When and Where to Seed?

Effects of Sowing Time and Relative Prairie Quality on First Year Establishment of 23 Native Prairie Species.

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Washington D.C.
History of South Puget Sound Prairies

- Created by glaciers
- Native Americans maintained prairies using fire
- Part of a highly imperiled eco-region

(Hamman et al., 2011)
Importance of South Puget Sound Prairies

- 4 ESA listed species
- Various ecosystem services
- Only about 3% left
Role of JBLM Fish & Wildlife

- The program mission is to protect, maintain, and enhance the various ecosystems on the installation to promote native biodiversity and support the military mission.
- ~90,000 acres total
  - ~18,000 acres grassland, prairie, and savanna
  - ~11,000 acres Priority Habitat
- Highest quality and largest remnant native prairie in South Puget Sound
Restoration of South Puget Sound Prairies

- Restoration requires huge investments of time and resources (Frischie and Rowe, 2012)

- 1 Plug costs about $3 (Dunwiddie and Martin, 2015)

- 1,000 Seeds cost about $0.30 (Dunwiddie and Martin, 2015)

- Seeds have extremely low establishment rates, typically <5% (J. Hamman unpublished data)
Research Question

- Does **temporal variation** of seed sowing or **relative prairie quality** affect the first year establishment of 23 native prairie species?

- Hypotheses:
  - Earlier (fall) sowings will have higher establishment
  - Higher quality prairie will have higher establishment
## Methods - Species Selection

- Used best available science to calculate seed mix
- 23 species
  - 21 genera
  - 13 families
  - 3 functional groups

<table>
<thead>
<tr>
<th>Scientific Name</th>
<th>Common Name</th>
<th>Family</th>
</tr>
</thead>
<tbody>
<tr>
<td>Achillea millefolium</td>
<td>yarrow</td>
<td>Asteraceae</td>
</tr>
<tr>
<td>Armeria maritima</td>
<td>sea thrift or sea pink</td>
<td>Plumbaginaceae</td>
</tr>
<tr>
<td>Balsamorhiza deltoidea</td>
<td>deltoid balsamroot</td>
<td>Asteraceae</td>
</tr>
<tr>
<td>Cerastium arvense</td>
<td>field chickweed</td>
<td>Caryophyllaceae</td>
</tr>
<tr>
<td>Clarkia amoena</td>
<td>farewell to spring</td>
<td>Onagraceae</td>
</tr>
<tr>
<td>Collinsia grandiflora</td>
<td>giant Blue-eyed Mary</td>
<td>Plantaginaceae</td>
</tr>
<tr>
<td>Collinsia parviflora</td>
<td>blue-eyed Mary</td>
<td>Plantaginaceae</td>
</tr>
<tr>
<td>Danthonia californica</td>
<td>California oatgrass</td>
<td>Poaceae</td>
</tr>
<tr>
<td>Eriophyllum lanatum</td>
<td>woolly sunflower or Oregon sunshine</td>
<td>Asteraceae</td>
</tr>
<tr>
<td>Erigeron speciosus</td>
<td>aspen fleabane</td>
<td>Asteraceae</td>
</tr>
<tr>
<td>Festuca roemeri</td>
<td>Roemer's fescue</td>
<td>Poaceae</td>
</tr>
<tr>
<td>Koeleria macrantha</td>
<td>prairie Junegrass</td>
<td>Poaceae</td>
</tr>
<tr>
<td>Lomatium utriculatum</td>
<td>spring gold or common lomatium</td>
<td>Apiaceae</td>
</tr>
<tr>
<td>Lupinus albicaulis</td>
<td>sicklekeel lupine</td>
<td>Fabaceae</td>
</tr>
<tr>
<td>Lupinus bicolor</td>
<td>miniature lupine</td>
<td>Fabaceae</td>
</tr>
<tr>
<td>Microseris laciniata</td>
<td>cutleaf silverpuffs</td>
<td>Asteraceae</td>
</tr>
<tr>
<td>Plectritis congesta</td>
<td>slender cinquefoil</td>
<td>Valerianaceae</td>
</tr>
<tr>
<td>Potentilla gracilis</td>
<td>slender cinquefoil</td>
<td>Rosaceae</td>
</tr>
<tr>
<td>Ranunculus occidentalis</td>
<td>western buttercup</td>
<td>Ranunculaceae</td>
</tr>
<tr>
<td>Sericocarpus rigidus</td>
<td>white-topped aster</td>
<td>Asteraceae</td>
</tr>
<tr>
<td>Sisyrinchium idahoense</td>
<td>Idaho blue-eyed grass</td>
<td>Iridaceae</td>
</tr>
<tr>
<td>Solidago simplex</td>
<td>sticky goldenrod or Mt. Albert goldenrod</td>
<td>Asteraceae</td>
</tr>
<tr>
<td>Viola adunca</td>
<td>Early blue violet</td>
<td>Violaceae</td>
</tr>
</tbody>
</table>
3 Perennial Grasses

15 Perennial Forbs

5 Annual Forbs

All photos except Festuca roemerii taken by Rod Gilbert
3 Perennial Grasses

15 Perennial Forbs

5 Annual Forbs

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3 Perennial Grasses

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Methods - Site Selection

- Three sites selected in 2014 prescribed burn areas
  - High Quality Prairie*
  - Medium Quality Prairie*
  - Low Quality Prairie*

*Quality is relative
Methods

- Three replicates per prairie
- Hand raking and seed mix sowing
  - September 29, 2014
  - October 29, 2014
  - December 17, 2014
  - March 16, 2015
- Data collection: May-June 2015
- Data analysis:
  - General Linear Model and post-hoc Steel-Dwass multiple comparisons in JMP
  - Shannon’s Diversity Index in Excel
12 of 23 species were found in at least one control plot
Results

- Species analyzed independently
- Each shows a unique pattern

**Plectritis congesta**

<table>
<thead>
<tr>
<th>Sowing Time</th>
<th>Control</th>
<th>September</th>
<th>October</th>
<th>December</th>
<th>March</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
<td>B</td>
<td>C</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Mean count (plants/3m²)

- **Sowing time** $p < 0.0001$
- **Site quality** $p < 0.39$

Photo by Rod Gilbert
3 Perennial Grasses

1/15 Perennial Forbs

4 species influenced by sowing time

4/5 Annual Forbs

All photos except Festuca roemerli taken by Rod Gilbert
1/3 Perennial Grasses

3/15 Perennial Forbs

0/5 Annual Forbs

4 species influenced by relative prairie quality

All photos except Festuca roemeri taken by Rod Gilbert
5 species were not influenced by either sowing time or relative prairie quality

All photos except Festuca roemerii taken by Rod Gilbert
0/3 Perennial Grasses

8/15 Perennial Forbs

1/5 Annual Forbs

9 species were excluded from analysis

All photos except Festuca roemeri taken by Rod Gilbert
0/3 Perennial Grasses

8/15 Perennial Forbs

1/5 Annual Forbs

9 species were excluded from analysis, of those, 3 species were not found at all.

All photos except Festuca roemeri taken by Rod Gilbert.
3 Perennial Grasses

- 4 species influenced by relative prairie quality
- 5 species were not influenced by either sowing time or relative prairie quality

15 Perennial Forbs

- 4 species influenced by sowing time
- 5 species were not influenced by either sowing time or relative prairie quality
- 9 species were excluded from analysis, of those, 3 species were not found at all

5 Annual Forbs

All photos except Festuca roemeri taken by Rod Gilbert
## Results: Species

<table>
<thead>
<tr>
<th>Seed Sowing Time</th>
<th>Relative Prairie Quality</th>
<th>Both</th>
<th>Neither</th>
<th>Not analyzed-too few plants</th>
<th>Not analyzed-no plants found</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collinsia spp.*</td>
<td>Achillea millefolium**</td>
<td>None</td>
<td>Cerastium arvense</td>
<td>Balsamorhiza deltoidea</td>
<td>Armeria maritima</td>
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<td></td>
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<td></td>
</tr>
</tbody>
</table>

4/22 = 18% 18% 0% 23% 27% 14%

* Supports Priority Effects/Neutral Theory (earlier sowing times are better)
** Supports Ecological Filtering/Niche Theory (higher quality prairies are better)
Results: Community

- All 22 sown species included in analysis of richness and abundance
- Suggests seed limitation

![Shannon-Wiener Diversity Index](chart.png)

Photo by Rod Gilbert
Conclusions

- Does temporal variation of seed sowing or relative prairie quality affect the first year establishment of 23 native prairie species?
  - Yes, sowing time affects 4 species
    - earlier (fall) sowing typically has higher establishment
  - Yes, relative prairie quality affects 4 different species
    - higher quality prairie typically has higher establishment
Take home messages

- **When to seed:**
  - Timing of seed sowing is important
  - Try matching seed sowing to natural plant life cycles if possible
  - Consider storing seed until following year

- **Where to seed:**
  - Match the seed to the site
  - Try to be flexible with species/site selection
  - Consider using cheap seeds (generalist species and annuals) in low quality sites, expensive seeds in higher quality

- More research is needed, of course!
Acknowledgements

- Center for Natural Lands Management
- JBLM Fish and Wildlife
- The Evergreen State College Masters of Environmental Studies
- Institute for Applied Ecology
- Many others
Key sources


Questions?

Please feel free to contact me with comments/questions:

Sarah.L.Krock@gmail.com
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This and additional presentations available at http://nativeseed.info