“After the Fire: What Works, What Needs to Change”

The Next Steppe Conference

Thursday, November 6, 2:45 p.m. -4:05 p.m.

Moderator:
Mike Pellant, BLM

Presenters:
Dr. David Pyke, USGS
Jeff Rose, BLM
Dr. Jay Kerby, The Nature Conservancy


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science for a changing world
Forest and Rangeland
Ecosystem Science
Center
Sagebrush steppe post-fire rehabilitation projects: Using the past to guide the future
David A. Pyke,
U.S. Department of the Interior
U.S. Geological Survey

Emergency Stabilization & Rehabilitation (ES&R)

AKA: Burned Area Emergency Response (BAER)

- Objectives
  - Reduce Soil Erosion
  - Prevent Invasive Spread
  - Rehab Critical Habitat
- How?
  - Revegetation
    - Seed Drills
    - Aerial/Broadcast
    - Transplants
- Timeframe
  - Plans due 2-3 wks after fire
  - Complete in 1-3 yrs

Milford Flat Fire, UT

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Are Seedings Effective in Erosion Control?

- Short-term (1-2 years)
  - Ineffective – seeded plants can't establish fast enough (Robichaud et al. 2000; 2010; Pyke et al 2013)
  - Wind Erosion – Consider allowing annual plants to establish to hold soil. (M. Miller et al 2012)
  - Slopes Water Erosion – Mulch, drift fences, physical obstructions (waddles)
- Long-term (3+ years)
  - Revegetation more effective at higher elevations (Knutson et al 2014)

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Water Erosion Control Alternatives to Seeding

- Water Erosion Reduction on hillslopes (Robichaud et al. 2010)
  - Straw Mulch
    - Effective at low to high rain intensity and amount
    - Disadvantage
      - Weed-free grass straw can still have cheatgrass – use rice straw
      - Wind redistribution – use tackifier (e.g. guar, psyllium)
  - Wood Mulch
    - Effectiveness like straw
    - Longer lasting
    - Doesn't blow around
    - Disadvantage
      - Greater Cost

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Wind Erosion Control
Alternatives to Seeding

- Wind Erosion Reduction (Robichaud et al. 2010)
  - Straw Mulch with tackifier
    - Organic vs. Poly Acrylamide (PAM)
      - PAM can reduce infiltration in some soils
  - Wood Mulch
    - Could be a use of Pinyon/Juniper
    - Disadvantage
      - Greater Cost

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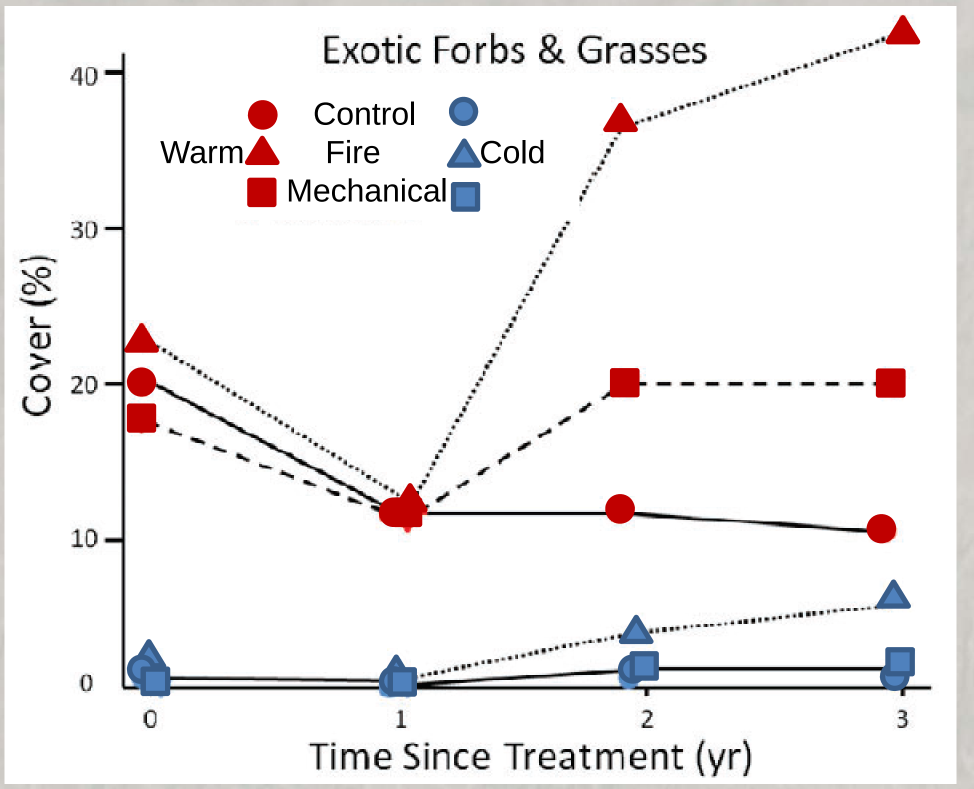
Fire and Cheatgrass (without seeding)



from Miller et al. 2013

Short-term (1-2 years)

- Fire itself reduces annual grass cover (Miller R. et al 2013)
- Confirmed in SageSTEP results

Long-term (3+ years)

- Cover of perennial grasses > annual grasses or deep-rooted perennials > 2-3 plants/m^2
  - Perennials should dominate
- If not, depends on Resilience of site (Soil Temp/Moisture)
  - Warm-dry sites cheatgrass likely will dominate

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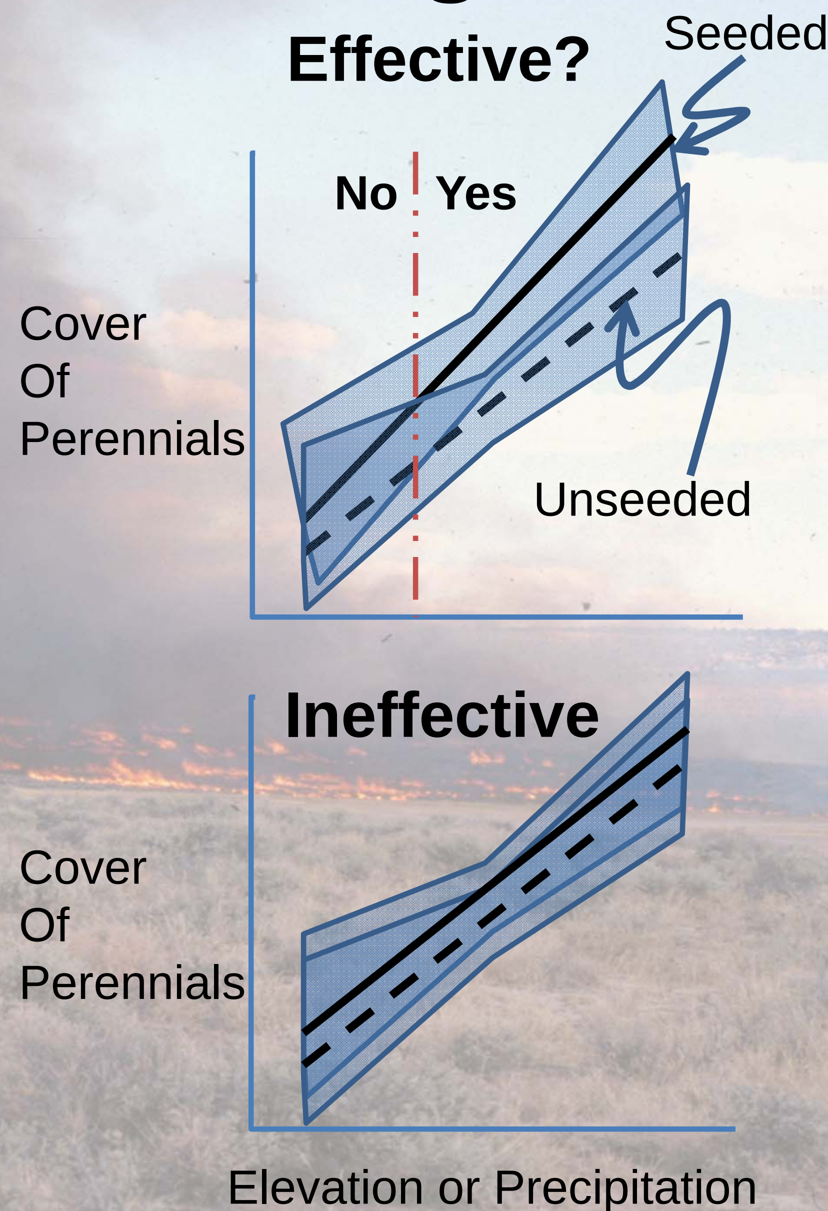
How to Interpret ES&R Findings?

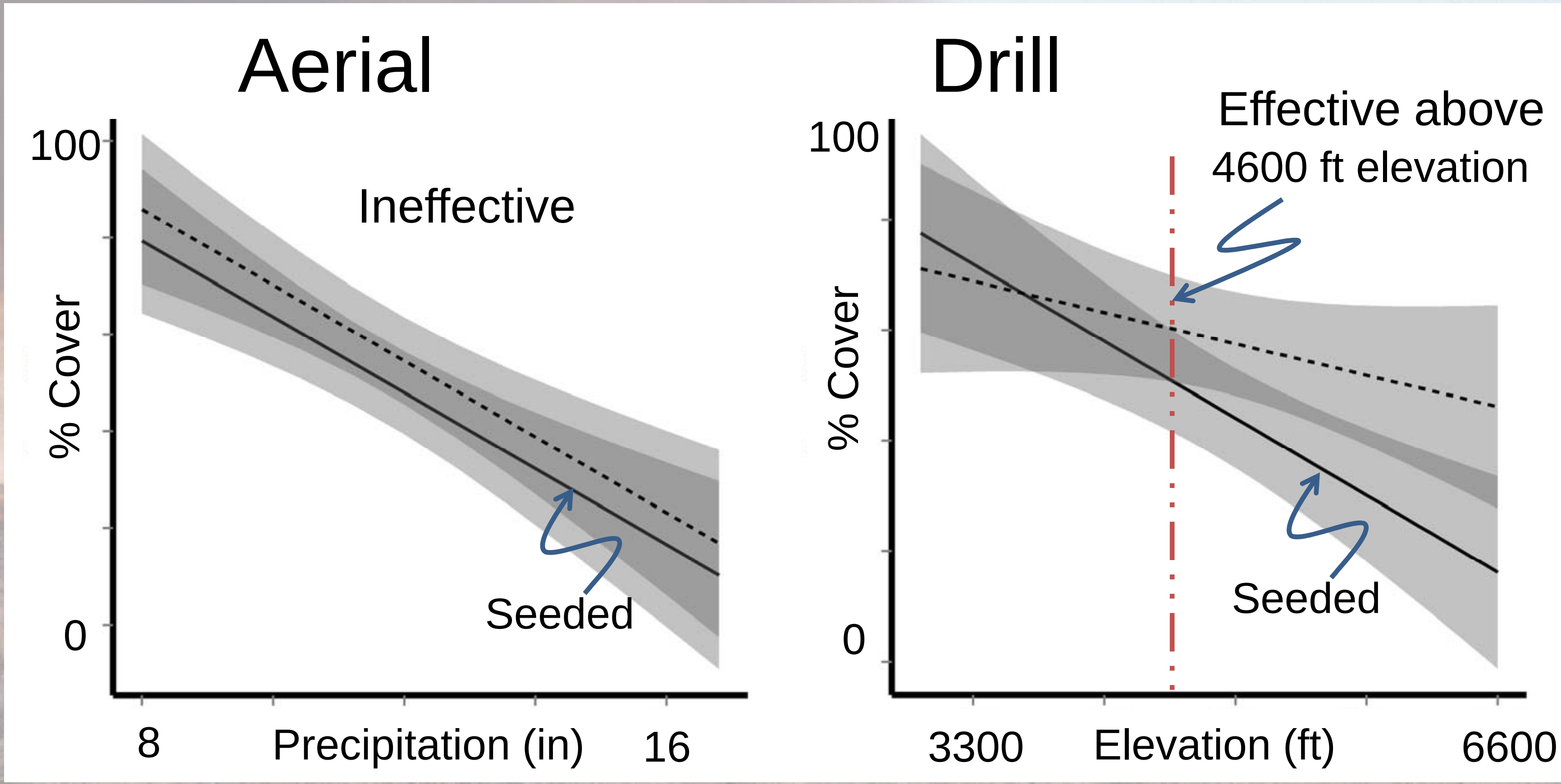
Seeded *vs* Unseeded

- If effective:
  - Only light shading over one line
- Effectiveness not likely
  - Dark shading over both lines



Invasive Annual Grasses

mainly cheatgrass



Drill seeding controls cheatgrass above 4600 ft

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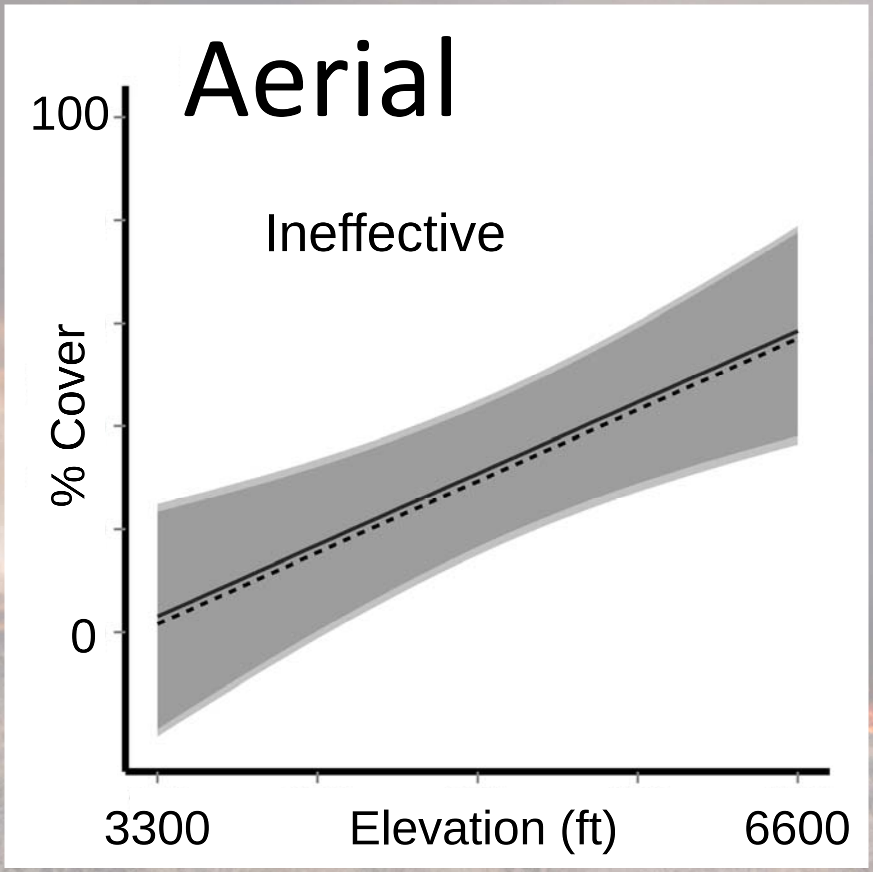
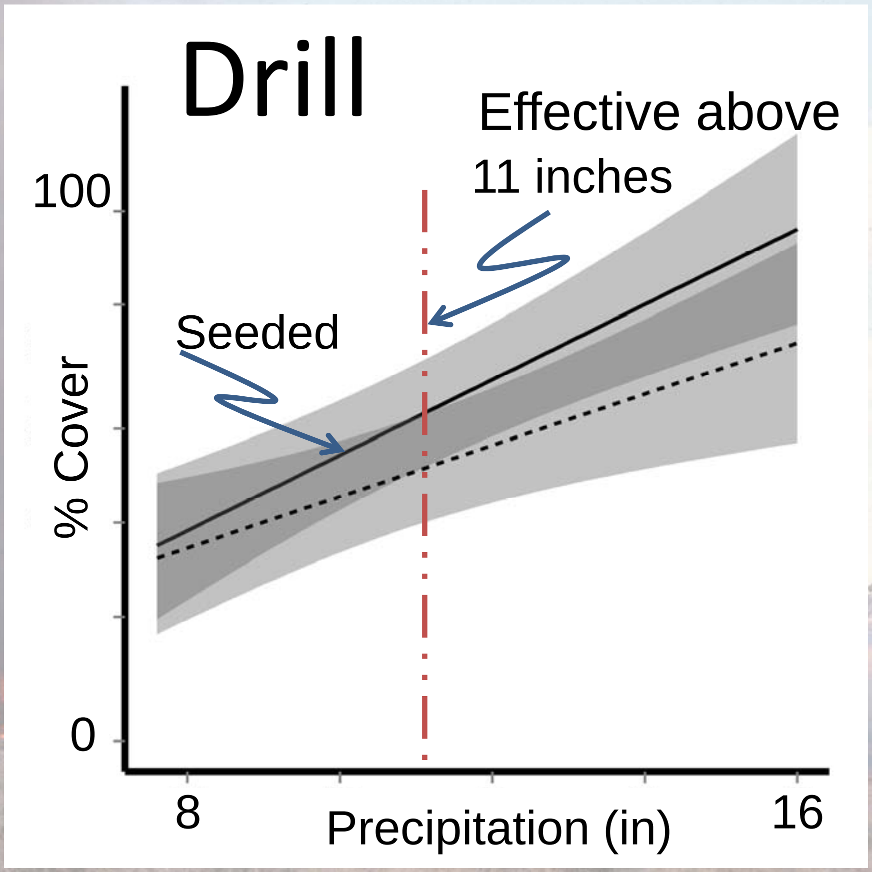
Knutson et al 2014 J. Appl. Ecol.

Total Perennial Plant Cover





- Drill is effective above 11 inches of annual precipitation
    - Due to seeded non-native perennial grasses

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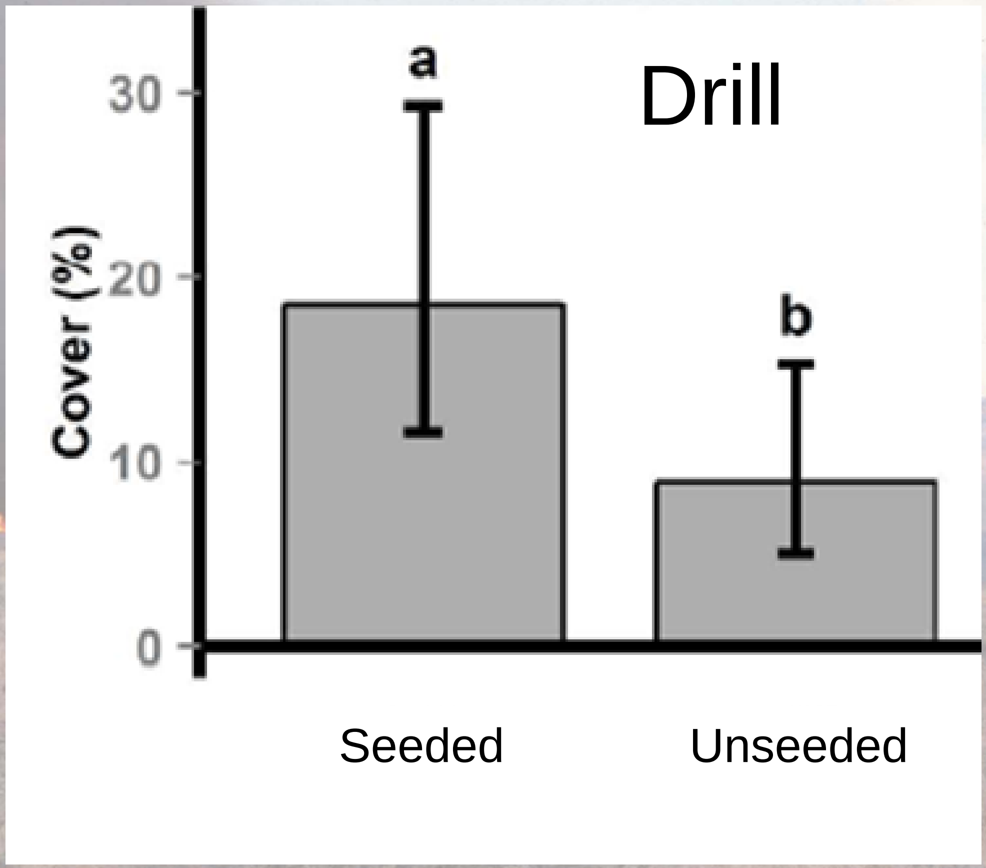
Knutson et al 2014 J. Appl. Ecol.

Native Perennial Grasses Only
No Non-native Forage Grasses or Shrubs

- Native drill-seeded grass cover was twice that of unseeded
- Forage grasses potentially outcompete natives
- Consider seeding natives without forage grasses



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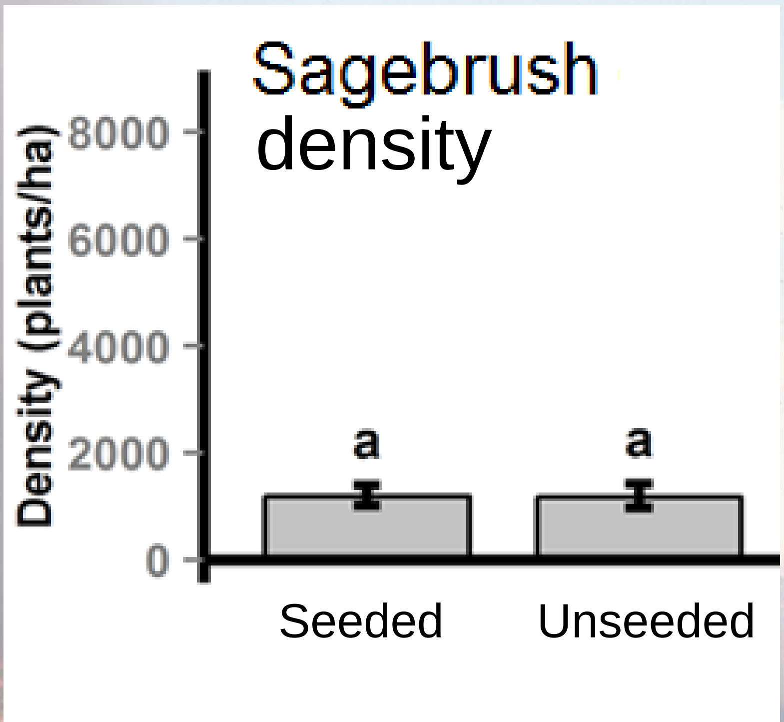
Knutson et al 2014 J. Appl. Ecol.

Sagebrush – Aerial or Drill



- Seeding sagebrush was ineffective
- Alternative techniques needed
  - Transplants, surface seeded with compaction
- New Project - SageSuccess

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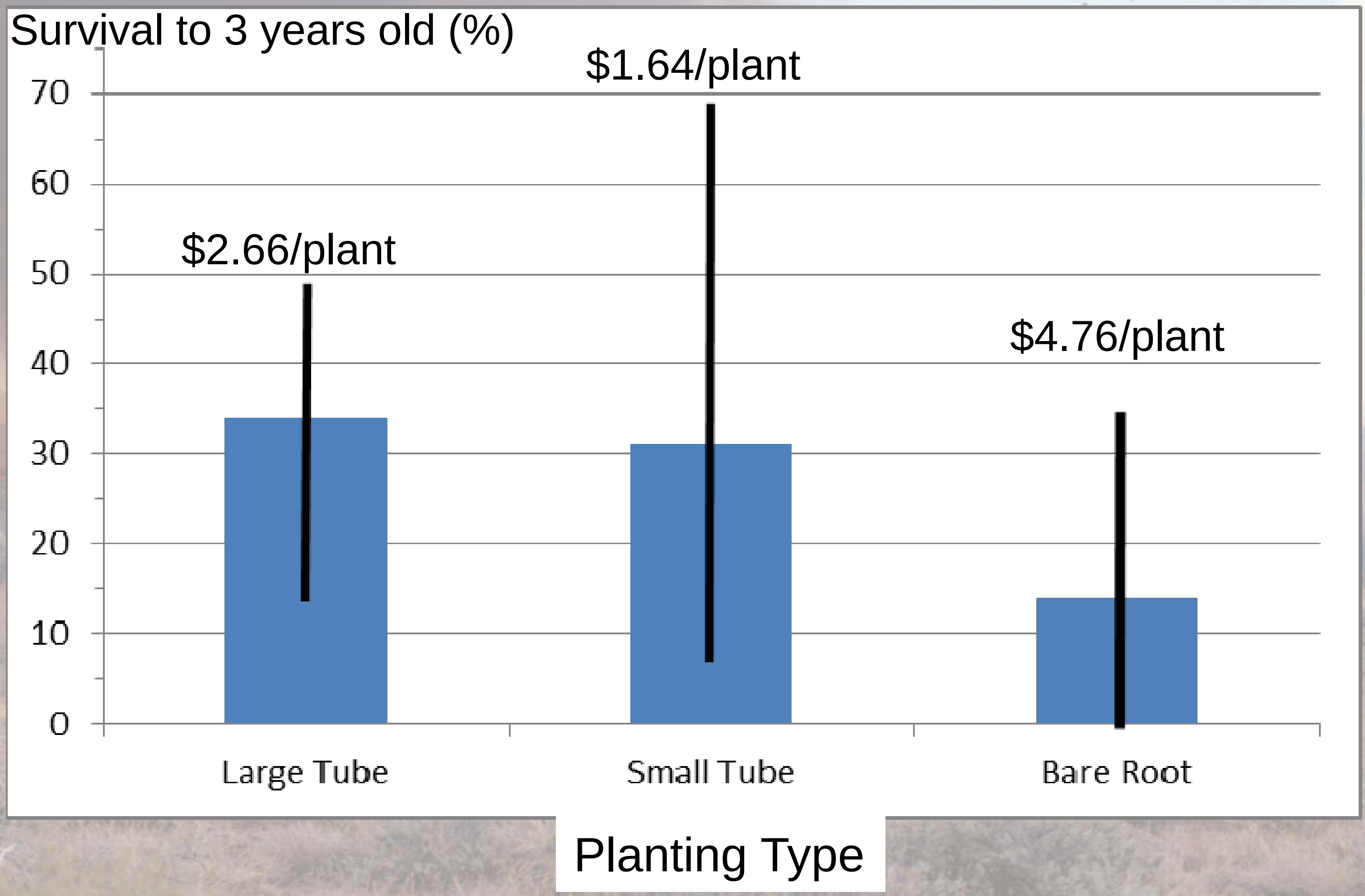
Sagebrush Transplant Survival & Average Cost per Surviving Plant



Dettweiler-Robinson et al. 2013 REM

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Mimic Patchy Fires with Surviving Sagebrush

- Transplants - 40 plants/ac yields 10 living plants/ac
  - Yield in 3 years
  - Grid - 1 surviving plant every 60 ft
  - $17/ ac
- Aerial seedings of sagebrush
  - $21/ac (seed + trtmnt) n=13, failure rate is high – BLM ES&R reports
- Cost vs. Benefit?

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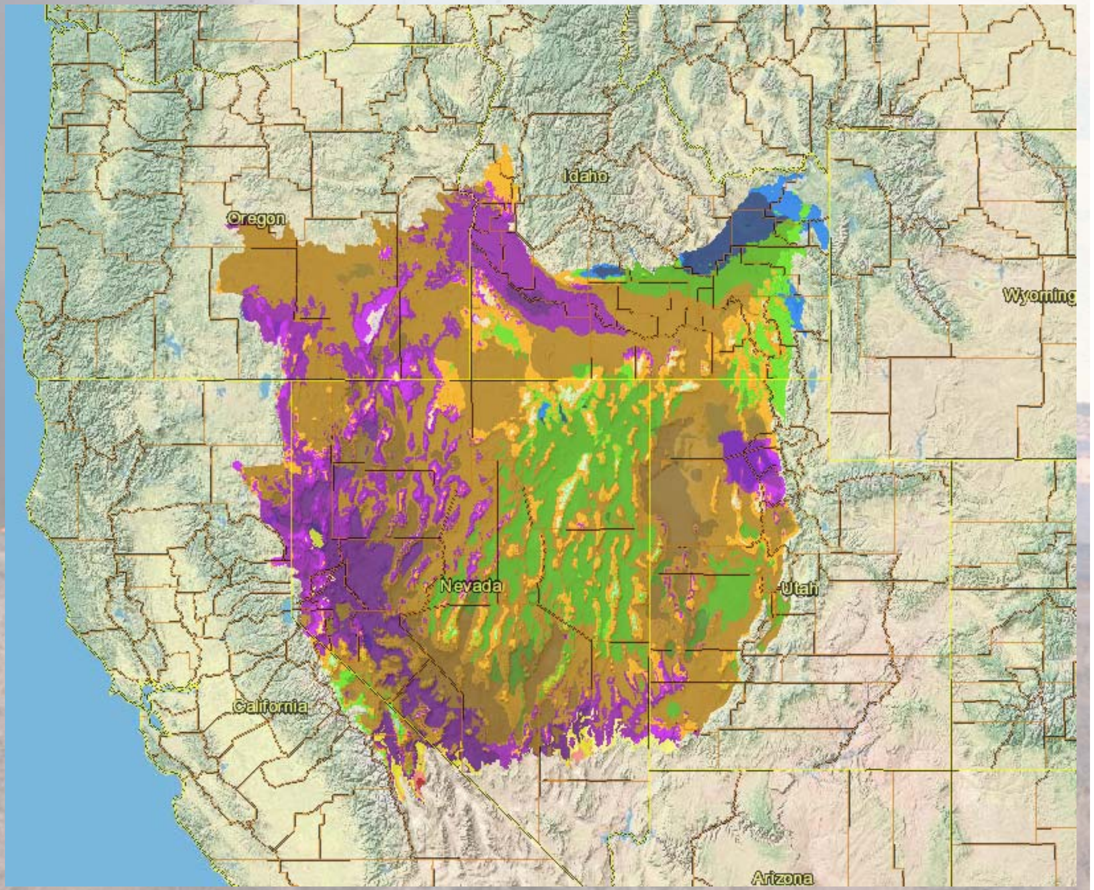
Improving Seeding Success

- Provisional Seed Zones
  - Purchase seeds from zone to be planted
  - Requires site identification of seeds



From Bowers et al. 2014 Ecol. Appl.

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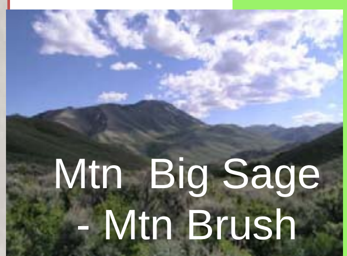
Sage-Grouse Habitat Matrix

Proportion of Landscape Dominated by Sagebrush

Resilience to Disturbance & Resistance to Invasive Annual Grasses

	Low < 25% Sagebrush-Dominated Landscape	***Medium*** 25-65% Sagebrush-Dominated Landscape	***High*** > 65% Sagebrush-Dominated Landscape
High	Natural sagebrush recovery possible. Sagebrush restoration potential is high	Natural sagebrush recovery possible. Sagebrush restoration potential is high, but only in large patches.	Sagebrush sufficient & natural recovery from disturbances likely.
Moderate			
Low	Natural sagebrush recovery or restoration not likely	Natural sagebrush recovery or restoration not likely	Natural sagebrush recovery possible, but rare due to climate



Perennial herbaceous sufficient to recover
Annual invasive risk is low
Restoration potential high
Recovery from inappropriate grazing high

Perennial herbaceous inadequate to recover
Annual invasive risk is high
Restoration potential low; needs multiple interventions
Recovery from inappropriate grazing is low

From Chambers et al. 2014 USFS GTR-326

If First You Don't Succeed …

- Reseed until successful
  - Arid ecosystems natural establishment is sporadic
    - Seed Production
    - Seedling germination
    - Seedling establishment
  - Weather dependent
  - Only Seed Production is controlled by purchasing seed.

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Post-fire Grazing Management

No Seeding

- Why post-fire rest?
  - Cover for erosion protection
  - Recover tillers
  - Seeds for new recruits
    - Fires create voids (deaths)
    - Need seeds for seedlings

- Considerations:
  - Healthy stand of deep-rooted grasses (>3plants/m^2)
    - 2 growing season minimum; more if < 3/m^2
    - Allow maximum reproduction and regrowth; Dormant or Winter season only

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Miller et al 2013 USFS GTR

Post-fire Grazing Management

With Seeding

- Seedlings vulnerable to trampling and defoliation
- Need to establish roots and shoots
- Must compete with annual grasses
- Rest period ↑ with ↓ site resilience, species, special conditions

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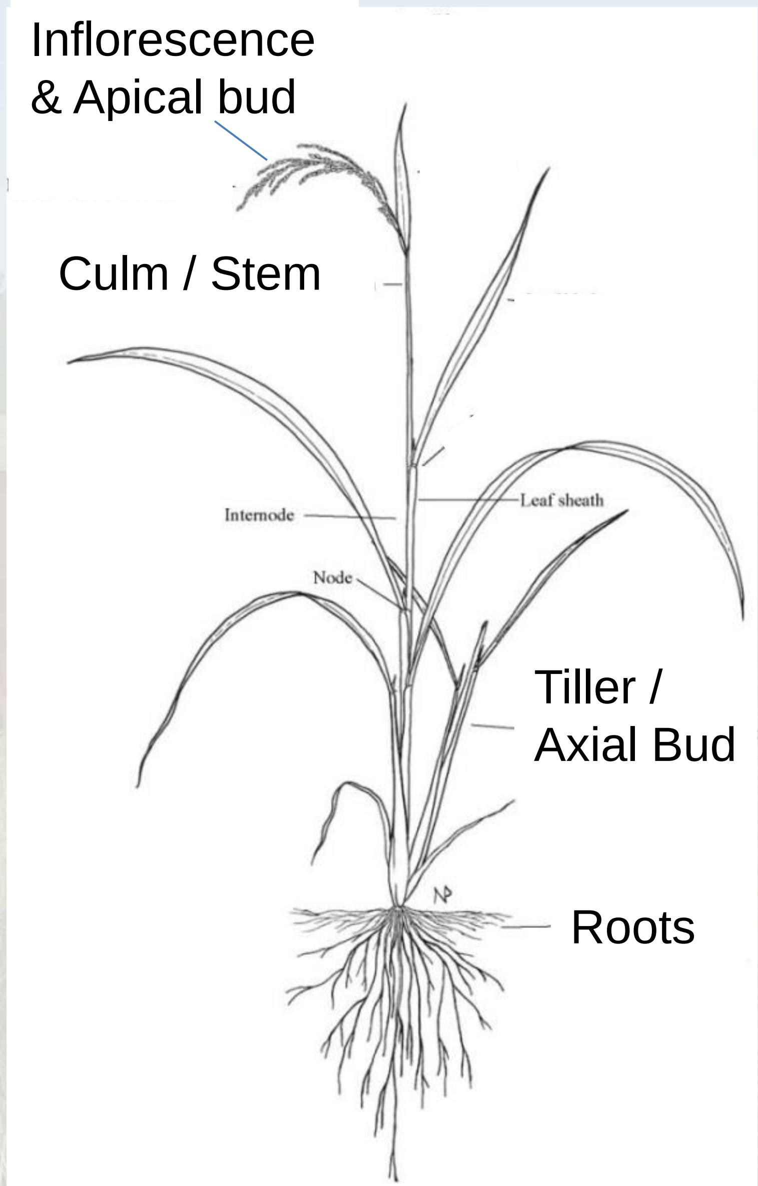
Grazing Impacts on Grasses

Pre-boot to boot

- Active growth
- Graze apical bud? (Boot stage)
  - Stimulates axial bud growth
  - Next years plant has fewer tillers & culms; slowly decreases in size
  - May impact production & seeds

Briske & Richards 1995



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Minimum Years nongrazing

Table 1—Recommended minimum years of nongrazing following revegetation of different vegetative types, and according to special treatments and site conditions.

Vegetative type	Special treatment or site conditions	Recommended growing seasons with no livestock grazing following seeding
Subalpine		3
Aspen-conifer		2
Aspen, Gambel oak, maple	Broadcast seed prior to leaf fall	3
Ponderosa pine		2
Mountain brush		2
Juniper-pinyon	Above 14 inches (36 cm) annual precipitation	2
Juniper-pinyon	Below 14 inches (36 cm) annual precipitation	3
Mountain big sagebrush		2
Basin big sagebrush	Above 14 inches (36 cm) annual precipitation	2
Basin big sagebrush	Below 14 inches (36 cm) annual precipitation	3
Wyoming big sagebrush	Above 12 inches (30 cm) annual precipitation	3
Wyoming big sagebrush	Below 12 inches (30 cm) annual precipitation	4
Black sagebrush		3
Shadscale		3 to 4
Black greasewood		2
Inland saltgrass		1
Blackbrush		3

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(Stevens, R Chap 16 in Monsen et al 2004)

Add Years To Establish

Gear to Maximum Species

Table 3—Years normally required for certain plant species to establish, mature, and flower.

Fast 2 years	Intermediate 2 to 3 years	Slow 3 to 4 years	Very slow 4 to 6 years
Bluegrass, Kentucky	Alfalfa	Crownvetch	*Balsamroot*
Brome, mountain	Aster spp.	Lupine spp.	Bitterbrush, antelope
Burnet, small	Brome, Regar	Milkvetch, cicer	Ceanothus, Martin
Kochia, forage	Brome, smooth	Rabbitbrush, low	Ceanothus, snowbush
Orchardgrass	Canarygrass, reed	Rabbitbrush, rubber	Chokecherry, black
Rye, mountain	Dropseed, sand	Ricegrass, Indian	Cliffrose
Squirreltail, bottlebrush	Eriogonum, Wyeth	*Sacaton, alkali*	Currant, golden
Sweetclover, yellow	Fescue, hard sheep	Sagebrush, big	Elderberry, blue
Timothy	Flax, Lewis	Sagebrush, black	Ephedra, green
Wheatgrass, crested	Globemallow	Saltbush, fourwing	Mountain mahogany, curlleaf
Wheatgrass, desert	Goldeneye, showy	Shadscale	Mountain mahogany, true
Wheatgrass, intermediate	Penstemon, Palmer	Sweetvetch, Utah	Serviceberry, Saskatoon
Wheatgrass, pubescent	Sainfoin	Wildrye, Great Basin	
Wheatgrass, slender	*Sweetanise*	Wildrye, Russian	
	Wheatgrass, bluebunch	Winterfat	
	Wheatgrass, Siberian		
	Wheatgrass, tall		

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(Stevens, R Chap 16 in Monsen et al 2004)

Special Conditions = Additional Years

- Typical Wy. Sage Seeding Example
  - Arid site = 4 years
  - Big sagebrush = 4 years
  - Site with cheatgrass = 3 years
- Total years growing season nonuse = 11!
- Standard growing season nonuse = 2 years
  - Should be rare
    - Exception – Cool-moist site sown with only introduced forage grasses or forage kochia

Table 2—Additional growing seasons of nonuse (beyond recommended growing seasons indicated in table 1) required due to special conditions.

Site conditions	Years
Burned and broadcast seeded	+1
Slower growing shrubs seeded or released (table 3)	+2 to +4
Seedings in cheatgrass, red brome, medusahead, or halogeton communities	*+l to +3*
Poor seedbed conditions	+1
Erosive soils	+l to +3
Soils with exposed and disturbed subsoil	+2
Precipitation 2 or more inches (5 cm) less than average during first growing season	+1 to +3
Precipitation 2 or more inches (5 cm) less than average during second and third growing season	+1
Outbreak of insects or disease	+1 to +3
Excessive number of rodents and rabbits	+1 to +3

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(Stevens, R Chap 16 in Monsen et al 2004)

Considerations

- Short-term stabilization – Use mulches
- Arid ecosystems will require multiple interventions
  - If seeding is necessary, repeat until establishment
  - ES&R policy timeline is too restrictive for arid ecosystems
- Aerial seeding rarely successful except on resilient sites with introduced forage grasses
- Mixing introduced forage grasses with natives should be avoided.
- Post-fire grazing management after seedings needs to follow recommendations

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Application of Current Research in Post-fire Management

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