Project Overview

- 3-year goal – Effectiveness of fuel treatment
- Long-term goal – Improved understanding of wildland fire behavior
- 2 field experiments to date

New Jersey Pinelands National Reserve
1.1 million acres ~23% of NJ

- Averages 1300 wildfires per year (2003-2013)
- Large crown-fire event every 5-10 years
- High level of WUI
- RxB conducted on 12,000 acres per year
Measurement Techniques - Fuel

- 36 pre- and post-fire clip plots (3 per understory tower)
- Fuels sampled by size class
  - Forest floor: fine, repro., 1hr, 10hr, 100hr
  - Shrub and Oak layer: 1hr, 10hr (live and dead)

- Pre- and post-fire Airborne Laser Scanning data (400 kHz, pulse density 5.12 pts/m²)
- Provides canopy height and bulk densities (calibrated by upward sensing LiDAR)
- Resolution of 10 x 10 x 1 m
Measurement Techniques - Fire

- Aerial imagery: Series of georeferenced stills taken using RIT’s Wildfire Airborne Sensor Program (WASP)

- Towers: overstory (8 thermocouples and 1 3D Sonic Anemometer) and understory (5 thermocouples, 1 vertical flow sensor, 1 vertical dual-band radiometer)

- Fire behaviour packages: 4 thermocouples, 6 thin-skin calorimeters (total heat flux), 3D flow velocity
Fire Progression
Fireline Intensity $I_f = ROS \cdot \Delta m \cdot h$

**U5:**
~1500-4100 kW·m$^{-1}$

**U11:**
~4700-6000 kW·m$^{-1}$

**Forest floor – U5**

<table>
<thead>
<tr>
<th></th>
<th>fine</th>
<th>wood 1hr</th>
<th>FF total</th>
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<tbody>
<tr>
<td>mean</td>
<td>575.7</td>
<td>-0.7</td>
<td>575.0</td>
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<tr>
<td>consumption [g·m$^{-2}$]</td>
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**Shrubs and Oaks – U5**

<table>
<thead>
<tr>
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<th>1hr L+D</th>
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<tr>
<td>mean</td>
<td>324.0</td>
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<td>consumption [g·m$^{-2}$]</td>
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**Forest floor – U11**

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<td>consumption [g·m$^{-2}$]</td>
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**Shrubs and Oaks – U11**

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<tr>
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<td>419.7</td>
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<tr>
<td>consumption [g·m$^{-2}$]</td>
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Plot 5 & 11
LiDAR models of ‘Available Fuels’

Pre-Fire Bulk Density

% Consumption

- P3: 63.18
- P4: 65.89
- P5: 68.46
- P6: 71.01

Courtesy of Wikimedia Commons
Preliminary Visual Results
Preliminary Visual Results
Preliminary Visual Results
Fuel - Branch and Bark Consumption

No more than 53% of shrub mass was consumed. 1 hour fuels:
S\(_1\) < 2 mm; S\(_2\) = 2-4 mm; S\(_3\) = 4-6.35 mm
All S\(_1\) consumed but less than 50% of S\(_2\) and no S\(_3\).

- Most Radius variations between 0.32 and 6 mm.
- Same thickness as the bark collected in pans.
Firebrands

First attempt to quantify firebrand

Firebrands allowed a surface fire to cross easily a narrow fuel break
Firebrands

The firebrand density was determined by collecting samples with and without plastic film.

![Image of firebrand collection](image1)

![Graph showing firebrand thickness distribution](image2)

426 Measurements

- Bark Slices
- branches

Number of Firebrands vs. Thickness (x10^{-3} m)
Firebrands
Conclusions

• Valuable data collected on fire behavior in a forested environment
• Both fire progression/behavior and total fuel consumption
• Estimation of fire-line intensity for different types of fire spread
• Analysis of fire behavior related to fuel distribution and wind
• Firebrand characterization (size and time)
• Much more work to be done to thoroughly analyze results from both years
Thank you!

Albert Simeoni, Eric Mueller, Nicholas Skowronski, Kenneth Clark, Robert Kremens, Michael Ghallagher, Jan Thomas, Mohamad El Houssami, Alexander Filkov, Bret Butler, John Hom, William Mell