Synergistic Monitoring for Adaptive Management of Sagebrush Ecosystems
We Can’t Continue To Do Nothing!
Group 1: Loamy 8-10

1: Reference State

1.1 Plant Community
- Wyoming big sagebrush ~30%
- Spiny hop sage 2-5%
- Thurber's needlegrass ~45%
- Bluebunch wheatgrass 2-10%
- Forbs 2-8%

1.2 Plant Community
- Wyoming big sagebrush decreases
- Perennial bunchgrasses increase

1.3 Plant Community
- Wyoming big sagebrush increases
- Perennial understory is reduced

State 2

2.1 Plant Community
- Wyoming big sagebrush ~30%
- Spiny hop sage 2-5%
- Thurber's needlegrass ~45%
- Bluebunch wheatgrass 2-10%
- Forbs 2-8%
- Annual non-native species present

2.2 Plant Community
- Wyoming big sagebrush decreases
- Perennial bunchgrasses increase
- Annual non-native species stable to increasing

2.3 Plant Community (At Risk)
- Wyoming big sagebrush increases
- Thurber's needlegrass and bluebunch wheatgrass decrease
- Bluegrass and squirreltail increase
- Annual non-native species stable to increasing

State 3

3.1 Plant Community
- Decadent Wyoming big sagebrush and rabbitbrush dominate overstory
- Squirreltail decreases
- Bluegrass may or may not be present or dominant
- Annual non-native species increase
- Bare ground increases

3.2 Plant Community
- Seeded community with introduced non-native and native species
- Wyoming big sagebrush may be re-establishing
- Annual non-native species may still be present or increasing

State 4

4.1 Annual Plant Community
- Cheatgrass and/or tansy mustard dominate site

4.2 Plant Community
- Broom snakeweed and rabbitbrush dominate overstory
- Annual non-natives dominate understory
- Wyoming big sagebrush may be present in trace amounts
- Bare ground increases
STM Applications
Wildfires and Preventative Land Treatments

J. Swanson, S. Swanson, K. McAdoo, B. Schultz, G. McCuin University of Nevada; UNR Cooperative Extension

And Tamzen

Ranches
Mowing Sagebrush May be a Management Tool

Sherman Swanson, John Swanson, Peter Murphy, Kent McAdoo, and Brad Schultz
What is most important to sage grouse?
• Required sagebrush habitats remain resistant and resilient
• At no time do populations lose too much essential habit
Ideally, Mowed areas will retain resilience and mowing will increase resistance.
If not retaining resilience and increasing resistance, does mowing usefully break up fuel continuity?
Some sagebrush remained
On all but a few plots
Some sagebrush remained
On all but a few plots
No or few annuals or exotics led to no or few annuals or exotics
More annuals and exotics
~20%

More Perennials & Native Forbs
~80%
Annuals & Exotics increased more 
~25%

Perennials & Native Forbs increased more 
~75%
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Litter and live vegetation increased. Bare soil, rock, and cryptogams decreased.

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Includes all mowing events:

\[ N = 76 \]

For significant relationships:
Spearman's \( \rho \)

\[ P \text{ value} \]

For each relationship:
Spearman's \( \rho \)

\[ P \text{ value} \]

(Note: text may slightly obscure some data)
Native grass
Native forbs
Cheatgrass
Exotic forbs

Event (post-mowing) absolute cover
Untreated site absolute cover (sites paired with mowing events)

Includes all mowing events:
$N = 76$

For significant relationships:
Spearman's $\rho$
P value

For each relationship:
Spearman's $\rho$
P value

(Note: text may slightly obscure some data)
Includes all mowing events:

\[ N = 76 \]

For significant relationships:
Spearman's \( \rho \)

\[ P \text{ value} \]

For each relationship:
Spearman's \( \rho \)

\[ P \text{ value} \]

(Note: text may slightly obscure some data)
More untreated sagebrush -> Less mowed cheatgrass

"natural" break evident for exotic forbs at 35% sagebrush RC?
(correlation switches direction)

No "natural" break evident for cheatgrass at 35% sagebrush RC

Sagebrush in control sites
Dominance of native herbs (forbs + grasses)

% Native grasses (absolute cover in control plots)

Net % dominance in absolute cover after mowing

Native herbs (forbs + grasses)

Exotic herbs (forbs + cheatgrass)

Pearson's $r = 0.4629$, $P < 0.0001$

Spearman's $\rho = 0.5324$, $P < 0.0001$
Native herbs (forbs + grasses)

Net % dominance in absolute cover after mowing

Exotic herbs (forbs + cheatgrass)

% Native grasses (absolute cover in control plots)

F 5.13
Prob > F 0.0011

0 – 5
5.1 – 10
10.1 – 15
15.1 – 20
20 +

(n = 36)
(n = 9)
(n = 15)
(n = 11)
(n = 5)

0 – 5
5 – 10
10 – 15
15 – 20
20 +

(0 = 36)
(10 = 15)
(15 = 11)
(20 = 5)
Is dominance of native herbs (forbs + grasses) after mowing predicted by pre-mowing total grasses (native + intr + cheatgrass)?

Net % dominance in absolute cover after mowing

Native herbs (forbs + native & intr grasses)

Exotic herbs (forbs + cheatgrass)

% Total grasses (absolute cover in control plots)

- 0 – 5 (n = 29)
- 5.1 – 10 (n = 13)
- 10.1 – 15 (n = 11)
- 15.1 – 20 (n = 9)
- 20.1 – 30 (n = 7)
- 30+ (n = 7)

F = 2.78
Prob > F = 0.0239
What site characteristics best predict native & exotic herbaceous *dominance after* mowing & *the shift* from untreated to mowed sites?

*Technique used:* multiple regression with predictor variables added in a stepwise fashion:

At each step:

1) the predictor that best-improves model fit is added

"Fit" = a measure of the amount of variation in the response explained by the predictors in the model

3 fit criteria were compared: $\text{AdjR}^2$, $\text{AIC}_c$, SBC (Schwarz Bayesian info. Criterion)

2) each predictor added in earlier steps is removed & model fit re-checked

--predictor stays out of model if fit improves

--predictor returned to model if fit worsens

Model building *stops* when no additional predictors improve fit

For the following slides, only those models using $\text{AIC}_c$ are shown as this fit criteria was between $\text{AdjR}^2$ and SBC in model economy
Responses of management interest:

1. **Post-mow native cover** = grass + forbs + seeded grass \((N + P)\)

2. **Post-mow exotic cover** = cheatgrass + forbs \((A)\)

3. **Post-mow native dominance**
   \[= \text{Native cover (grass + forbs + seeded grass)} - \text{Exotic cover (cheatgrass + forbs)} \quad (N + P - A)\]

4. **Shift in native cover**
   \[= \text{Native cover mowed sites} - \text{Native cover untreated sites} \quad (N + P)_{\text{mow}} - (N + P)_{\text{untreat}}\]

5. **Shift in exotic cover**
   \[= \text{Exotic cover mowed sites} - \text{Exotic cover untreated sites} \quad (A)_{\text{mow}} - (A)_{\text{untreat}}\]

6. **Shift in native dominance**
   \[= \text{Native dominance in mowed sites} - \text{Native dominance in untreated sites} \quad (N + P - A)_{\text{mow}} - (N + P - A)_{\text{untreat}}\]

\(N = \text{native forbs + grasses} \quad P = \text{seeded grasses} \quad A = \text{exotic forbs + cheatgrass}\)
Candidate predictor variables for multiple regression

Unburned (control) plot cover variables:

- basal cover: bare soil, litter, rock, cryptogam, live vegetation
- foliar cover: live sagebrush, dead sagebrush, other shrubs, native forbs, exotic forbs, native grass, seeded grass, cheatgrass

Site covariates:

- categorical: region [nw NV, ce NV, ne NV]
  - MLRA [Malheur HP, Humboldt, Owyhee HP, Great Salt Lake*]
  - ecosite [Lmy8-10, Lmy10-14, DrLm8-10, Other†, Unknown §]

- continuous: elevation
  - elapsed time [years since mow]
  - slope position [1=bottom, 2=lower, 3=middle, 4=upper, 5=top]

* includes two sites from S NV Basin & Range
† pools sandy loam, sandy slope, stony loam, saline terrace, clay slope
§ ecosite unknown
Native grass & Seeded grass

Coefficient $\beta_{\text{std}}$

Native grass

Seeded grass

int

Native grass

Seeded grass

MLRA

Cryp

Native forbs

Sagebrush

MLRA

Humb

Malheur

Owyhee

GSLk

Model Building Step

Selected Step

$\text{AIC}_c$

Native grass

Seeded grass

Cryp

Native forbs

Sagebrush

MLRA

Rock

Aspect

Sagebrush slope position

Sagebrush slope position
Cheatgrass & Region cover in untreated sites best predict *post-mowing* exotic cover (A)
Cheatgrass & Native grass cover in untreated sites best predict post-mowing native herbaceous dominance \((N + P - A)\)
Cryptogams & (=) Sagebrush cover in untreated sites best predict the shift in native herbaceous cover from untreated to mowed sites (shift in N + P)
MLRA & Elapsed time (since mowing) best predict *the shift* in exotic cover from untreated to mowed sites (shift in A)
Region & Elapsed time (since mowing) best predict the shift in native dominance from untreated to mowed sites (shift in N + P - A)
Place fuel breaks where they will most likely provide protection of large vulnerable habitats, increased resilience, and decreased risk of shifting dominance to annuals.

Resilient locations have:

• Herbaceous vegetation dominated by perennial grasses,

• Little cover of cheatgrass or other annuals, and

• Are dominated by sagebrush, especially if it is not too large.