Functional group responses to burn severity in three ponderosa pine ecosystems a decade after fire

Beth A. Newingham\textsuperscript{1}, Andrew T. Hudak\textsuperscript{2}, April G. Smith\textsuperscript{1}, Benjamin C. Bright\textsuperscript{2} and Azad Henareh Khalyani\textsuperscript{3}

\textsuperscript{1}USDA Agricultural Research Service, Reno, NV
\textsuperscript{2}USFS Rocky Mountain Research Station, Moscow, ID
\textsuperscript{3}Colorado State University, Fort Collins, CO

International Fire Ecology and Management Congress
Orlando, FL 2017
Vegetation Types
1. Subarctic Boreal Spruce
2. Moist Mixed Conifer
3. Dry Mixed Conifer
4. Ponderosa Pine
5. Mixed Chaparral
Research Questions

Understory Responses

1. Are there effects of burn severity on plant communities a decade after fire?

2. Does post-fire recovery differ among ponderosa pine communities?
## Fire Characteristics

<table>
<thead>
<tr>
<th></th>
<th>Egley, OR</th>
<th>Hayman, CO</th>
<th>Jasper, SD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Year Burned</strong></td>
<td>2007</td>
<td>2002</td>
<td>2000</td>
</tr>
<tr>
<td><strong>Year Resampled</strong></td>
<td>2016</td>
<td>2015</td>
<td>2015</td>
</tr>
<tr>
<td><strong>Years Post-fire</strong></td>
<td>9</td>
<td>13</td>
<td>15</td>
</tr>
<tr>
<td><strong>Mean Elevation (m)</strong></td>
<td>1587</td>
<td>1825</td>
<td>1739</td>
</tr>
<tr>
<td><strong>Mean Annual Temp (°C)</strong></td>
<td>5.7</td>
<td>5.3</td>
<td>5.4</td>
</tr>
<tr>
<td><strong>Mean Annual Precip (mm)</strong></td>
<td>320</td>
<td>421</td>
<td>563</td>
</tr>
</tbody>
</table>
Burn Severity

MTBS = Monitoring Trends in Burn Severity

dNBR = differenced Normalized Burn Ratio

Egley, OR  Hayman, CO  Jasper, SD
Experimental Design

**Site Stratification**

1. Burn severity (dNBR)  
   - Ranged 6 to 925
2. Elevation  
   - Ranged 1507-2859m
3. Aspect  
   - TRASP (Transformed Aspect)

**Sampling**

Five plots per site

- Visually estimated cover

[Diagram of sampling setup with 30m and 1m² measurements]
Analysis

Multivariate Non-metric multidimensional scaling (NMS) ordination
- dNBR
- Plant cover
- Climate
Univariate

Multiple linear regression

Explanatory variables:
- dNBR
- Mean annual precipitation after fire

Response variables:
- Cover (%)
  - Annual & perennial
  - Native & introduced
  - Graminoid, forb, shrub
  - Total
  - Species
- Shannon’s Diversity (H’)

Analysis
Functional Group
Results
Burn Severity Effects

**P< 0.05;  *P< 0.10

** P< 0.05;  *P< 0.10
Burn Severity Effects

![Graphs showing the relationship between burn severity and vegetation cover and diversity across different locations.](image)

- **Egley, OR**: **P < 0.05**; **P < 0.10**
- **Hayman, CO**: **P < 0.10**
- **Jasper, SD**: **P < 0.05**; **P < 0.10**

**Total Cover (%) vs. dNBR**

**Shannon's Diversity (H') vs. dNBR**
Precipitation Effects

**P < 0.05; *P < 0.10**
Precipitation Effects

** P< 0.05; *P< 0.10
Growth Form and Species Results
Native vs. Introduced Cover

Burn severity did not affect shrub cover

** P< 0.05; *P< 0.10
Native Species Cover

- **P < 0.05;   *P < 0.10**
**Introduced Species Cover**

![Graph showing Bromus tectorum cover (%) vs. dNBR for Egley, OR, Hayman, CO, and Jasper, SD.](image)

- **Egley, OR**
  - **P** < 0.05; **P** < 0.10

- **Hayman, CO**

- **Jasper, SD**

**P** < 0.05; **P** < 0.10
A decade after fire...

<table>
<thead>
<tr>
<th>Cover</th>
<th>Egley, OR</th>
<th>Hayman, CO</th>
<th>Jasper, SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual</td>
<td>dNBR +</td>
<td>.</td>
<td>.</td>
</tr>
<tr>
<td>Perennial</td>
<td>dNBR +</td>
<td>.</td>
<td>Precip +</td>
</tr>
<tr>
<td>Native</td>
<td>dNBR +</td>
<td>.</td>
<td>Precip +</td>
</tr>
<tr>
<td>Introduced</td>
<td>dNBR +</td>
<td>Precip</td>
<td>Precip +</td>
</tr>
<tr>
<td>TOTAL</td>
<td>dNBR +</td>
<td>.</td>
<td>Precip +</td>
</tr>
<tr>
<td>Diversity</td>
<td>Shannon’s</td>
<td>.</td>
<td>dNBR + _</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cover</th>
<th>Egley, OR</th>
<th>Hayman, CO</th>
<th>Jasper, SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Native Grass</td>
<td>.</td>
<td>.</td>
<td>.</td>
</tr>
<tr>
<td>Introduced Grass</td>
<td>dNBR +</td>
<td>Precip</td>
<td>.</td>
</tr>
</tbody>
</table>
Understory Responses

1. Are there effects of burn severity on plant communities a decade after fire?
   • Yes, burn severity increased cover and diversity.

2. Does post-fire recovery differ among ponderosa pine forests?
   • Yes, burn severity effects most prevalent at the drier ponderosa pine forests that are 9-12 years post-fire.
Recovery Trajectories

Driest

Ponderosa Pine

Wettest
Questions?

Funded by Joint Fire Science Program

www.frames.gov/partner-sites/long-term-recovery

Long-term Recovery After Wildfire
Egley
### Elevation Effects

#### Shannon's Diversity ($H'$) vs. Elevation (m)

<table>
<thead>
<tr>
<th>Location</th>
<th>Elevation</th>
<th>Diversity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Egley, OR</td>
<td>1500-1700</td>
<td>**</td>
</tr>
<tr>
<td>Hayman, CO</td>
<td>2000-2750</td>
<td>**</td>
</tr>
<tr>
<td>Jasper, SD</td>
<td>1600-2000</td>
<td>P&lt; 0.05</td>
</tr>
</tbody>
</table>

**P< 0.05; *P< 0.10**