Fire and Fuel Reduction Treatments in Riparian Areas: Management in the Context of Climate Change:

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Presentation Overview:

In the context of climate change,

► Fire properties, behavior and history in riparian areas;
► Riparian areas and local fire regimes;
► Postfire processes and recovery in riparian areas;
  ▪ Riparian functions: large wood recruitment to streams; shade; habitat;
  ▪ Role of invasives & herbivory; importance of species traits.
► Fuel management treatments in riparian areas.
Riparian Areas: Highly Diverse

- Alpine tundra
- Subalpine forest
- Mixed conifer forest
- Montane forest

Riparian Area Land Cover:
1-2% in mountainous areas;
0.5 % in sagebrush steppe.
Properties and Behavior of Fire in Riparian Areas

Physical Features
- Microclimate
- Basin topography
- Basin & channel geomorphology

Fire Environment Triangle (Pyne et al. 1996)
Properties and Behavior of Fire in Riparian Areas

**Physical Features**
- Surface Water
- Saturated Soils
Properties and Behavior of Fire in Riparian Areas

Vegetation – Fuel Characteristics
- Biomass ("loading" mass/area)
- Bulk Density (mass/volume)
- Size Distribution (SA/volume)
- Chemistry (volatiles vs. nonvolatiles)
- Ratio: live/dead
- Shading/ exposure
- Strata (surface, understory, overstory)
- Continuity (horizontal & vertical)

### Projections of Changing Climatic Conditions

<table>
<thead>
<tr>
<th>Region</th>
<th>Observed 20th Century Climate</th>
<th>Projections for 21st Century</th>
</tr>
</thead>
<tbody>
<tr>
<td>West</td>
<td>Warmer and generally wetter.</td>
<td>Continued warming &amp; increased precipitation.</td>
</tr>
<tr>
<td></td>
<td>• Increased T; up to 2-5 F (1-3 C).</td>
<td>• Increased T: 3-4 F (2 C) by 2030s, 8-11 F (4.5-6 C) by 2090s.</td>
</tr>
<tr>
<td></td>
<td>• Increased P; in much of region, up to 50% in some areas.</td>
<td>• Increased P; in winter, esp. in CA.</td>
</tr>
<tr>
<td></td>
<td>Highly variable climate with exceptionally wet &amp; dry periods.</td>
<td>More extreme wet and dry years.</td>
</tr>
<tr>
<td></td>
<td>Length of snow season decreased by 16 days in CA &amp; NV. Extreme ppt events have increased.</td>
<td></td>
</tr>
<tr>
<td>Pacific Northwest</td>
<td>Warmer and wetter.</td>
<td>Much greater average warming over the region.</td>
</tr>
<tr>
<td></td>
<td>• Increased T: 1-3 F (0.5 – 1.5 C).</td>
<td>• Increased T: 3 F (1.5 C) by 2030s, 5 F (3 C) by 2050s.</td>
</tr>
<tr>
<td></td>
<td>• Increased P: 10% (on ave.); 30-40 % in eastern WA, no.ID.</td>
<td>• Wetter on ave. across region.</td>
</tr>
<tr>
<td></td>
<td>Significant recurring patterns of year-to-year variability.</td>
<td>• Increased ppt. in winter.</td>
</tr>
<tr>
<td></td>
<td>• Warm, dry years with light snowpack, low streamflows.</td>
<td>• Same or decreased ppt. in summer.</td>
</tr>
<tr>
<td></td>
<td>• Cool, wet years with heavy snowpacks, high streamflows</td>
<td></td>
</tr>
</tbody>
</table>

From: Furniss et al., 2010. *Water, climate change, and forests.* PNW-GTR-812
Fire History in Riparian Areas

Challenges of reconstructing riparian fire histories

- Methodological constraints
- Frequent natural disturbances affecting streamside areas (flooding, debris flows)
- Many riparian areas have been severely altered (grazing, beaver removal, logging, mining, flow alteration)
- Limited understanding of natural fire dynamics, reference fuel loads, historic range of variability; understudied vegetation types and geographic regions
- Discrepancies in published information

Tower Fire (1996), NE Oregon
<table>
<thead>
<tr>
<th>Location</th>
<th>Forest Type</th>
<th>Riparian Fire Return Interval (yrs)</th>
<th>Sideslope Fire Return Interval (yrs)</th>
<th>Citation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blue Mountains, OR</td>
<td>Dry, Douglas-fir and Grand Fir series</td>
<td>13-36</td>
<td>10-20</td>
<td>Olson 2000</td>
</tr>
<tr>
<td>Elkhorn Mountains, OR</td>
<td>Dry, Ponderosa Pine, Douglas-fir series</td>
<td>13-14</td>
<td>9-32</td>
<td>Olson 2000</td>
</tr>
<tr>
<td>Salmon River Mountains, ID</td>
<td>Dry, Ponderosa Pine and Douglas-fir series</td>
<td>11-19</td>
<td>9-29</td>
<td>Barrett 2000</td>
</tr>
<tr>
<td>No. Sierra Nevada Mtns, CA</td>
<td>Dry, Ponderosa/ Jeffrey Pine</td>
<td>10-87</td>
<td>10-56</td>
<td>Van De Water &amp; North 2010</td>
</tr>
<tr>
<td><strong>Dry Forest Type Average</strong></td>
<td></td>
<td>12-36</td>
<td>10-31</td>
<td></td>
</tr>
<tr>
<td>Cascade Range, OR</td>
<td>Mesic, Douglas-fir series</td>
<td>35-39</td>
<td>27-36</td>
<td>Olson and Agee 2005</td>
</tr>
<tr>
<td>Klamath Mountains, CA</td>
<td>Mesic, Douglas-fir series</td>
<td>16-42</td>
<td>7-13</td>
<td>Skinner 1997</td>
</tr>
<tr>
<td><strong>Mesic Forest Type Average</strong></td>
<td></td>
<td>26-41</td>
<td>17-25</td>
<td></td>
</tr>
</tbody>
</table>

Riparian Areas and Local Fire Regimes

1. Burn like adjacent uplands; i.e. wildfires burn with similar frequency & severity;

2. Burn less frequently and/or less severely than adjacent uplands;

3. Burn more frequently and/or severely than adjacent uplands;

4. Riparian serve as fire breaks.
Some Riparian Areas Burn Like Uplands

Where similar upland-streamside vegetation, moisture conditions, terrain & topography occur.

- Small drainages, intermittent or ephemeral streams;
- Headwaters; upper portions of narrow drainages.

When large fires burning under severe fire weather exceed the influence of local topography & riparian-upland vegetation differences.
Some Riparian Areas Burn Like Uplands

Riparian vs. Upland Fire Severity

(Halofsky and Hibbs 2008; slide by Alan Tepley)
Some Riparian Areas Burn Less Frequently and/or Less Severely than Uplands

- Where riparian vegetation distinctly different from uplands;
- Where saturated soil conditions, presence of riparian wetlands, or hydrologic inputs from hillslopes influence fire behavior.
Steady flow, fish-bearing
Moderate flow, fish-bearing
Low flow, few fish

Variation in Fire Severity within the Stream Network

Biscuit Fire

<table>
<thead>
<tr>
<th>Plant Association</th>
<th>Basal Area Mortality (%)</th>
<th>Stream Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ponderosa Pine</td>
<td>Yellow</td>
<td>a</td>
</tr>
<tr>
<td>Dry Mixed Conifer</td>
<td>Green</td>
<td>b</td>
</tr>
<tr>
<td>Wet Mixed Conifer</td>
<td>Green</td>
<td>b</td>
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B & B Fire

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<th>Plant Association</th>
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(Halofsky and Hibbs 2008; slide by Alan Tepley)
Riparian Forests as Fire Refugia

Eastern Cascades, Washington (Camp et al. 1997)
Oldest trees most common in areas with high soil and fuel moisture, including stream confluences and valley bottoms.

Mount Rainier (Hemstrom and Franklin 1982)
“Nearly every major river valley contains a streamside old-growth corridor.”

Klamath Mountains (Skinner 2003)
Median fire intervals were nearly double in riparian areas compared to upland sites.
Riparian Areas Burn More Severely than Uplands

- Where riparian areas serve as chimneys or corridors for severe fire;
- Little vegetative difference from adjacent uplands;
- Intermittent stream valleys;
- Primarily south aspects;
- Upper portions of drainage networks.

Pyne et al. 1996. *Introduction to Wildland Fire*
Riparian Areas Burn More Frequently and/or More Severely than Adjacent Uplands

- **Where** fuel abundance / accumulation is higher in riparian areas than uplands due to management or natural conditions;
- Primarily south aspects;
- Middle to upper part of drainage network.

Agee 1998. The landscape ecology of western fire regimes. NW Science 72, 24-34.
“…dense stands of trees in the Angora SEZ likely contributed to the rapid spread upslope to Angora Ridge and across the slope to the base of Tahoe Mountain.” Murphy et al. 2007. USDA, R5-TO-025
Riparian Areas as Fire Breaks

- **Where** perennial stream valleys create breaks in fuel characteristics & continuity;
- **Where** saturated soil conditions, presence of riparian wetlands, or hydrologic inputs from hillslopes influence fire behavior;
- **When** fires burn with low intensity.
Post-fire processes and recovery

Wallowa Mountains, NE Oregon, 5 years after Teepee Butte Fire
Post-fire processes and recovery

Little Granite Creek
Bridger-Teton NF

Elevation: 6500’ – 7000’
Vegetation: Lodgepole Pine
Precipitation: 21”
Each LW piece (n ≈ 900) was tagged and tracked over time.
Each LW piece \((n \approx 900)\) was surveyed.
Post-fire Recruitment and Transport of Large Wood

Boulder Creek Reach 41 (BC41)

Severely burned
Relatively wide valley bottom
Forested riparian area

Perimeter of Boulder Creek Fire (2000)
Post-fire Recruitment and Transport of LW

Ryan and Dwire (in preparation)
Post-fire Recruitment and Transport of LW

Ryan and Dwire (in preparation)
LW Source Boulder Creek 2002 and 2008

Perimeter of Boulder Creek Fire (2000)

2002

- Unknown
- Riparian
- Hillslope
- Floated

Pieces of wood (number/100 m)

2008

- Downstream of Burn
- Moderately Burned
- Severely Burned
Post-fire recovery of riparian shrubs

Measured (3 sampling periods):
- Shrub height, width (volume)
- Basal and clonal resprouting
- Mortality
Post-fire recovery of riparian shrubs

Influence of herbivory on shrub growth

(x ± 1SE; height, crown area, crown volume).

Dwire et al. 2006. *JAWRA.*
New sprouts observed in transects:

<table>
<thead>
<tr>
<th>Species</th>
<th>Common Name</th>
<th>Sept 2002</th>
<th>June 2003</th>
<th>Sept 2003</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Rosa woodsii</em></td>
<td>Wood’s rose</td>
<td>13</td>
<td>22</td>
<td>12</td>
</tr>
<tr>
<td><em>Pachistima myrsinities</em></td>
<td>Mountain boxwood</td>
<td>16</td>
<td>4</td>
<td>13</td>
</tr>
<tr>
<td><em>Ribes lacustre</em></td>
<td>Black gooseberry</td>
<td>37</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td><em>Symphoricarpus alba</em></td>
<td>Snowberry</td>
<td>10</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td><em>Salix boothii</em></td>
<td>Booth’s willow</td>
<td>81</td>
<td>1</td>
<td>9</td>
</tr>
<tr>
<td><em>Amelanchier alnifolia</em></td>
<td>Serviceberry</td>
<td>35</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td><strong>All Species</strong></td>
<td></td>
<td>332</td>
<td>381 (+49)</td>
<td>439 (+58)</td>
</tr>
</tbody>
</table>
Sprout from Surviving Root Crown

*Salix wolfii*

*Salix boothii*

*Salix drummondiana*
Sprout from Surviving Root Crown

*Sheperdia canadensis*

*Lonicera involucrata*

*Ribes lacustre*

*Dasiphora fruticosa*

*Paxistima myrsinites*

*Amelanchier albnifolia*
Clonal - sprout from rhizomes, stem base, and surviving root crowns

*Symphoricarpos albus*

*Rosa woodsii*
Regenerate from seed following fire:

Wild hollyhocks
Iliamna rivularis
Caribou National Forest, Idaho

Ceanothus velutinus
Herbaceous: sprout from rhizomes, stem base, and surviving root crowns

Carex lenticularis

Carex aquatilis
Fire and Invasive Plants in Riparian Areas

Riparian areas are susceptible to invasion

- Stream networks = corridors for movement of propagules
- High resource availability
- Periodic flow-related disturbance creates habitat heterogeneity
- Human-caused disturbance (roads, flow alteration, grazing, proximity to existing nonnative plant populations)

Many riparian areas have been invaded

- Non-native woody species are as frequent and abundant as natives (Tamarisk, Russian olive; Friedman et al. 2005)
- Invasive herbaceous species are prevalent along many streams (Magee et al. 2008, Ringold et al. 2008)
- Invasives increase after fire (Jackson and Sullivan 2009)
Land Management Impacts on Fire in Riparian Areas

Fire Suppression
A Guide To Riparian Fuel Treatments in the Interior West (JFSP project)

Kate Dwire, Riparian Ecologist, RMRS, Fort Collins, CO
Kristen Meyer, Ecologist, BLM, Grand Junction, CO
Sandra Ryan, Geomorphologist, RMRS, Fort Collins, CO
Gregg Riegel, USFS Area Ecologist, Bend, OR
Tim Burton, Riparian Consultant, Boise, ID

1. Literature review: effects of fire and fuels treatments issues in riparian areas;
2. Survey: Completed and proposed riparian fuels projects;
3. Case Studies: Challenges and opportunities - closer look at 5 riparian fuel treatments;
Treatment Size:
- < 100 acres: 53%
- 100-300 acres: 40%
- > 300 acres: 20%

Treatment Target:
- Riparian areas: 47%
- Riparian areas included as part of larger project: 59%

Treatment Location:
- In wildland-urban interface: 75%
- Not in WU interface: 22%

Management Objectives:
- Single objective: 44%
- Multiple objective: 56%
- Primary objective = fuel reduction: 81%
- Primary objective = restoration/habitat improvement: 41%

Project Objectives and Effectiveness

a) Project Objectives

b) Effectiveness at Meeting Project Objectives
Riparian Vegetation Types

a) Completed Projects

Riparian Vegetation Types (% completed projects)

- willow
- cottonwood
- conifer
- upland shrub
- meadow

b) Proposed Projects

Riparian Vegetation Types (% proposed projects)

- dominant
- subdominant
- present
- not present
Treatment Methods

a) Treatment Methods

- Prescribed burn
- Mechanical thinning (chain saws)
- Mechanical thinning (heavy equipment)
- Scattering
- Pile burning
- Mastication
- Other

Post burning/ thinning

b) Treatment Combinations

- Single Method
- Two Methods
- Three Methods
- Four Methods
- Five Methods
- Six Methods

Number of Projects

- USFS
- BLM
- USFWS
- NPS
Constraints to Riparian Fuel Treatments

- Potential Litigation
- T & E Species
- Administrative Resources
- Resource Management Plans Standards
- Lack of Line Officer Support
- Lack of Agreement Among Specialists
- Other

Number of Respondents

- USFS
- BLM
- USFWS
- NPS
Summary:

► Fire properties, behavior and history in riparian areas: depends on context;

► Riparian areas and local fire regimes: depends on context;

► Postfire processes and recovery in riparian areas;
  - Large wood recruitment to streams; depends on location in stream network;
  - Recovery rates depend on fire severity; generally fast; species traits important.

► Fuel management treatments in riparian areas: best viewed as restoration projects.
Thank You!