

When and Where to Seed?

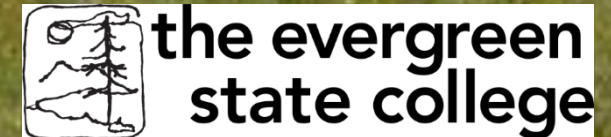
Effects of Sowing Time and Relative
Prairie Quality on First Year Establishment
of 23 Native Prairie Species.

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1,2

History of South Puget Sound Prairies

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

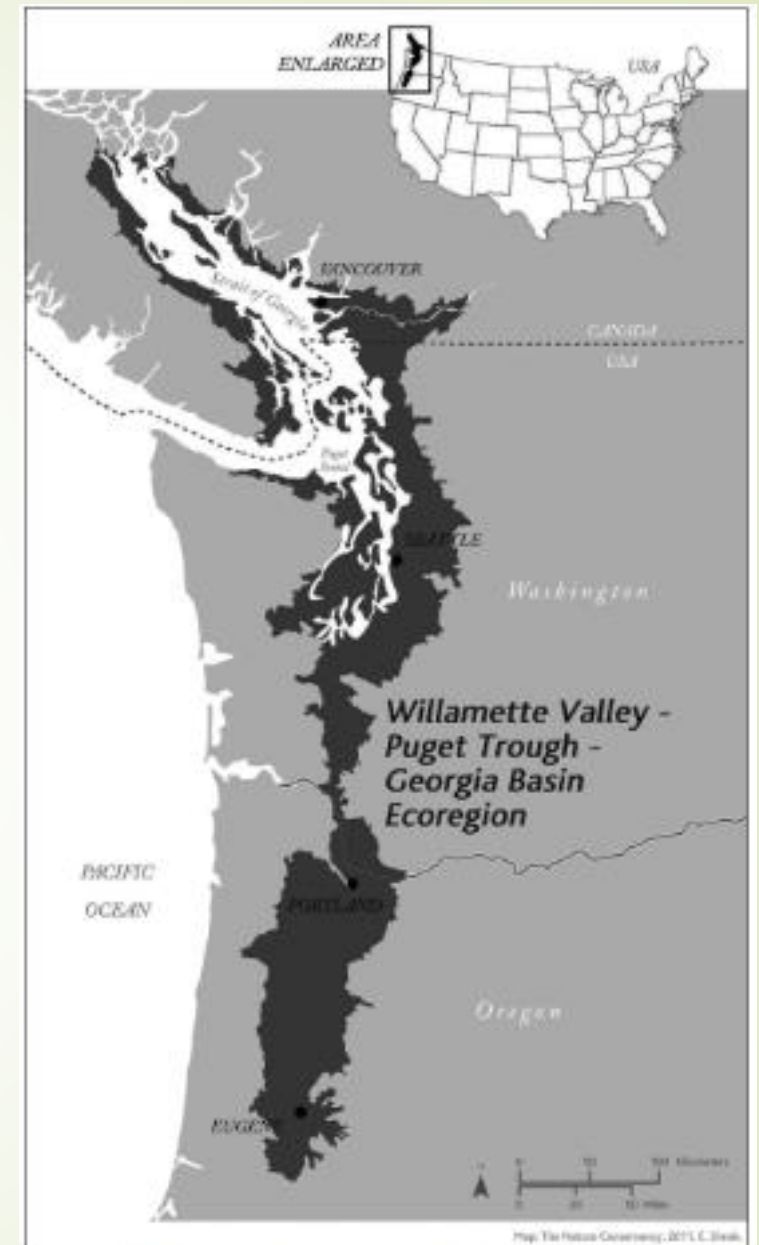


Figure 1. The focus area of this paper is the Willamette Valley – Puget Trough – Georgia Basin Ecoregion, defined by its distinct climate, geology and native species.

Importance of South Puget Sound Prairies

- 4 ESA listed species
- Various ecosystem services
- Only about 3% left



Photo: CNLM



Photo: WDFW



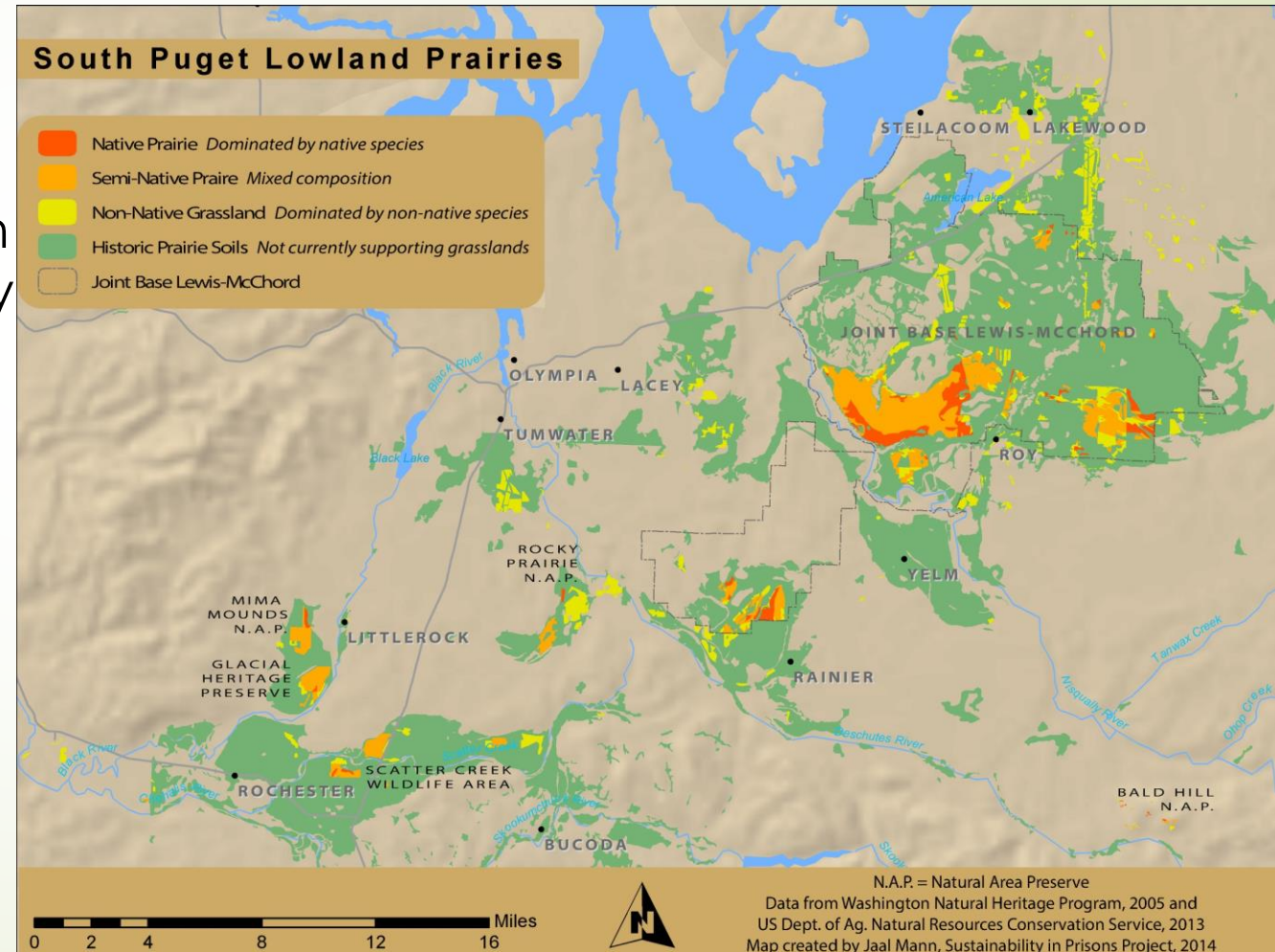
Photo: Thurston County



Photo: Thurston County

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5% (S. Hamman unpublished data)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

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

3 Perennial Grasses

15 Perennial Forbs

5 Annual Forbs



3 Perennial Grasses



15 Perennial Forbs



5 Annual Forbs

3 Perennial Grasses



15 Perennial Forbs



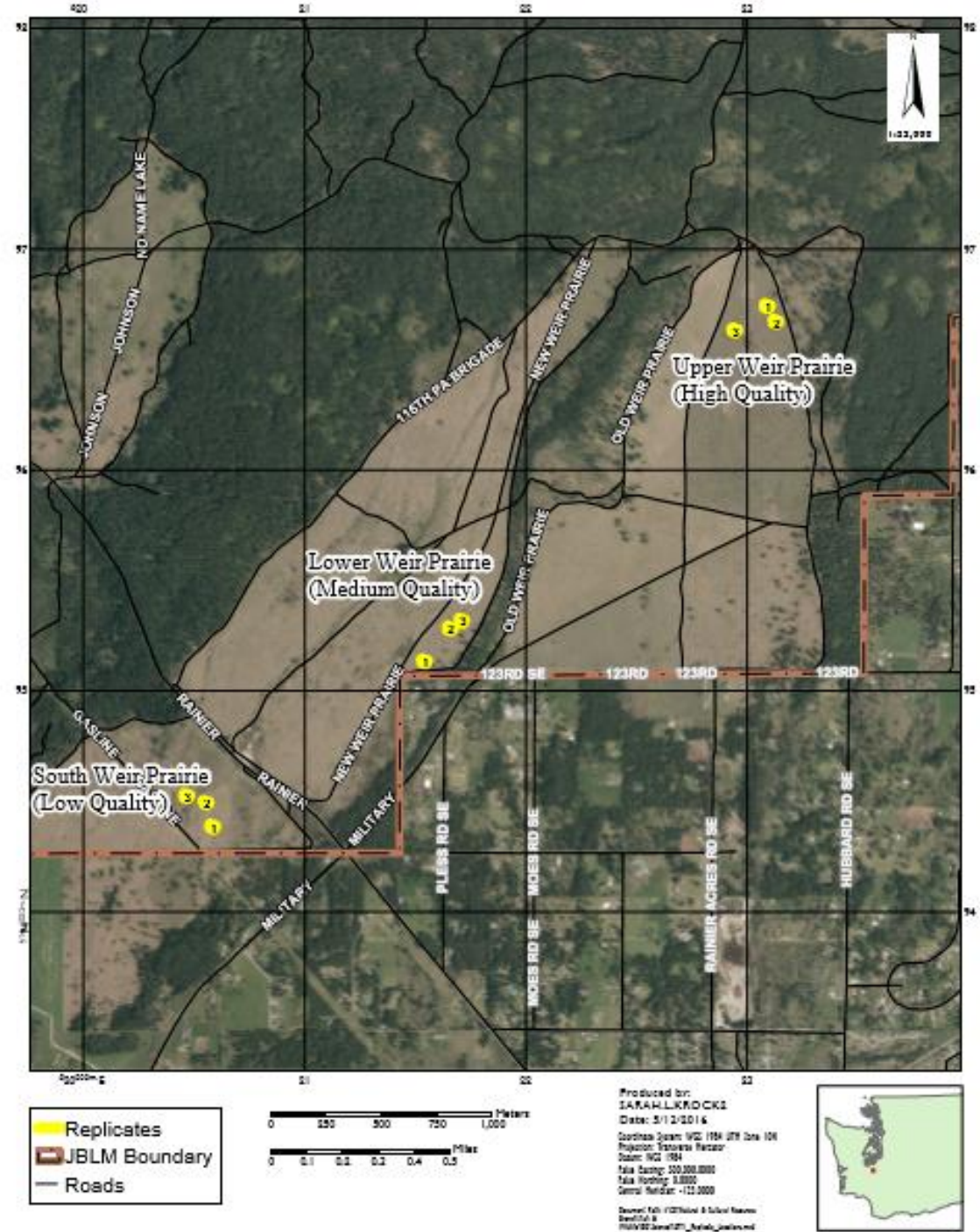
5 Annual Forbs



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



3/3 Perennial Grasses



8/15 Perennial Forbs



12 of 23 species
were found in
at least one
control plot

1/5 Annual Forbs

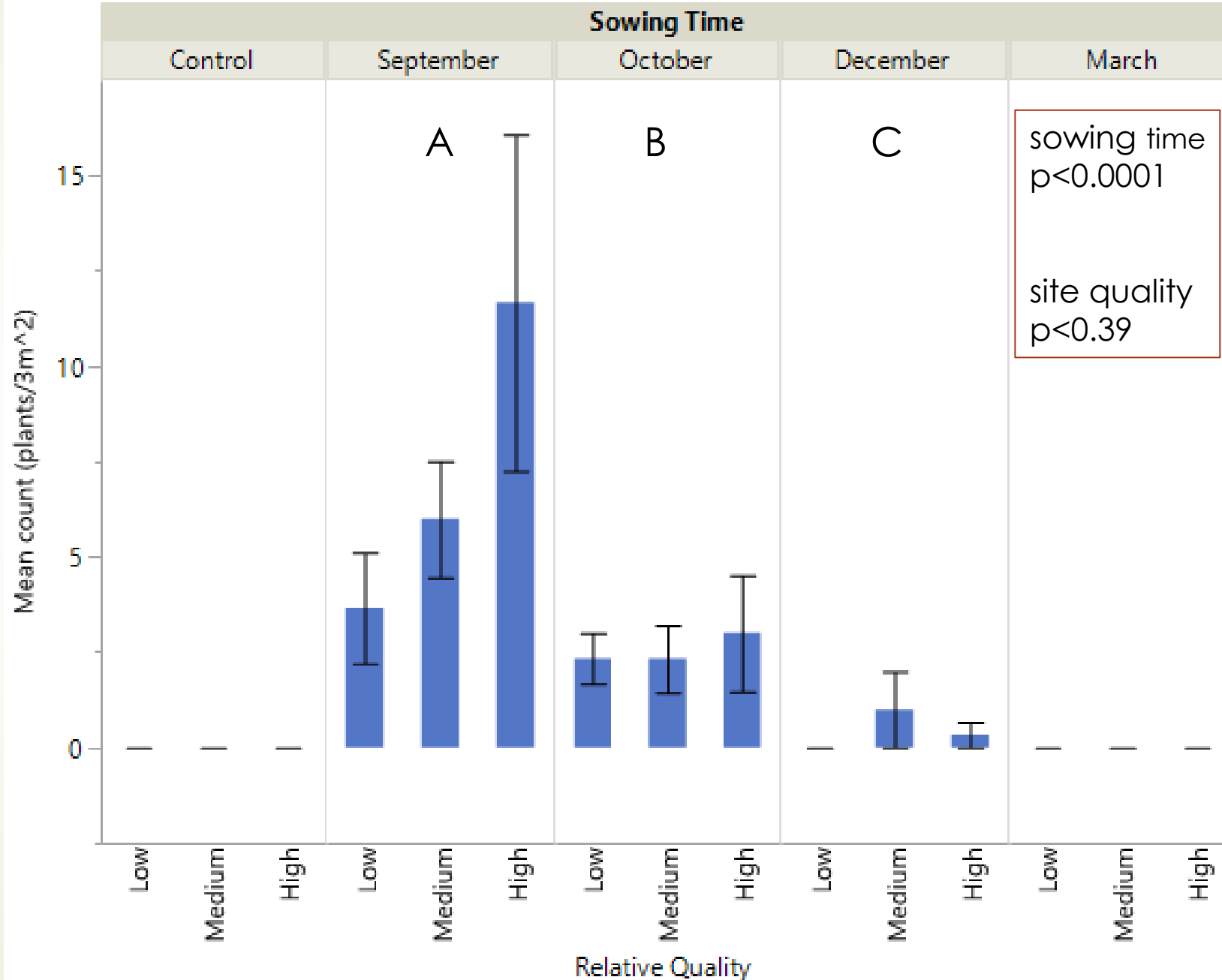


Results

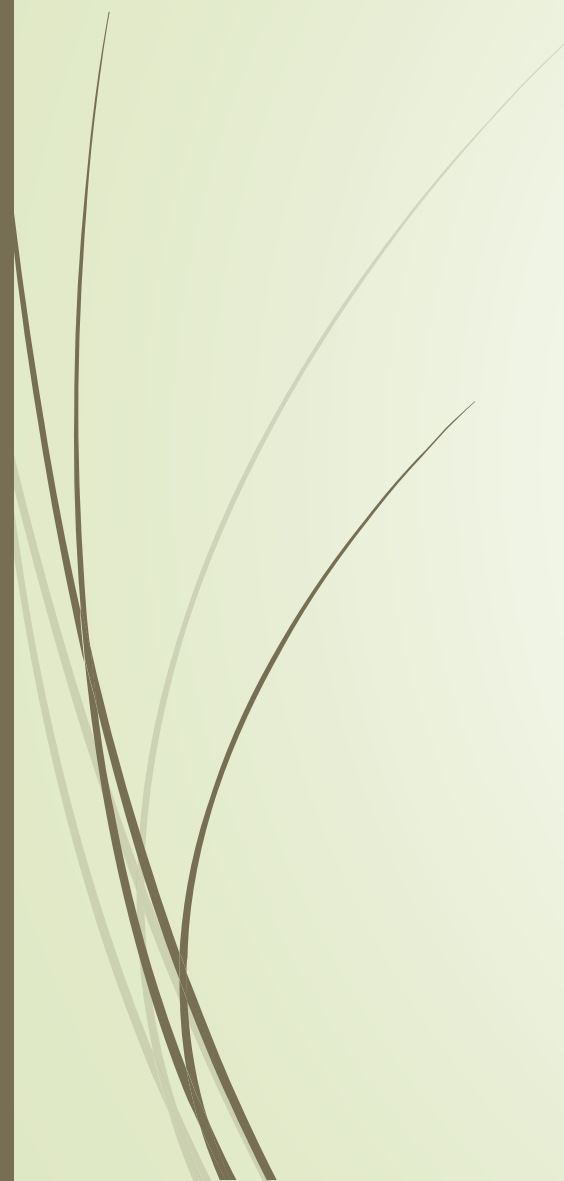
- Species analyzed independently
- Each shows a unique pattern



Plectritis congesta



3 Perennial Grasses



1/15 Perennial Forbs

4/5 Annual Forbs



4 species
influenced by
sowing time

1/3 Perennial Grasses

3/15 Perennial Forbs

0/5 Annual Forbs

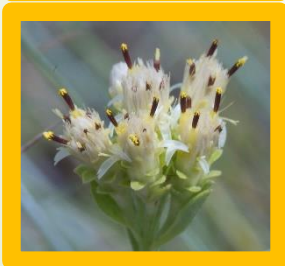


4 species
influenced by
relative prairie
quality

2/3 Perennial Grasses

3/15 Perennial Forbs

0/5 Annual Forbs

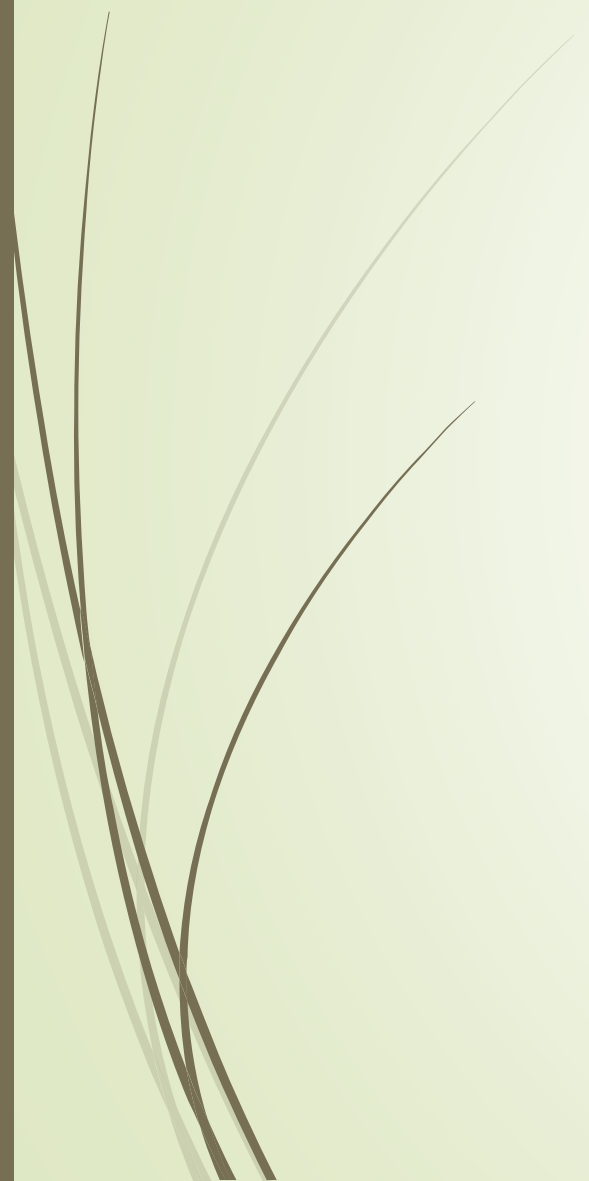


5 species were not influenced by either sowing time or relative prairie quality

0/3 Perennial Grasses

8/15 Perennial Forbs

1/5 Annual Forbs



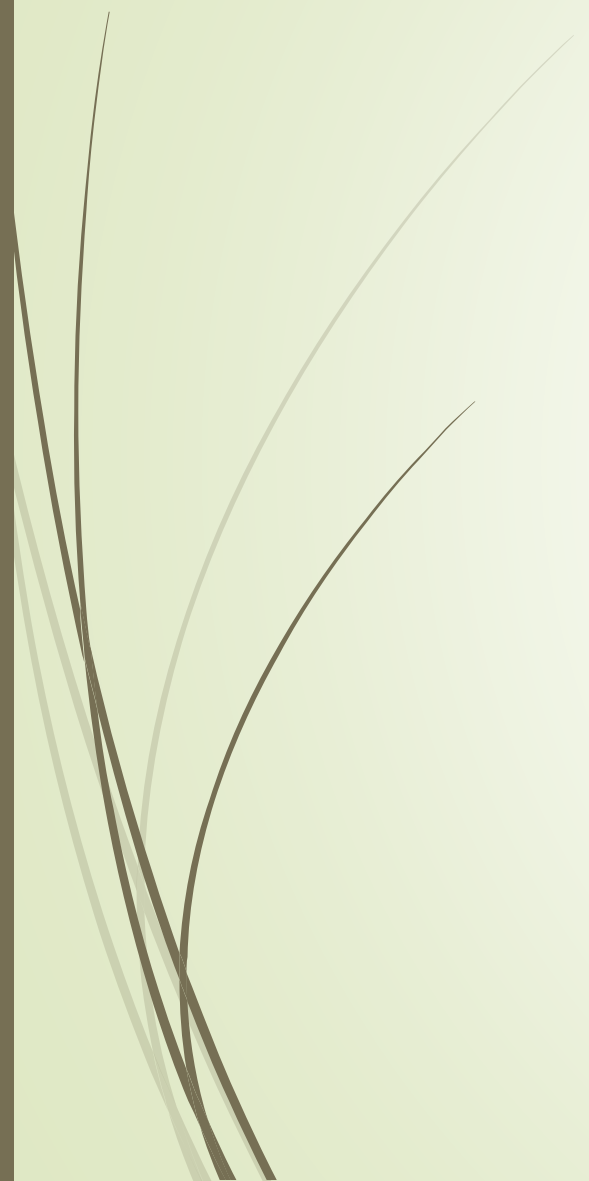
9 species were excluded from analysis



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



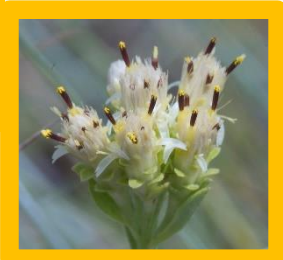
3 Perennial Grasses



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 Annual Forbs



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

All photos except *Festuca roemerii* taken by Rod Gilbert

Results: Species

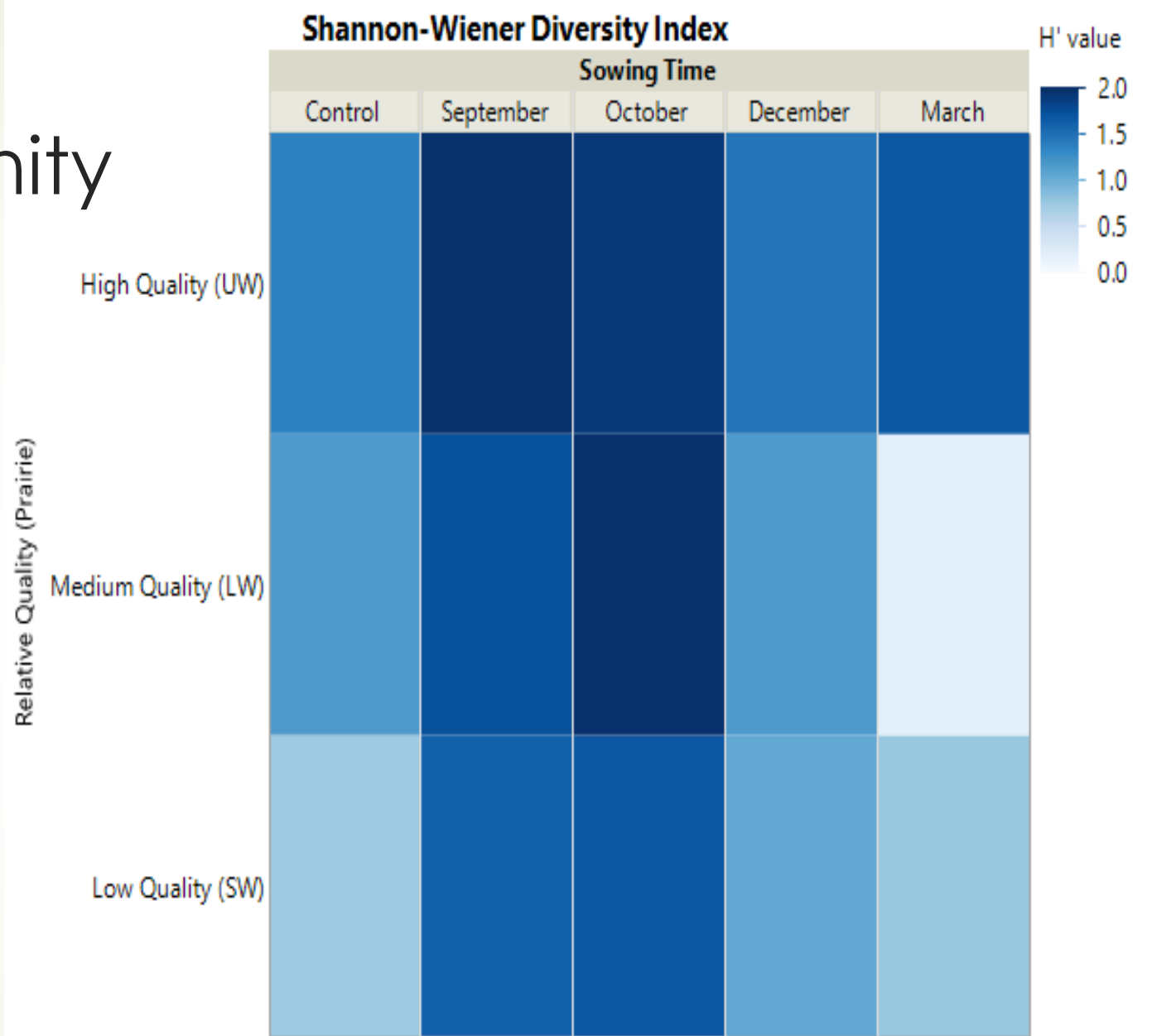
Seed Sowing Time	Relative Prairie Quality	Both	Neither	Not analyzed- too few plants	Not analyzed- no plants found
<i>Collinsia</i> spp.*	<i>Achillea millefolium</i> **	None	<i>Cerastium arvense</i>	<i>Balsamorhiza deltoidea</i>	<i>Armeria maritima</i>
<i>Lupinus abicaulis</i> *	<i>Danthonia californica</i> **		<i>Festuca roemerii</i>	<i>Clarkia amoena</i>	<i>Solidago simplex</i>
<i>Lupinus bicolor</i>	<i>Eriophyllum lanatum</i>		<i>Koeleria macrantha</i>	<i>Erigeron speciosus</i>	<i>Viola adunca</i>
<i>Plectritis congesta</i> *	<i>Ranunculus occidentalis</i> **		<i>Microseris laciniata</i>	<i>Lomatium utriculatum</i>	
			<i>Sericocarpus rigidus</i>	<i>Potentilla gracilis</i>	
				<i>Sisyrinchium idahoense</i>	
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





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



Photo by Rod Gilbert

- Dunwiddie, P. W., & Martin, R. A. (2016). Microsites Matter: Improving the Success of Rare Species Reintroductions. *Plos One*, *11*(3), e0150417. <http://doi.org/10.1371/journal.pone.0150417>
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- Martin, L. M., & Wilsey, B. J. (2012). Assembly history alters alpha and beta diversity, exotic-native proportions and functioning of restored prairie plant communities. *Journal of Applied Ecology*, *49*(6), 1436–1445. <http://doi.org/10.1111/j.1365-2664.2012.02202.x>

Questions?



Please feel free to contact me
with comments/questions:

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