



RE-ESTABLISHMENT OF WYOMING BIG SAGEBRUSH USING CONTAINER GROWN SEEDLINGS

UW Department of Ecosystem Science & Management

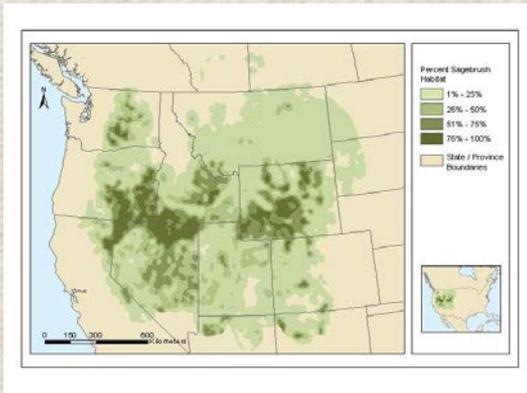
Advisor: Pete Stahl

Graduate Student: Casey Balthrop



BACKGROUND

- Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*) is a keystone species to much of the western United States
- Once encompassing over 60 million ha (148 million acres) and among the largest remaining intact vegetation types
- Large portions have disappeared over the past century

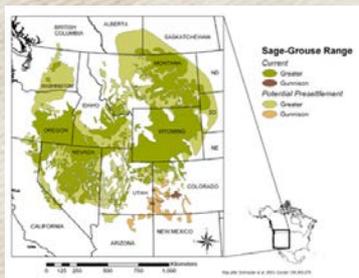




BACKGROUND



- Habitat to some of our favorite Rocky Mountain megafauna
However...
- The Greater Sage-Grouse (*Centrocercus urophasianus*) is one obligate species of **particular concern**
 - Comprises 99% of their winter diet as well as essential cover for nesting and predator avoidance
- Habitat loss associated with the removal of sagebrush is considered to be the biggest threat to the species (USFWS)



News Release

**U.S. Fish and Wildlife Service Protects
Gunnison Sage-Grouse as Threatened Under
Endangered Species Act**



BACKGROUND

- Greater sage-grouse is currently declared “warranted but precluded” to be listed as federally endangered (2010)
 - Final decision deadline → September 2015
- Large scale efforts in place to both conserve and increase existing bird populations
 - Wyoming Core Area Strategy
 - Identified 31 Core Populations or ‘Core Areas’
 - Includes 23.4% of WY and 82% of state’s grouse population



BACKGROUND

- Establishment of big sagebrush can be accomplished in two ways; direct seeding or transplanting (Shuman et al. 1998)
- Although direct seeding is the most cost effective method.. its reliability has not been good (Williams et al. 2002)
 - Particularly when seeded into already established grass stands





CHALLENGES



- Sagebrush seed are very small
 - Average of 2,500,000 cleaned seeds per pound! (McArthur et al. 1979)
- 85-90% of seeds fall within 1 m of mother plant (Young 1989)
 - Long periods of time needed to naturally recolonize a large area
- One method to overcome this is to plant greenhouse grown seedlings in “islands” across a burn area
 - Providing a supplemental seed source to be naturally dispersed



- This project aims to develop an effective planting method for these Wyoming big sagebrush ‘seed source islands’



PROJECT ORIGINATION

- Research project funded and developed by the Douglas Core Area Restoration Team
 - Multi-stakeholder group working to restore Sage Grouse habitat
- Identified gaps in the science of sagebrush ‘island’ plantings
- Worked closely with team to develop a study aimed at identifying BMP’s for planting in the Douglas Core Area
- Help guide future restoration projects



OBJECTIVES

- Develop an effective method for planting Wyoming big sagebrush seedlings within the Douglas Core Area
 - Maximizing: survival, available soil moisture, plant biomass, percent cover, reproduction potential, habitat quality, etc..
- Compare the effectiveness of winter broadcast seeding Wyoming big sagebrush into snowbanks vs. exposed vegetation



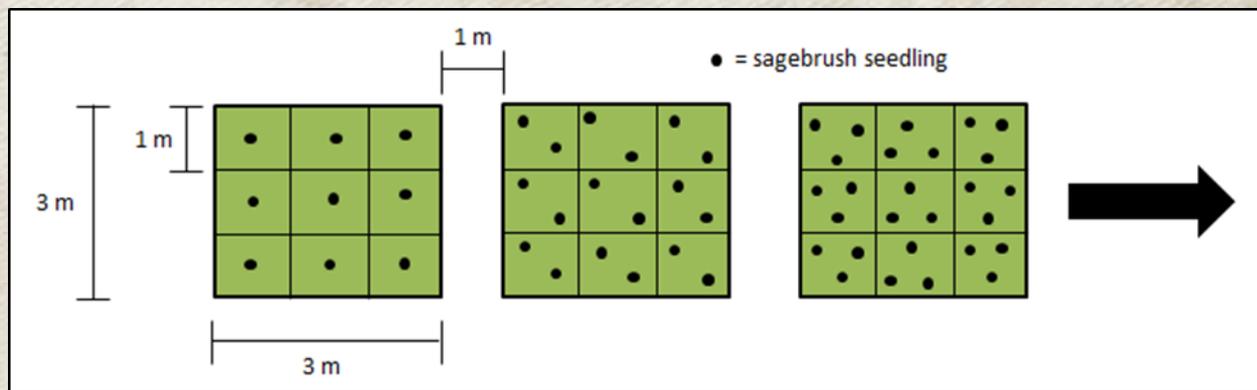
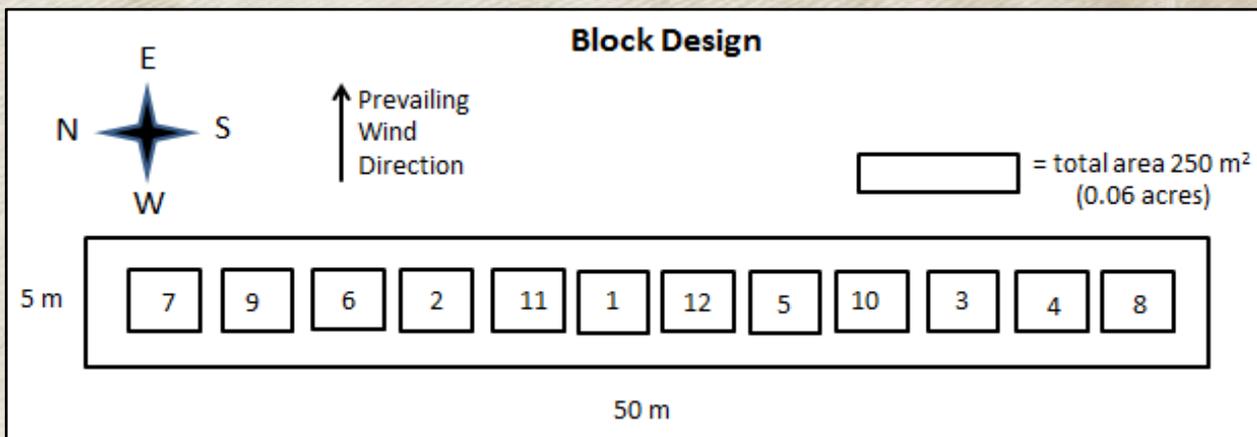
EXPERIMENTAL DESIGN

3 Factor Factorial Randomized Complete Block Design

Treatment #	Density	Fabric Mulch	Snow Fence	Seedlings	Area
1	1 seedling/m ²	Yes	Yes	9	9 m ²
2	1 seedling/m ²	Yes	No	9	9 m ²
3	1 seedling/m ²	No	Yes	9	9 m ²
4	1 seedling/m ²	No	No	9	9 m ²
5	2 seedling/m ²	Yes	Yes	18	9 m ²
6	2 seedling/m ²	Yes	No	18	9 m ²
7	2 seedling/m ²	No	Yes	18	9 m ²
8	2 seedling/m ²	No	No	18	9 m ²
9	3 seedling/m ²	Yes	Yes	27	9 m ²
10	3 seedling/m ²	Yes	No	27	9 m ²
11	3 seedling/m ²	No	Yes	27	9 m ²
12	3 seedling/m ²	No	No	27	9 m ²
Total (block)	-	-	-	216 seedlings/ per block	108 m ² + 33 m ² = 141 m ²
Total (w/replicates)	-	-	-	648 seedlings total	423 m ² total area needed



EXPERIMENTAL DESIGN



TREATMENTS



- Density
 - Intraspecific competition
 - Percent cover
- Polypropylene Fabric Mulch
 - Allows air, water and nutrients to pass (not sunlight)
 - Conserves soil moisture
 - Eliminates interspecific competition
- Mother plant
 - Sagebrush 'motherplant' mimic
 - Alter microsite conditions



BASELINE CONDITIONS

Species	Common Name	Frequency	%
VUOC	Six weeks fescue	109/480	22.71
PASM	Western wheatgrass	92/480	19.17
ALDE	Desert alyssum	50/480	10.42
BARE	Bareground	45/480	9.38
POSE	Sandberg Bluegrass	45/480	9.38
BOGR	Blue grama	33/480	6.88
BRTE	Cheatgrass	28/480	5.83
BRJA	Japanese brome	18/480	3.75
HECO	Needle & thread	16/480	3.33
An. Forb	Annual forb	14/480	2.92
PLPA	Wolly plantain	10/480	2.08
KOMA	Prairie junegrass	8/480	1.67
CAFI	Threadleaf sedge	6/480	1.25
AGCR	Crested wheatgrass	4/480	0.83
SPCO	Scarlet globemallow	2/480	0.42



- Growing Medium (Soil Used to Grow Seedlings, Collected February 2014)
 - pH – 6.51
 - EC – 60 μ s
 - Classification – Sandy loam (64.6% sand, 25.8% silt, 9.6% clay)
- Block 1
 - pH – 7.25
 - EC – 110 μ s
 - Classification – Sandy clay loam (62.8% sand, 20.4% clay, 16.8% silt)
- Block 2
 - pH – 6.89
 - EC – 50 μ s
 - Classification – Sandy loam (60.8% sand, 29.2% silt, 10.0% clay)
- Block 3
 - pH – 6.77
 - EC – 40 μ s
 - Classification – Sandy loam (72.6% sand, 20.2% silt, 7.2% clay)





SEED COLLECTION



METHODS: SEED COLLECTION & CLEANING

- Collected on November 2, 2013 from unburned stands adjacent to the restoration site (locally adapted)
 - Done by stripping and cutting the seed stalks into bags
- Spread out to dry on newspaper for 72 hours at 24°C
- Cleaned to a purity of 10.6% PLS using a series of three screen sizes and mechanical hand separation





Top Screen (3.35 mm)



Middle Screen (2.0 mm)



Bottom Screen (250 µm)



Leftover Debris

METHODS: SOIL PREPARATION

- Native soil used for growing medium in greenhouse
 - Establishment of arbuscular mycorrhizae in root system
 - Symbiotic relationship; Increasing water and nutrient uptake (Stahl 1998)
- Collected from restoration site in February 2013 (top 0-10 cm)
- Soil was dried for 96 hours at 24°C and sieved to 1-cm





METHODS: GERMINATION

- Seedlings grown in Ray Leach Style “Cone-tainers”
 - 3.8 cm x 21 cm
- Filled with soil to top then fully saturated prior to seeding
- Apply thin coat of seed uniformly over saturated soil surface
- Soil surface kept moist with spray bottle for first 48 hours
 - Followed by full watering 3x/day for first week



METHODS: EMERGENCE

- Emergence was first observed 4 days after seeding
- Average emergence of 14 seedlings per container
- Thinned to 1 seedling per container after 2 weeks



METHODS: GREENHOUSE & HARDENING

- Seedlings grown for 65 days at 24°C
- Watered 1x every other day
- Following greenhouse growing period, seedlings moved outside to harden in lath house for 14 days prior to planting



METHODS: FIELD PLANTING

- Field planting took place May 19-22, 2014 (spring)
- Holes excavated using 8" gas powered auger
- Seedlings removed from plastic containers and placed in the center of the hole
 - Soil backfilled and compacted around seedling
- Each seedling received 0.5 gallons of water following planting



SANDY LOAM VS SANDY CLAY LOAM



METHODS: MONITORING



- Monitoring

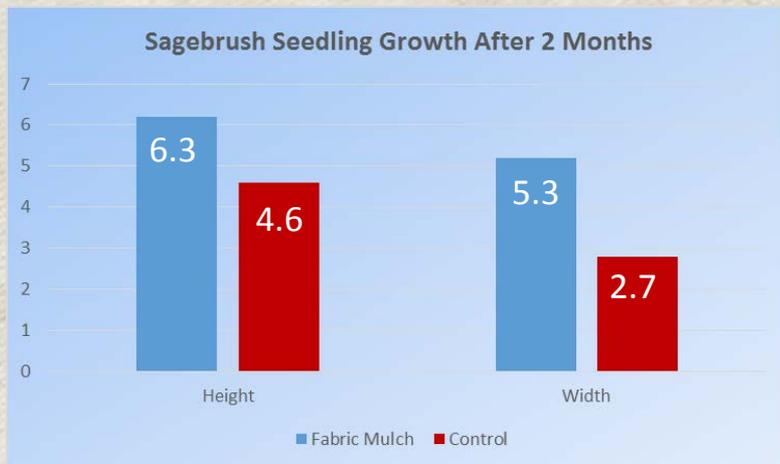
- Height (cm)
- 2 Width (cm)
- Survival
- Health Class
- Height to Base of Crown
- Branching
- Seed production (Y or N)
- Soil Moisture
- Temperature
- Wind Speed/ Direction
- Precipitation (mm)



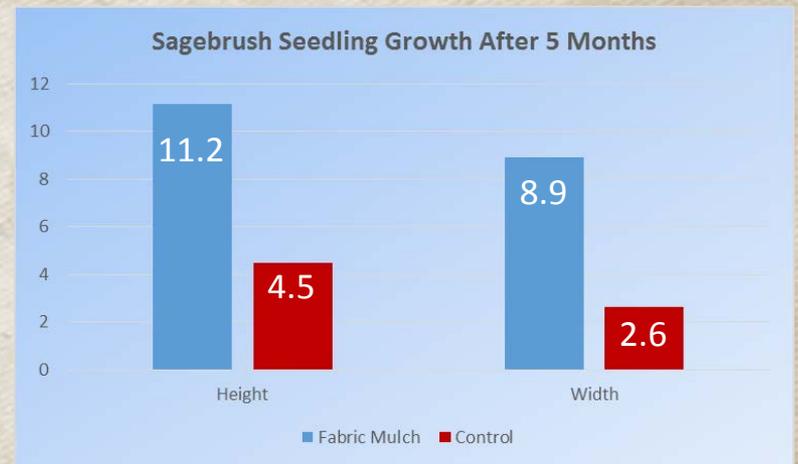
PRELIMINARY RESULTS



October 2014



July 2014



October 2014

SNOW ACCUMULATION



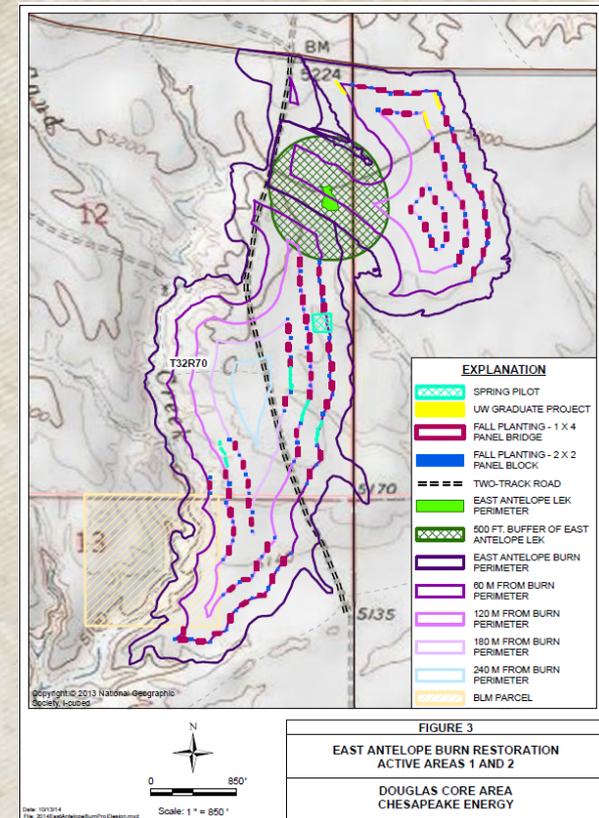
HERBIVORY



WINTER PROTECTION



APPLICATION IN THE DCA





MANAGEMENT IMPLICATIONS



- Planting to meet specific restoration goals?
 - 1 shrub/m² on 20% of reclaimed area (coal)
 - 5% sagebrush canopy cover (suitable habitat, executive order)
 - Matching pre-disturbance or reference conditions
 - 40 cm height (brood rearing habitat)
- Can these seed source islands be placed in locations with higher potential for dispersal than others?
 - Slope, aspect, surrounding vegetation, percent bareground...
- Planting into critical habitat areas or locations where traditional seeding has failed

BROADCAST EXPERIMENT



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ACKNOWLEDGMENTS

Huge Thanks To:

- Pete Stahl
- Calvin Strom
- Douglas Core Area Restoration Team
- Kristina Hufford

Field Planting:

- Mike Curran
- Seth Cude
- Brian Heath

And much more:

- ESM Graduate Students and Faculty
- SGIT
- Private Landowners Within the DCA

