The Feasibility of Chaparral Restoration on Type-converted Slopes

MEGAN ENGEL
KIMBERLYN WILLIAMS
CHRISTOPHER MCDONALD
JAN BEYERS
Introduction to the Project

• This study is being conducted in the San Timoteo Canyon on an Ecological Preserve owned by the Riverside Land Conservancy

• Historically this area had been used for rangelands.

• 1930s imagery indicates that the slopes had once been chaparral.
1938 Aerial Imagery Comparison to 2013 Aerial Imagery
(For the same locality south of Live Oak Canyon Road)
Objectives

- Compare the effectiveness of a broad-spectrum herbicide against a grass-specific herbicide
- Assess the difference between seeding and planting seedlings as a mode of restoration and which is more effective
- Analyze the seed bank of the research area to see if a relict seed bank that could possibly be used for restoration
Study Area
## Plot Design

<table>
<thead>
<tr>
<th>Treatment</th>
<th>No treatment</th>
<th>Smoke Water Application</th>
<th>Seeding</th>
<th>Planting</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Herbicide</td>
<td>Control</td>
<td>Control</td>
<td>Control</td>
<td>Control</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>SW</td>
<td>Seeding</td>
<td>Planting</td>
</tr>
<tr>
<td>Fusilade</td>
<td>Fusilade</td>
<td>Fusilade</td>
<td>Fusilade</td>
<td>Fusilade</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>SW</td>
<td>Seeding</td>
<td>Planting</td>
</tr>
<tr>
<td>Glyphosate + Fusilade follow up</td>
<td>Gly + Fus</td>
<td>Gly + Fus</td>
<td>Gly + Fus</td>
<td>Gly + Fus</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>SW</td>
<td>Seeding</td>
<td>Planting</td>
</tr>
</tbody>
</table>
Planting and Maintenance

- 4 different species were purchased:
  - *Adenostoma fasciculatum*
  - *Eriogonum fasciculatum*
  - *Quercus berberidifolia*
  - *Rhus ovata*

- Control and Fusilade plots were planted 20 Dec 2012, and Glyphosate + Fusilade follow-up plots were planted on 30 Jan 2013.
Seeding

The following species were purchased for seeding treatment:

- *Artemisia californica*
- *Adenostoma fasciculatum*
- *Eriogonum fasciculatum*
- *Gutierrezia sarothrae*
- *Quercus berberidifolia*
- *Rhus ovata*
- *Rhus trilobata*

*Seeding was unsuccessful*
Transplant Success

Control plot

Glyphosate + Fusilade follow-up plot
Survivorship of Transplants

Percent Survivorship of Transplants

- Glyphosate applied
- Fusilade applied

- No Herbicide
- Fusilade
- Glyphosate + Fusilade follow-up

Timeline:
- 7-Jan
- 22-Jan
- 6-Feb
- 21-Feb
- 8-Mar
- 23-Mar
- 7-Apr
- 22-Apr
- 7-May
Flowering Plants in Glyphosate + Fusilade follow-up Plots

*Adenostoma fasciculatum* in flower  *Eriogonum fasciculatum* in flower
Live Plant Canopy Volume

Eriogonum fasciculatum

Adenostoma fasciculatum

Quercus berberidifolia

Rhus ovata

Graphs showing live plant canopy volume (m³) for different species and treatments over time from 7-Jan to 7-May.

- No Herbicide
- Fusilade Only
- Glyphosate + Fusilade Follow-up
Soil Moisture

Sample Depth increments:
- 0-5 cm
- 5-15 cm
- 15-35 cm

<table>
<thead>
<tr>
<th>Treatment</th>
<th>No treatment</th>
<th>Smoke Water Application</th>
<th>Seeding</th>
<th>Planting</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Herbicide</td>
<td>Control</td>
<td>Control SW</td>
<td>Control</td>
<td>Control Planting</td>
</tr>
<tr>
<td>Fusilade</td>
<td>Fusilade</td>
<td>Fusilade SW</td>
<td>Fusilade</td>
<td>Fusilade Planting</td>
</tr>
<tr>
<td>Glyphosate + Fusilade follow up</td>
<td>Gly + Fus</td>
<td>Gly + Fus SW</td>
<td>Gly + Fus</td>
<td>Gly + Fus Planting</td>
</tr>
</tbody>
</table>


Soil Moisture Results

No Irrigation (not planted)

With Irrigation (planted plots)
Partial Summary

- The Glyphosate + Fusilade follow-up treatment promoted survival, growth and flowering of shrub seedlings
- Fusilade-only treatment was not effective
- Soil moisture content of the Glyphosate + Fusilade follow-up treated plots was higher
Is There a Relict Native Seed Bank on the Site?

- The soil was spread into flats, and 4 different treatments were applied:
  - no treatment
  - smoke water
  - smoke water + heat
  - gibberellic acid.

- Plants were then transplanted and keyed.
Seed-Bank Results

Native Species in plots that did not come up in the seed-bank Study:

- *Calochortus plummerae*
- *Dichelostemma capitatum*

<table>
<thead>
<tr>
<th>Species</th>
<th>Total Number of Seedlings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bromus diandrus</td>
<td>120</td>
</tr>
<tr>
<td>Schismus barbatus</td>
<td>100</td>
</tr>
<tr>
<td>Croton setigerus</td>
<td>80</td>
</tr>
<tr>
<td>Amsinckia menziesii</td>
<td>60</td>
</tr>
<tr>
<td>Hirschfeldia incana</td>
<td>40</td>
</tr>
<tr>
<td>Gnaphalium sp.</td>
<td>20</td>
</tr>
<tr>
<td>Eradatum citrarium</td>
<td>10</td>
</tr>
<tr>
<td>Emmananthée ?</td>
<td>8</td>
</tr>
<tr>
<td>Calandrinia ciliata</td>
<td>6</td>
</tr>
<tr>
<td>Centaurea melitensis</td>
<td>4</td>
</tr>
<tr>
<td>Eryngium fasciculatum</td>
<td>2</td>
</tr>
<tr>
<td>Eucrypta chrysanthenifolia</td>
<td>1</td>
</tr>
<tr>
<td>Astragalus didymocarpus var.</td>
<td>1</td>
</tr>
<tr>
<td>Eriogonum fasciculatum</td>
<td>1</td>
</tr>
</tbody>
</table>

Weedy Non-Natives
Weedy Natives
Other Native Herbs
Native Shrubs
Summary

- Glyphosate + Fusilade follow-up was most effective.
- Plant growth and survivorship in the plots with the Glyphosate + Fusilade follow-up treatment was more effective than non herbicide plots.
- Seeding was unsuccessful, and planting was successful in those plots that were treated with the Glyphosate + Fusilade follow-up.
- On this site, the relict seed bank was minor and may be insufficient to assist in restoration.
Acknowledgements

- US Forest Service
- Jan Beyers, PSW Research Station
- Kimberlyn Williams, CSUSB
- Christopher McDonalnd, UCANR
- Riverside Land Conservancy
- Riverside-Corona Resource Conservation District
- Wild California
- Rancho Santa Ana Botanic Garden
- RECON Native Plants
- Richard Perrette, Dan Engel, Larry Westrick, Lindsey Schultze, and Cathrine Lytle