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

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Long-term changes in Great Plains rangelands:
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Lack of human fire ignition and rise of woody plants
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after Fuhlendorf et al. 2007
Long-term changes in Great Plains rangelands:
Alteration of fire behavior
Long-term changes in Great Plains rangelands: Alteration of fire behavior
<table>
<thead>
<tr>
<th>Flame Length (feet)</th>
<th>Fireline Intensity (BTU ft$^{-1}$ s$^{-1}$)</th>
<th>Fire Suppression Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 4</td>
<td>&lt; 100</td>
<td>Fire can be attacked at head and flanks with hand tools; hand line should hold fire</td>
</tr>
<tr>
<td>4 – 8</td>
<td>100 – 500</td>
<td>Fires too intense for direct attack on head; hand line unreliable; mechanized equipment can be effective (plows, dozers, pumpers)</td>
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<tr>
<td>8 – 11</td>
<td>500 – 1,000</td>
<td>Fires present serious control problems (crowning, torching and spotting)</td>
</tr>
<tr>
<td>&gt; 11</td>
<td>&gt; 1,000</td>
<td>Crowning, spotting, and major fire runs probable; control at head of fire ineffective</td>
</tr>
</tbody>
</table>

Andrews and Rothermel 1986
Direct Fire Suppression Tactics Unsuccessful

Flame Length (m)

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
Using Prescribed Fire in Wildfire Conditions: A Radical Shift in Prescribed Fire and Fuels Management Philosophy
(a) high fuel moisture treatment

(b) low fuel moisture treatment

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
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.

\[ X^* = \int_{z(u=0)}^{z(0)} \frac{u(z)}{(g z)^{1/2}} \, dz \]  

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

Planned prescribed fire during summer of 2008

Prescribed fire March 7, 2008
Potential for EPPBA’s Approach to be Applied Elsewhere?

Experimental Evaluation:
75 experimental fires in extreme conditions across 4 ecoregions
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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)
Potential for EPPBA’s Approach to be Applied Elsewhere?

Consider that:

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

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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?