Research Update for Utah Juniper-Pinyon Woodlands
Outline

Vegetation and Resource Response to Treatments
Bruce Roundy

Fuel and Vegetation Response to Shredding and Prescribed Burning Treatments
Kert Young

Evaluation of the Relationship Between Remotely-Sensed and Ground-Reference Variables
April Hulet
Vegetation and Resource Response to Treatment

Bruce Roundy
Managing for Resilience

• Where should we treat?
• When should we treat?
• How should we treat?
Fluctuating Resource Hypothesis

Resources as a common denominator to understand vegetation changes

- Relative availability of desirable and non-desirable resource users
- Resource availability in relation to growth requirements
Management Question:

At what community phase should we introduce disturbance?

Phase I
Shrubs > 2/3 of relative cover

Phase II
Shrubs and trees share relative cover

Phase III
Trees > 2/3 relative cover
Management Question:

Does the kind of disturbance matter?

- Effects on residual desirables vs weeds
- Effects on resource availability

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Trees</th>
<th>Shrubs</th>
<th>Herbaceous perennials</th>
<th>Soil water</th>
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<tbody>
<tr>
<td>Undisturbed</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Burn</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>++</td>
</tr>
<tr>
<td>Cut</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Shredded</td>
<td>-</td>
<td>-/+</td>
<td>+</td>
<td>+</td>
</tr>
</tbody>
</table>
Vegetation Response to Disturbance

Tree canopy cover (%) 4 Locations 2008

- Control
- Burn
- Cut

Phases:
- Phase I
- Phase II
- Phase III

Legend:
- Phase I
- Phase II
- Phase III
Resource Response to Disturbance

**May-June Wet days 13-30 cm, 4 Locations**

- **Phase I**: Control, Burn, Cut
- **Phase II**: 2008
- **Phase III**: 2009

**May-June Wet days 13-30 cm, 2009- 7 Locations**

- **Phase I**: Control, Burn, Cut
- **Phase II**: 2009
- **Phase III**: 2009
Resource Response to Disturbance

Wet days 13-30 cm, 2008-2 Locations

- Control
- Burn
- Cut
- Shred

Phase I
Phase II
Phase III
The Role of Residual Species
The Role of Residual Species

2009 burn, cut, shred

R² = 0.68

Cheatgrass cover (%) vs. Perennial grass cover (%)

R² = 0.68

Cheatgrass cover (%) vs. Perennial grass cover (%)

R² = 0.68

Cheatgrass cover (%) vs. Perennial grass cover (%)

R² = 0.68
Managing for Resilience: Preliminary Conclusions

- Treat sites where and when residual desirables dominate
- Mechanical treatments may leave more residuals and reduce weed invasion potential
- Fire or mechanically treating at Phase III frees up more resources for weed invasion
- Residual shrubs and perennial herbs
- Weed propagule pressure
Related research-

Water repellent soils: Matt Madsen

- What is the extent?
- What factors relate to its occurrence and severity?
- What is its role in weed invasion?
- Can seed coatings improve post-fire revegetation?
Related research - Effects of shredding

- What are shredded fuel characteristics?
- How fast do fuels decompose?
- What are effects on soil and invasive species?
- How do responses vary with initial tree cover?
- What are the effects of post-shred prescribed fire?
Thanks to the Managers
Fuel and Vegetation Responses to Shredding and Prescribed Burning Treatments

Kert Young

Patch of Shredded Fuels
The Concern

Invasive Grasses

Degradation Pathway

Native Grasses

Restoration Pathway

Juniper

Mechanical Shredding

Shredded Residue

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Hypothesis

- Shredded juniper fuels
  - Increased Decomposition by soil microorganisms
  - Increased Soil Organic C
    - Soil C:N ratio
  - Decreased Soil N availability
  - Decreased Cheatgrass success
  - Soil
Shredded Fuel Loads

Shredded Fuel Loads (kg/ha) vs Shredded Depth (cm)

Legend:
- ••• Biomass by Depth
- Regression
- ---- 95% CI's

Total Shredded Fuels (kg/ha)

y = 62 + 9082 x
Adj R² = .92
Fuels by Treatment and Method

Fuels loads – before vs 1-yr post-treatment

Fuel Load
10 - 1000 hr (kg/ha)

Tree Cover / Total Perennial Cover (%)
Fuels by Treatment and Method
Surface Fuels – 2 yrs post-treatment

Surface Fuel Load
10 - 1000 hr (kg/ha)

Tree Cover / Total Perennial Cover (%)

Planar-intersect
- Burn
- Control
- Shred
- Cut-and-Drop
Shredding Juniper Results

- Shredding juniper in general
  - Increased soil N supply rate
  - Increased biomass-per-plant for bluebunch and cheatgrass

- Shredded juniper fuels specifically
  - Small decrease in soil N availability
  - Increased bluebunch and cheatgrass percent emergence

- Invasive versus native grass across treatments
  - Bluebunch had ~30% greater emergence than cheatgrass
Response to Hypothesis

- Shredded juniper fuels

- Increased decomposition by soil microorganisms

  - Increased Soil Organic C
  - Soil C:N ratio

- Decreased Soil N availability

- Decreased Cheatgrass success
Fire and Seedbank Results
Cheatgrass Seedbank and Cover

Results

• Seedbank Density
  • Pre-fire, cheatgrass emergence density seemed greatest in high juniper cover
  • Post-fire, cheatgrass density returned to pre-fire levels within 1- or 2-yrs

• Cover in the Field
  • Cheatgrass cover decreased with increased juniper cover or perennial grass cover
  • Cheatgrass cover exceeded pre-fire levels 1-yr post-fire at Stansbury
Vegetation Implications

- Control invasive species early before desired plants are weakened or lost.
- If cheatgrass is present, it can quickly return to at least pre-fire levels.
- Short window to plant desirable species if they were lacking before fire.
Evaluating the Relationship Between Remotely Sensed & Ground-Reference Variables

April Hulet
Objectives:

1. Select the appropriate imagery sources and analysis that have practical implications for the management of the sagebrush biome.
Devine Ridge, 2007

Blue Mountain, 2007

South Ruby

Marking Corral, 2006

Stansbury, 2007

Onaqui, 2006
## Imagery Collected:

<table>
<thead>
<tr>
<th>Location</th>
<th>Color</th>
<th>Color-IR</th>
<th>Panchromatic</th>
<th>Multispectral</th>
<th>Hyperspectral</th>
</tr>
</thead>
<tbody>
<tr>
<td>Onaqui</td>
<td>X</td>
<td>X</td>
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<td>Stansbury</td>
<td>X</td>
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<tr>
<td>Marking Corral</td>
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<td>X</td>
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<tr>
<td>South Ruby</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Devine Ridge</td>
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<td>X</td>
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<td></td>
</tr>
<tr>
<td>Blue Mountain</td>
<td>X</td>
<td>X</td>
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<td></td>
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</tr>
</tbody>
</table>
Objectives:

1. Select the appropriate imagery sources and analysis that have practical implications for the management of the sagebrush biome.

2. Develop image-processing approaches that best estimate tree, shrub, and intercanopy vegetation cover, density, and biomass.
Objectives:

- Investigate hierarchical object-oriented image analysis techniques
Objectives:

• Develop classification trees

Explanatory Variables:

• Mean and standard deviations of bands/pixels
• Topographic features
• Shape features
• GLCM and GLDV textures

Response Variables:

• Land cover types (ideally Level 3 variables)
• Fuel variables

Table 4. Canopy fuel variables

<table>
<thead>
<tr>
<th>Canopy fuel variables</th>
<th>Fire-carrying fuel variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tree canopy cover</td>
<td>Tree canopy cover</td>
</tr>
<tr>
<td>Tree density</td>
<td>Tree density</td>
</tr>
<tr>
<td>Tree biomass/canopy bulk density</td>
<td>Tree biomass/canopy bulk density</td>
</tr>
<tr>
<td>Shrub canopy cover</td>
<td>Shrub canopy cover</td>
</tr>
<tr>
<td>Shrub density</td>
<td>Shrub density</td>
</tr>
<tr>
<td>Shrub biomass</td>
<td>Shrub biomass</td>
</tr>
<tr>
<td>Herbaceous cover</td>
<td>Herbaceous cover</td>
</tr>
<tr>
<td>Herbaceous biomass</td>
<td>Herbaceous biomass</td>
</tr>
<tr>
<td>Down woody fuel material cover</td>
<td>Down woody fuel material cover</td>
</tr>
<tr>
<td>Litter cover</td>
<td>Litter cover</td>
</tr>
<tr>
<td>Bare ground cover</td>
<td>Bare ground cover</td>
</tr>
</tbody>
</table>

Laliberte et al. 2007
Objectives:

1. Select the appropriate imagery sources and analysis that have practical implications for the management of the sagebrush biome.

2. Develop image-processing approaches that best estimate tree, shrub, and intercanopy vegetation cover, density, and biomass.

3. Determine which remotely-sensed variables could be used as a surrogate for field measured variables.
Image Classification:

Juniper Cover
Juniper Cover

R^2 = 0.92
Image Classification:

Shrub Cover
Shrub Cover

$R^2 = 0.82$
Image Classification:

Herbaceous Cover
Herbaceous Cover

$R^2 = 0.88$
Further Research:

Compare the use of imagery platforms for fuel and vegetation variable detection:

- Evaluate spectral and spatial resolutions
- Evaluate regional differences (including plant composition)
- Evaluate treatment responses
Conclusions:

Utilizing multiple remote sensing platforms will allow us to better determine where to prioritize fuel management strategies.

High-resolution imagery can be used for monitoring purpose however, further refinement of methods needs to be evaluated.

Remotely-sensed imagery makes long-term monitoring on a landscape scale more feasible by reducing costs of ground based data collection.
Summary:

Burn with high perennial grass cover or mechanically treat at Phase I or II to avoid freeing up resources for invasion.

Follow-up cool season burning after mechanical treatments in dense juniper due to high surface-fuel loads.

Control invasive species early before desired plants are weakened or lost.

If cheatgrass is present, it can quickly return to at least pre-treatment levels without planting.