Effectiveness and effects of mastication and other mechanical treatments on fuel structure in chaparral

Teresa J. Brennan
Dr. Jon E. Keeley

MEDECOS Meeting
October 7th, 2014
Olmue, Chile
Mastication and other Treatments Defined

**MASTICATION**

**CRUSHING**

**PRESCRIPTION BURNING**
Mastication – a mechanical fuel treatment that changes the structure and size of fuels. Vegetation is chopped, ground, or chipped and the resulting material is left on the soil surface.
Masticator – generally consists of a cutting attachment and a vehicle to which the cutter is attached.

**Choice of cutting attachment**
- Rotary disc
- Horizontal drum

**Self-leveling cab for steep terrain**
Aerial views of mechanical treatments

Corte Madera mastication spring 2008-2009
Cleveland national forest

Leona Divide crushing winter 2008-2009
Angeles national forest
It is clear that these treatments alter fuel structure but....

How do we quantify this change?

How long does the treatment last?

What are the ecological effects?
Primary Study Objectives

1) Determine fuel bed composition and structure following treatment.

2) Assess the long-term effectiveness of the treatment over time.

3) Assess the potential effects of treatments on plant recovery and community response.

4) Create a digital photo series of mechanical fuel treatments showing a range of fuel loads in treated chaparral.
Study Site Selection

Study sites were selected across all four southern California forests and stratified by treatment type, post-treatment year & vegetation type.
Study Site Locations

Los Padres National Forest
- 20 Treatments, 61 Study Sites

Angeles National Forest
- 11 Treatments, 33 Study Sites

San Bernardino National Forest
- 33 Treatments, 77 Study Sites

Cleveland National Forest
- 25 Treatments, 61 Study Sites
**Study Site Design & Methodology**

**Fuel and vegetation surveys in treatments.**

**Treatment survey design**

- 10 m
- 20 m
- 30 m
- 40 m
- 50 m
- 60 m
- 70 m
- 80 m
- 90 m
- 100 m

**Control survey design**

- 10 m
- 20 m
- 30 m
- 40 m
- 50 m
- 60 m
- 70 m
- 80 m
- 90 m
- 100 m

**Vegetation surveys in controls**

**Stem samples from controls to determine pre-treatment age**

Objectives 1 & 2. Fuel bed structure and composition following treatment & the effectiveness over time.

Analyzed fuel load by looking at 4 main components.

- Live woody fuels
- Live herbaceous fuels
- Dead herbaceous fuels & litter
- Downed woody fuels (treatment debris)
Downed woody fuels

Significant decrease in cover, depth, and mass over time as was expected due to decomposition.

Comparison to Control

*Control mass estimated from FCCS models*

- Year 1 – treatment mass 2.25 > control mass
- Year 4 – treatment mass = control mass
- Year 8 – treatment mass .5 of control mass
Live woody fuels

Significant increase in cover, height, and mass over time.

Comparison to Control

By post treatment years 4-5 both mass and height are at ½ of the control mass and height.

Longevity of treatment is determined by the re-growth of woody vegetation.
Herbaceous fuels

- Not a significant decrease in live herbaceous mass over time.
- Significant increase in dead herbaceous mass over time

Comparison to Control

Live herbaceous cover
- 3-10% in controls
- 12-25% in treatments
- 1-4.5 times the cover in controls
Comparison by treatment type

- Fuel reduction was greatest for mastication plus burning
- Crushing treatments had the lowest fuel reduction
- Re-masticated treatments initially had more reduction in fuels but over time showed an increase
- Mastication treatments had the greatest increase in herbaceous fuels
Objective 3. Potential effects of treatments on plant recovery, community response, and soil disturbance.

Concerns of resource managers:

- Soil compaction
- Soil erosion and riling
- Soil equipment disturbance
- Increased OHV use/disturbance
- Habitat loss
- Exotic species
- Type conversion
Community composition and exotics

**Mastication**

<table>
<thead>
<tr>
<th>Years since treatment</th>
<th>Control</th>
<th>1-2</th>
<th>3-4</th>
<th>5-6</th>
<th>7-8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relative percent cover (%)</td>
<td>Exotic</td>
<td>Annual</td>
<td>Perennial</td>
<td>Shrub</td>
<td></td>
</tr>
</tbody>
</table>

**Crushing**

<table>
<thead>
<tr>
<th>Years since treatment</th>
<th>Control</th>
<th>2</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relative percent cover (%)</td>
<td>Exotic</td>
<td>Annual</td>
<td>Perennial</td>
</tr>
</tbody>
</table>

**Re-mastication**

<table>
<thead>
<tr>
<th>Years since treatment</th>
<th>Control</th>
<th>1</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relative percent cover (%)</td>
<td>Exotic</td>
<td>Annual</td>
<td>Perennial</td>
<td>Shrub</td>
</tr>
</tbody>
</table>

**Mastication plus burning**

<table>
<thead>
<tr>
<th>Years since treatment</th>
<th>Control</th>
<th>1</th>
<th>2</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relative percent cover (%)</td>
<td>Exotic</td>
<td>Annual</td>
<td>Perennial</td>
<td>Shrub</td>
</tr>
</tbody>
</table>
Objective 4. Create a digital photo series of mechanical fuel treatments in chaparral.

Management tool that can be used to quickly assess fuel loading in treatments

Photos from over 40 sites in various vegetation types
Vegetation Classes:
- Adenostoma dominated chaparral
- Arctostaphylos dominated chaparral
- Ceanothus dominated chaparral
- Quercus dominated chaparral
- Lower montane chaparral mix

Fuel loads:
- Range from 11-90 Mg/ha (5-40 tons/acre)
Will be available for resource managers online at the California Fire Science Consortium website and at the Digital Photo Series website in the near future.

http://www.cafiresci.org

http://depts.washington.edu/nwfire/dps/
Take home message

**The good**

Initial treatment reduces canopy height and live-woody cover by two-thirds, while concentrating downed-woody fuels at the surface.

**The bad**

Treatment longevity is short-term in chaparral dominated landscapes due to the re-sprouting capability of many shrub species.

Follow-up treatments increase herbaceous fuels and exotic species which increases the potential for type conversion.

**The ugly**

Increases in herbaceous annual plants = increased ignition potential!
Special Thanks to

Joint Fire Science Program & USDA Forest Service

2011 Field Crew
Chelsea Morgan, Callen Huff, Graydon Dill & Richard Mansfield

2012 Field Crew
Chelsea Morgan, Callen Huff, Warren Reed & Anthony Baniaga
Comparison of downed woody fuel load by treatment type

Mastication

Proportion of total fuel load by fuel class did not change significantly over time for mastication or other treatments

All treatments

There were significant differences in the proportions of fuel load by fuel class between treatment types
Vegetation Survey

- Percent cover & density for each species within 1 m² nested subplots
- Average height & percent cover within 2 m² nested subplot
- List additional species within the 10 m² subplot
- Stem samples were taken from obligate seeding species within the control to determine stand age at time of treatment

Corte Madera mastication spring 2009, Rx fall 2011
**Fuel & Cover Surveys**

Percent cover values 10 m²

- treatment debris
- rock
- untreated shrubs
- rilling/erosion
- standing dead fuels
- rodent activity
- herbaceous fuels
- equipment disturbance
- live woody fuels
- OHV disturbance
- bare ground
- other

All fuels surveyed within a ½ m² pvc frame

Depth/height recorded

All Fuels within the frame collected & separated by class, then weighed

- Live woody fuels
- Downed & treated fuels
- Litter & herbaceous fuels
- Fuel moisture