Taylor et al. 2012)
- Does not increase exotic species – KR bluestem or red imported fire ants

  (Twidwell et al. 2012; Twidwell et al. *in press*)
- Removes volatile fuels - kills up to 100% of Ashe juniper

  (Twidwell et al. 2009; Twidwell et al. *in press*)
- Kills significant levels of mature resprouting woody species

  (Twidwell et al. *to be submitted*)

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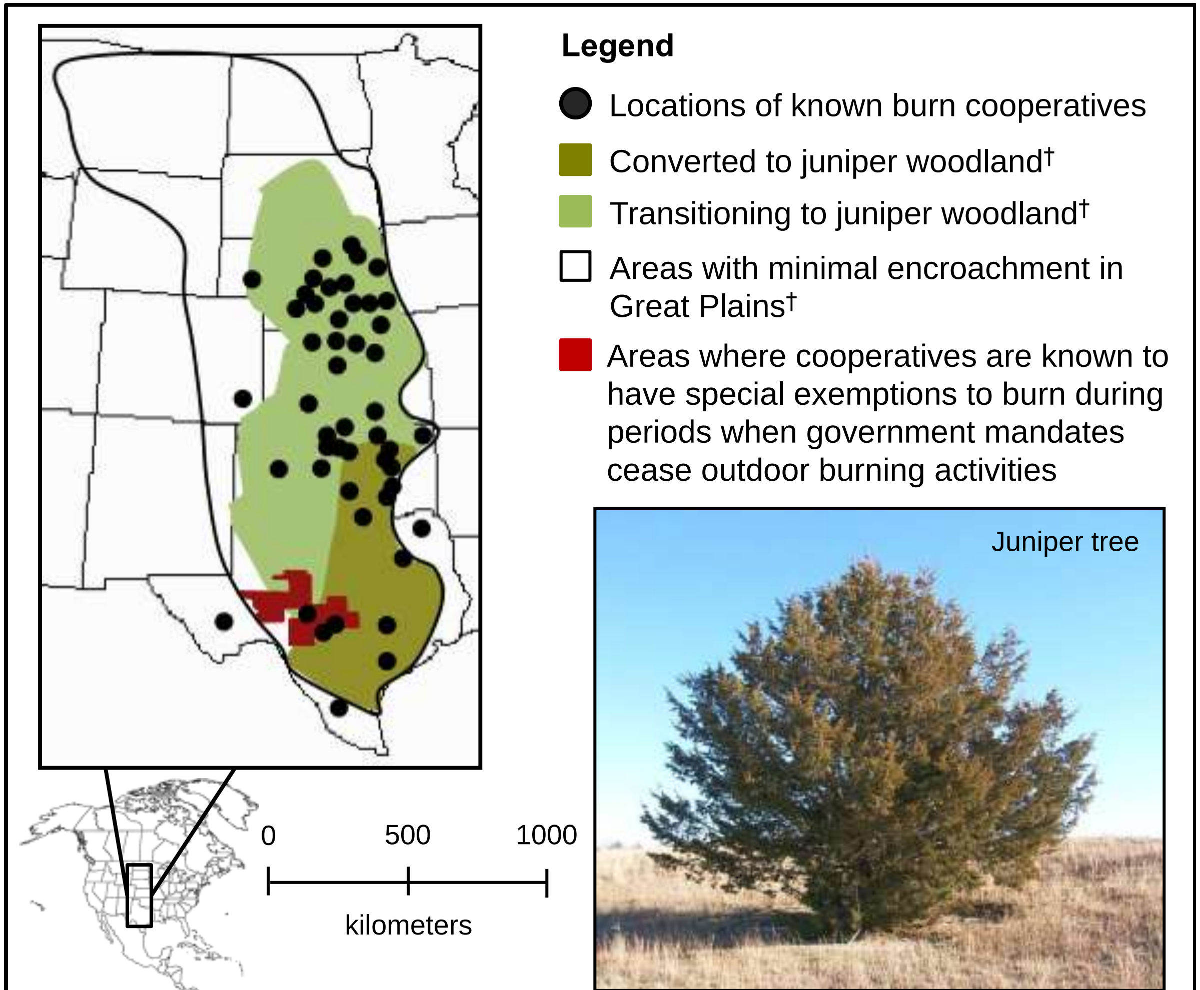


†Adapted from Engle et al. 2008

<u>Consider that</u>:

1997 – became first burn association in Great Plains

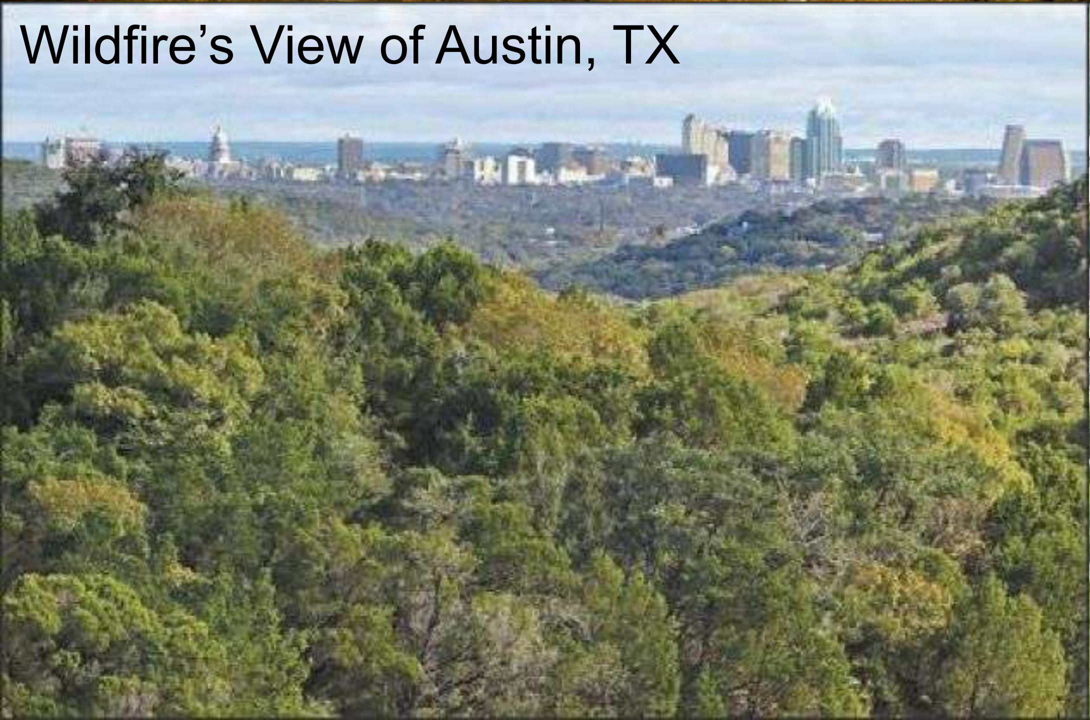
2013 – 50 PBAs exist

Approx. 150 fires and 80,000 acres in burn bans

4 PBAs recently received burn ban exemptions

Austin, TX's View of Bastrop Wildfire

Wildfire's View of Austin, TX



Photos: GILBERT W. ARIAS

Summary

- Long-term encroachment of woody plants throughout the southern plains
- Increased potential fire intensities and decreased fire suppression potential
- Unprecedented landowner effort to apply extreme prescribed fires to combat woody encroachment
- Experimental research shows numerous ecological benefits of extreme fire
- Fire physics models can help inform fuels management decisions


Questions?