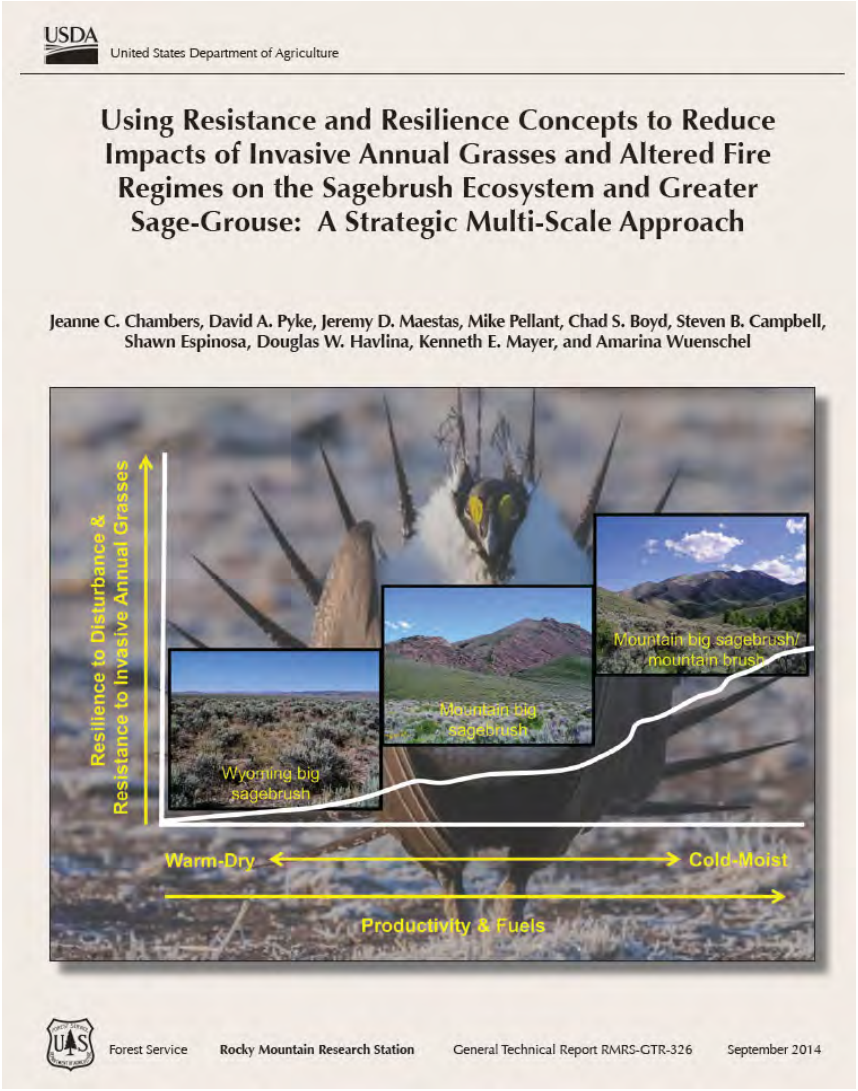
Incorporating Resilience and Resistance Concepts to Refine Prioritization and Treatments

Jeanne C. Chambers

WAFWA Fire and Invasives Working Group
Fire And Invasives Assessment



A Strategic Mult-scale Approach

- Developed by WAFWA Fire and Invasives Working Group
- Published as an RMRS GTR
- Included in Subregional EIS
- Served as basis for FIAT approach

http://www.treesearch.fs.fed.us/pubs/46329

RATIONALE FOR STRATEGIC APPROACH

FWS Conservation Objectives Team (2013)

Greater Sage-Grouse Management Objective ~

"the long-term conservation of sage-grouse and healthy sagebrush shrub and native perennial grass and forb communities by maintaining viable, connected, and well-distributed populations and habitats, through threat amelioration, conservation of key habitats, and restoration activities."

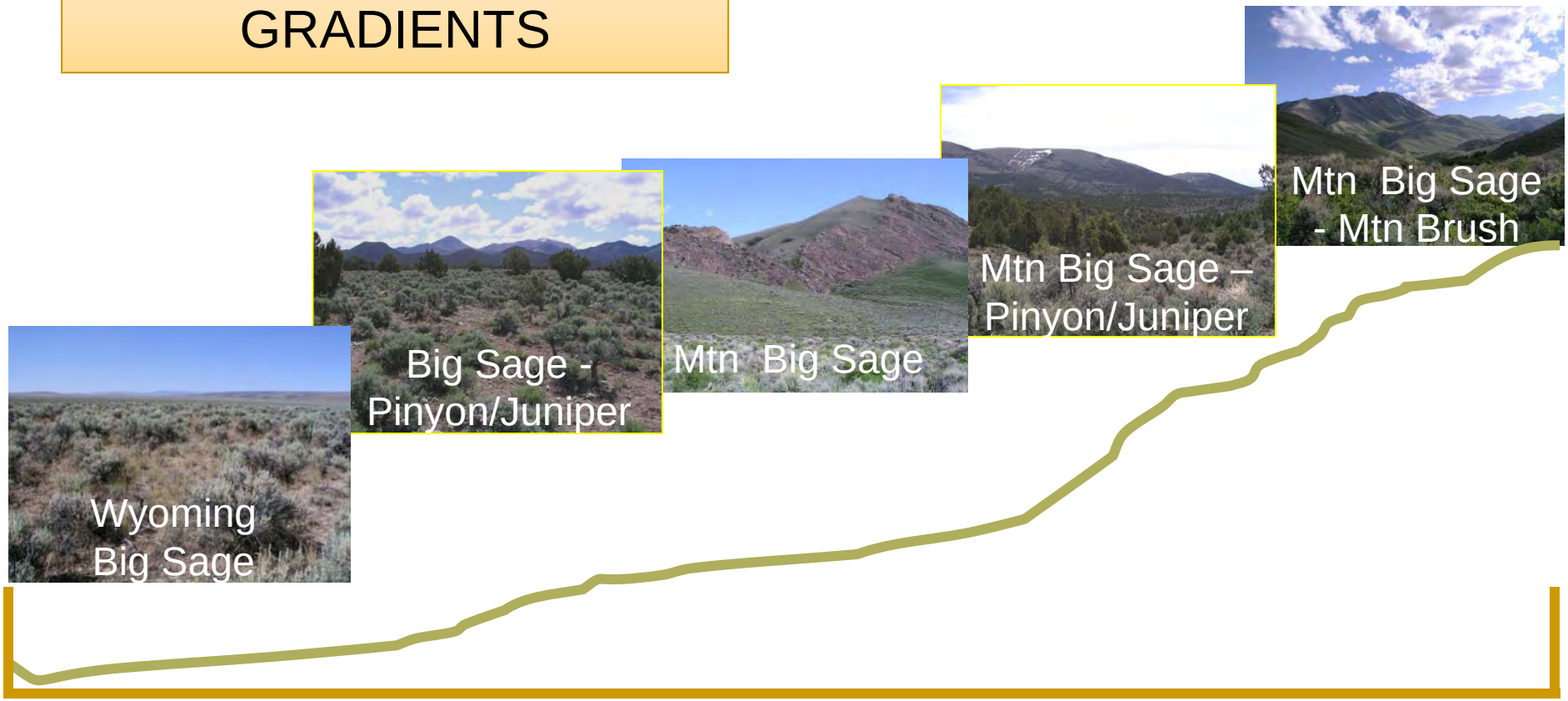
Key element ~ managing for *resilience*

- Broadly distributed and widely ranging species
- Requires large populations in large blocks across full range of habitats
- Strategic multi-scale approach – Landscape to site

Invasive Species, Wildfire and Conifer Management Goals

- *Increase resilience of native ecosystems to disturbance*
- *Enhance resistance to invasive species*
  - Maintain amount of landscape sagebrush cover required for sage-grouse
  - Increase perennial herbaceous species
  - Decrease invasive annual grass abundance & spread

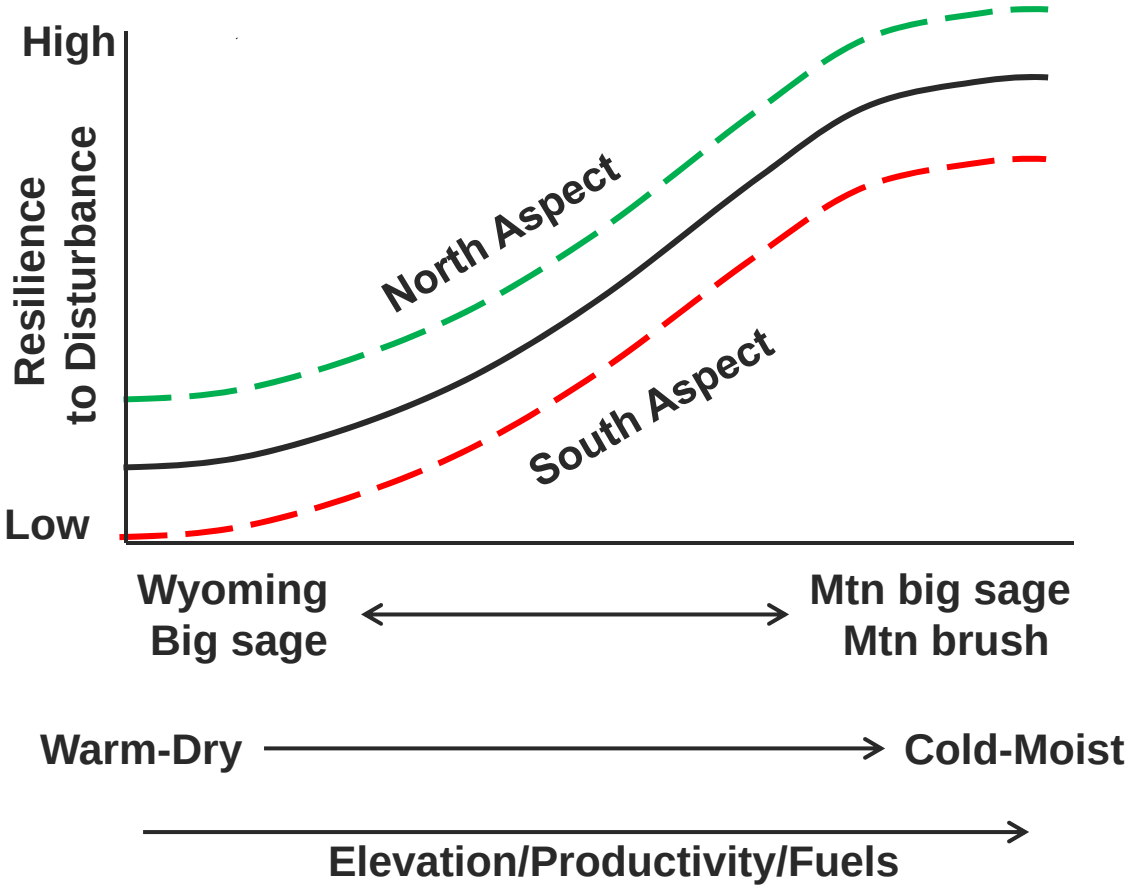
ENVIRONMENTAL GRADIENTS



Warm-Dry ⟷ **Cold-Moist**

Elevation/Productivity/Fuels →

Resilience to Disturbance



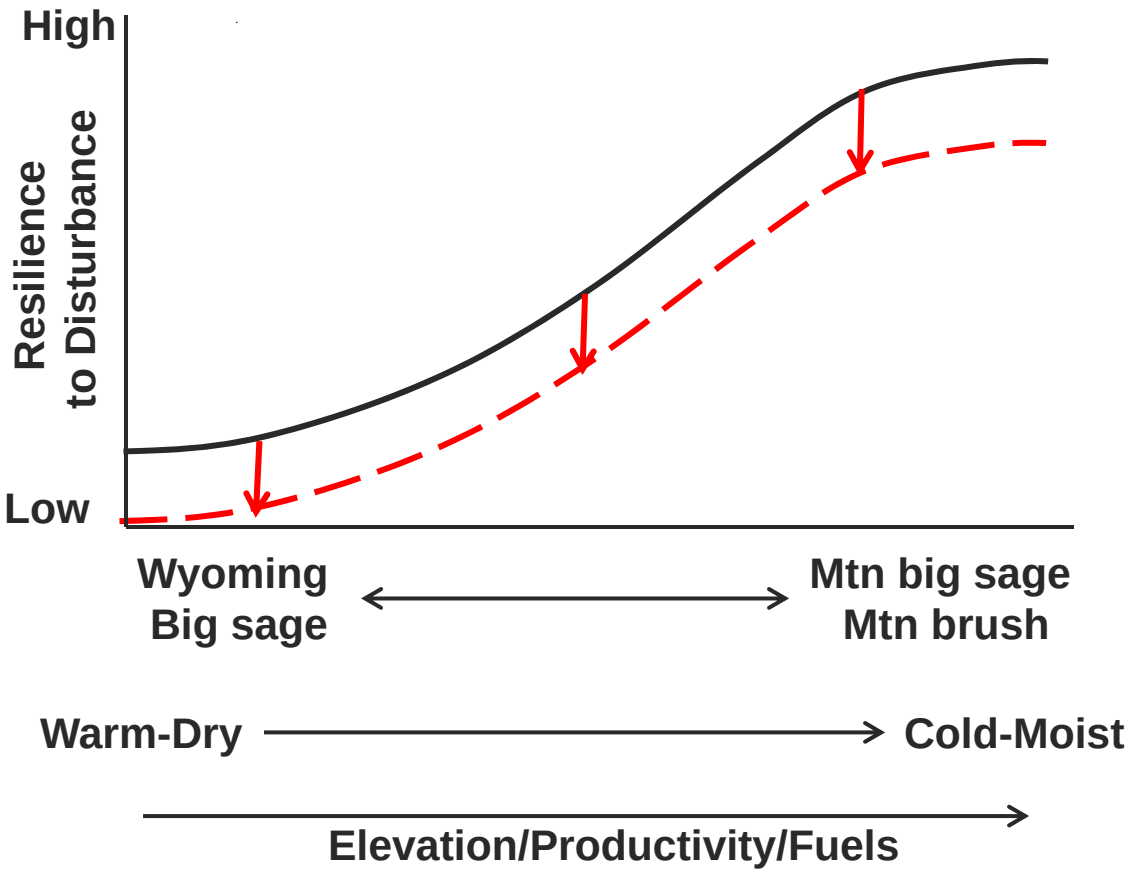
Resilience changes over environmental gradients

- ↑ More favorable growing conditions, higher productivity & fire tolerant species
- ▪ Less change
- ▪ More rapid recovery

± Aspect

(Wisdom and Chambers 2009; Brooks and Chambers 2011; Condon et al. 2011; Davies et al. 2012; Chambers et al. 2014a, b; Miller et al. 2014)

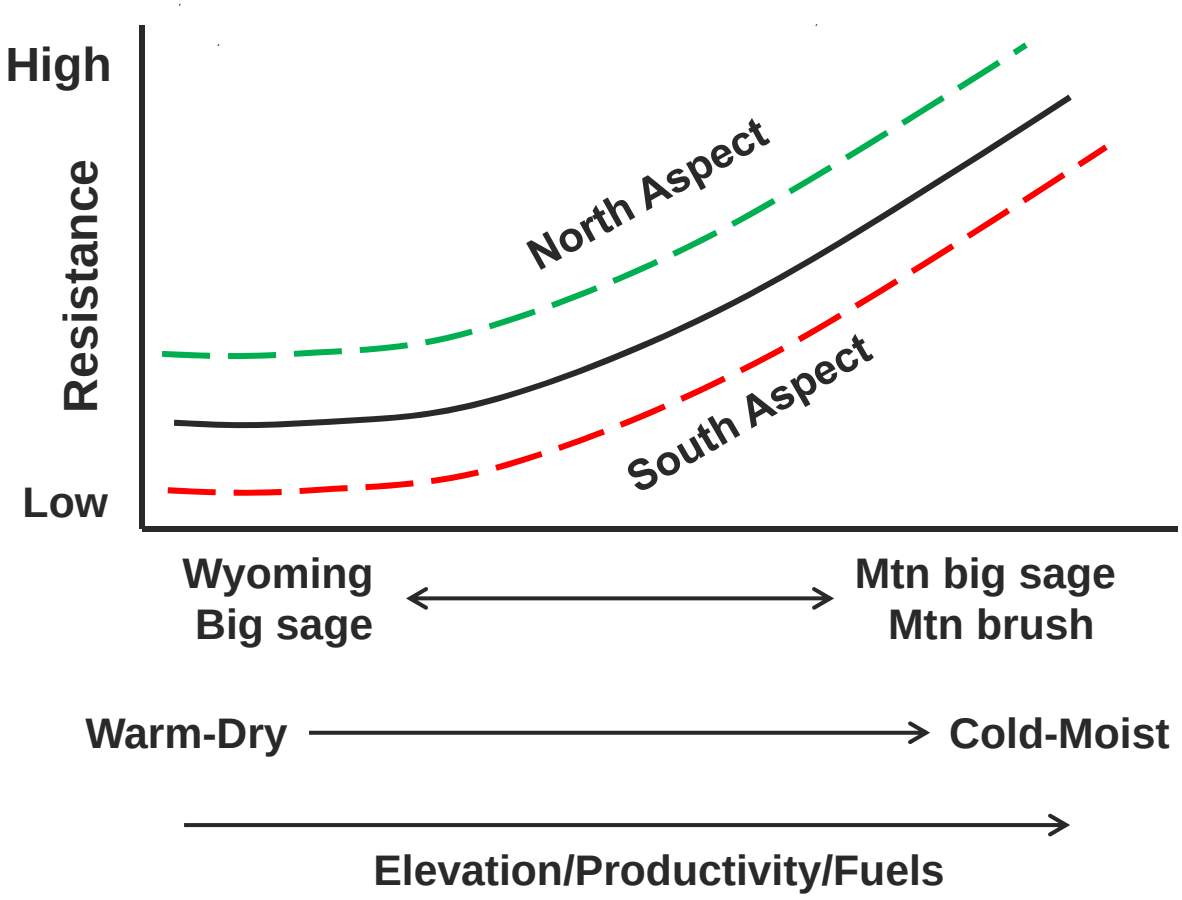
Resilience to Disturbance



Resilience decreases with disturbance/stress outside of natural range of variability

- Changes in vegetation structure or composition
  - ↑ Invasive species
  - ↑ Woody species
- Altered fire regimes

Resistance to Cheatgrass



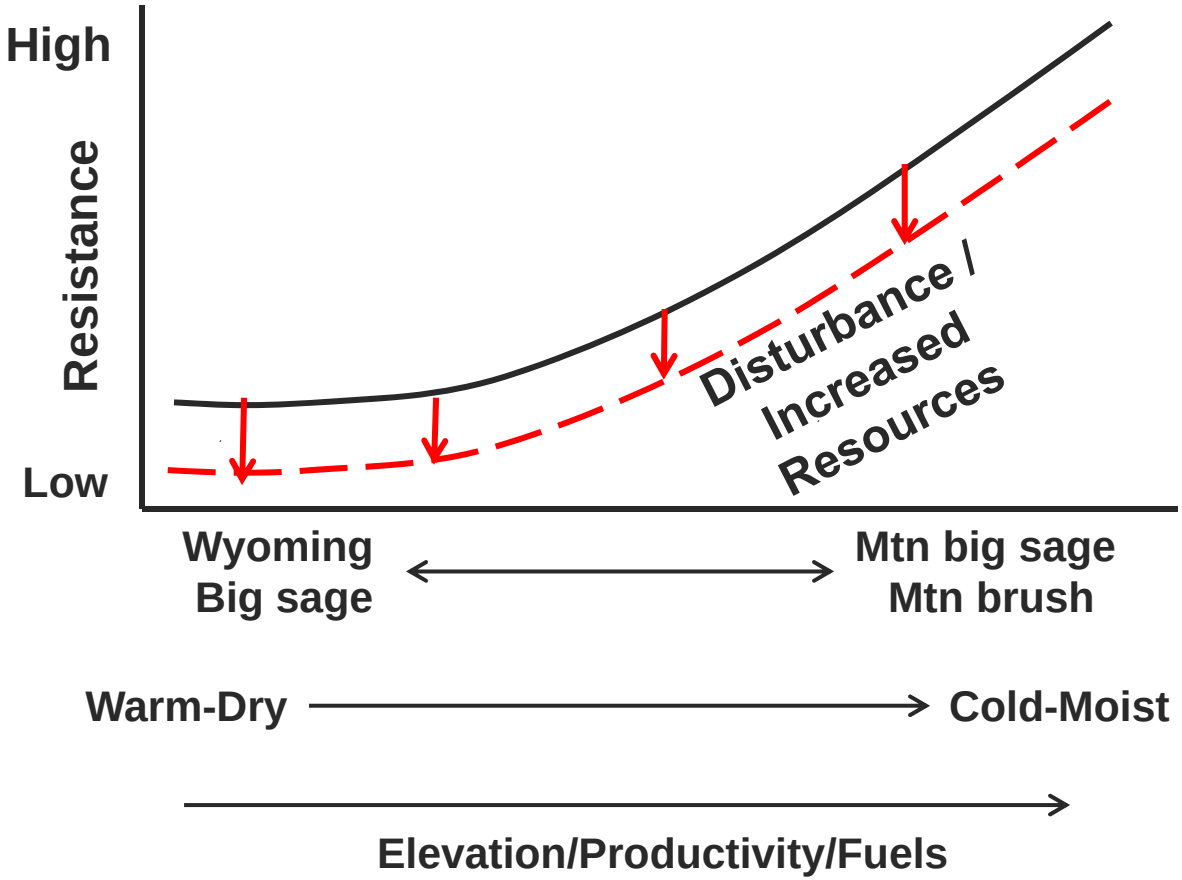
Resistance depends on climate suitability & community attributes

- Lowest – Wyoming sage
- Highest - mountain sage

± Aspect

(Chambers et al. 2007, Condon et al. 2011, Davies et al. 2012)

Resistance to Cheatgrass



(Chambers et al. 2007)

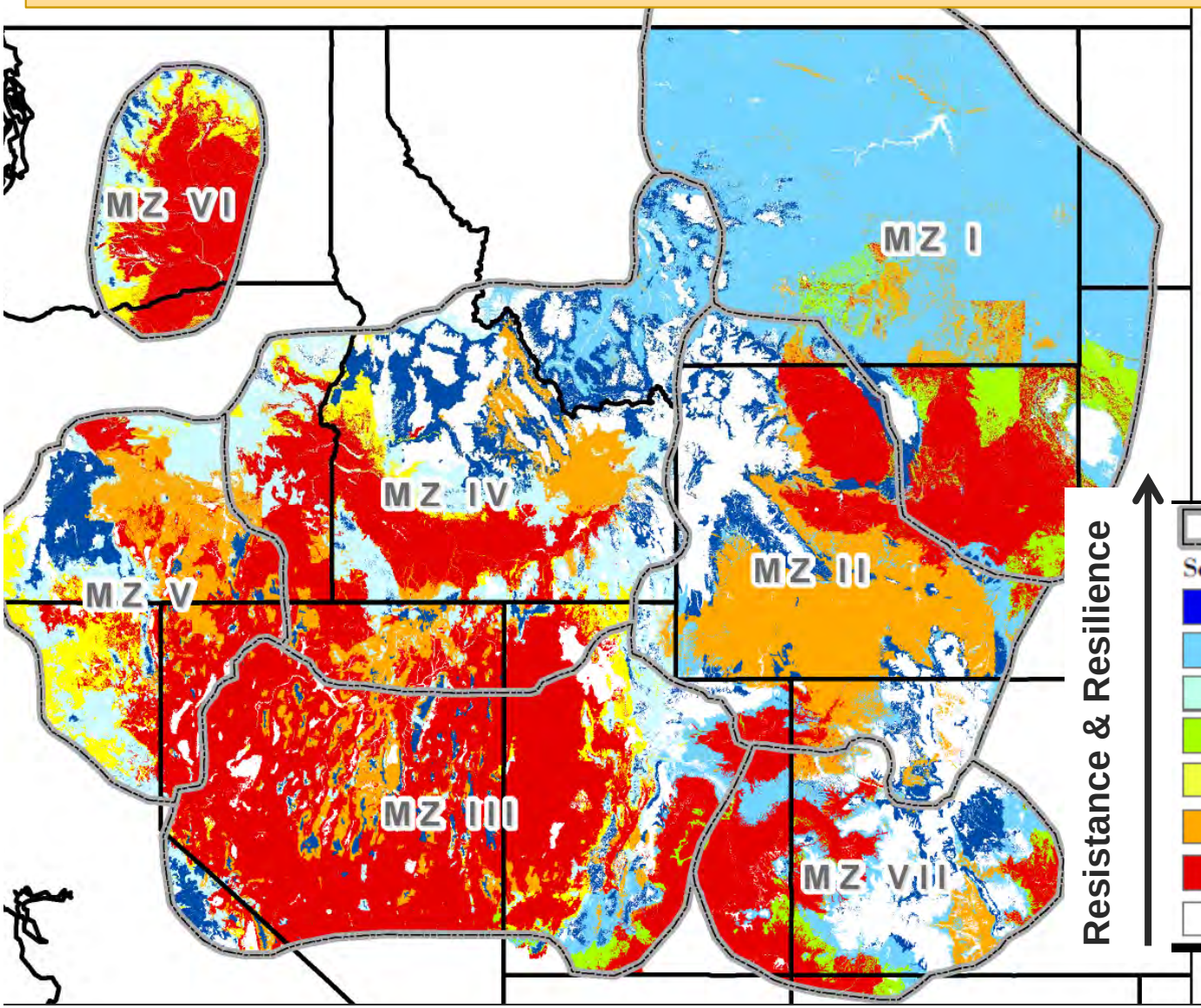
Resistance decreases with disturbance/stress

- Fire, surface disturbance, inappropriate grazing
- ➢ Increases in soil water & nutrients
- ➢ Decreased competition
  - o Removal – 2 to 3 fold
  - o Burning – 2 to 6 fold
  - o Removal + Burning –10 to 30 fold

Resistance & Resilience of Ecological Types

Ecological Type	Characteristics	Resilience and resistance
Cold & Moist *Cryic (all)*	Typical shrubs: Mountain big sagebrush, Snowfield sagebrush, snowberry, serviceberry, silver sagebrush, and/or low sagebrushes	Resilience – Moderately high Resistance– High
Cool & Moist *Frigid/Xeric*	Ppt: 12-22” Typical shrubs: Mountain big sagebrush, antelope bitterbrush, snowberry, and/or low sagebrushes **Piñon pine and juniper potential**	Resilience – Moderately high Resistance – Moderate
Warm & Moist *Mesic/Xeric*	Ppt: 12-16” Typical shrubs: Wyoming big sagebrush, mountain big sagebrush, Bonneville big sagebrush, and/or low sagebrushes **Piñon pine and juniper potential**	Resilience – Moderate Resistance – Moderately low
Cool & Dry *Frigid/Aridic*	Ppt: 6-12” Typical shrubs: Wyoming big sagebrush, black sagebrush, and/or low sagebrushes **Piñon pine and juniper potential moister sites**	Resilience – Low Resistance – Moderate
Warm & Dry *Mesic/Aridic*	Ppt: 8-12” Typical shrubs: Wyoming big sagebrush, and or black sagebrush and/or low sagebrushes **Piñon pine and juniper potential moister sites**	Resilience – Low Resistance – Low

Soil Temperature & Moisture Regimes



Soil temperature & moisture regimes = Indicator of resilience & resistance

Resistance & Resilience

Sage-grouse Management Zone

Soil Moisture & Temperature Regime

- Cold and Moist (Cryic)
- Cool and Moist (Frigid/Ustic)
- Cool and Moist (Frigid/ Xeric)
- Warm and Moist (Mesic/Ustic)
- Warm and Moist (Mesic/Xeric)
- Cool and Dry (Frigid/ Aridic)
- Warm and Dry (Mesic/ Aridic)
- Omitted or No Data

IRCS SURGO DATA – 1:24,000 with gaps filled with STATCO -1:250:000
(Maestas and Campbell 2014)

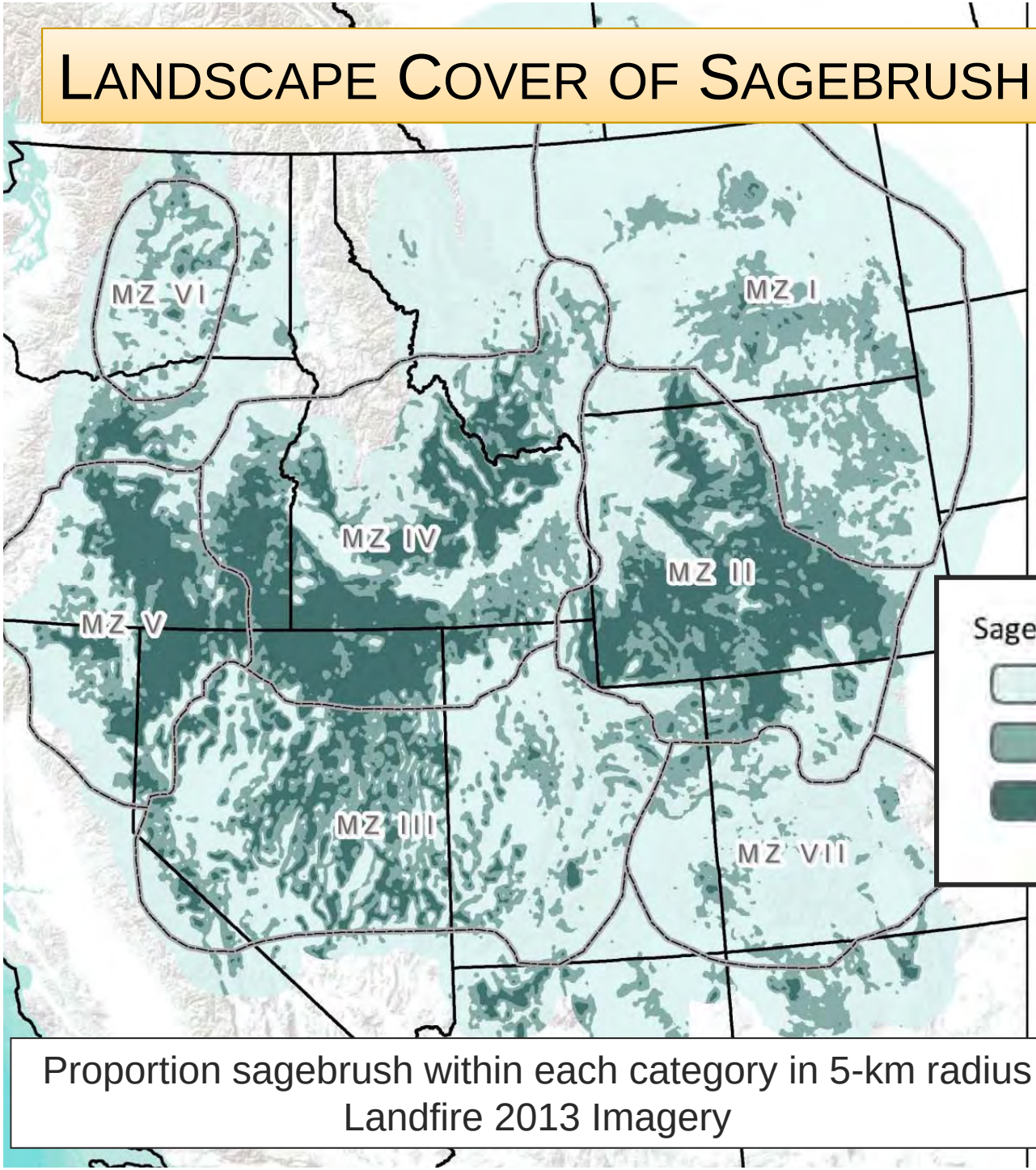
Sage-Grouse Habitat Requirements

- ***Landscape cover of sagebrush***
  - High risk of extirpation with < 25% land cover of sagebrush
  - Intermediate probability of persistence with 25 to 65% cover
  - High probability of persistence with > 65% land cover of sagebrush
    (5-30 km radii around leks; Aldridge & Boyce 2007, Knick et al. 2013, Wisdom et al. 2011)
  - ➢ Only land cover variable positively associated with sage-grouse in all NV management areas (Coates et al. 2014 Open Report)

- ***Landscape cover of conifers***
  - Leks average < 1% *if conifer cover is present*
  - Leks are absent *with > 40% conifer cover*
    (5-km radii around leks; Knick et al. 2013)

- ***Cover of annual grasses***
  - Nesting areas have < 6 to 8% annual grass
    (Johnson et al. 2011; Kirol et al. 2012; Lockyer et al. in press)

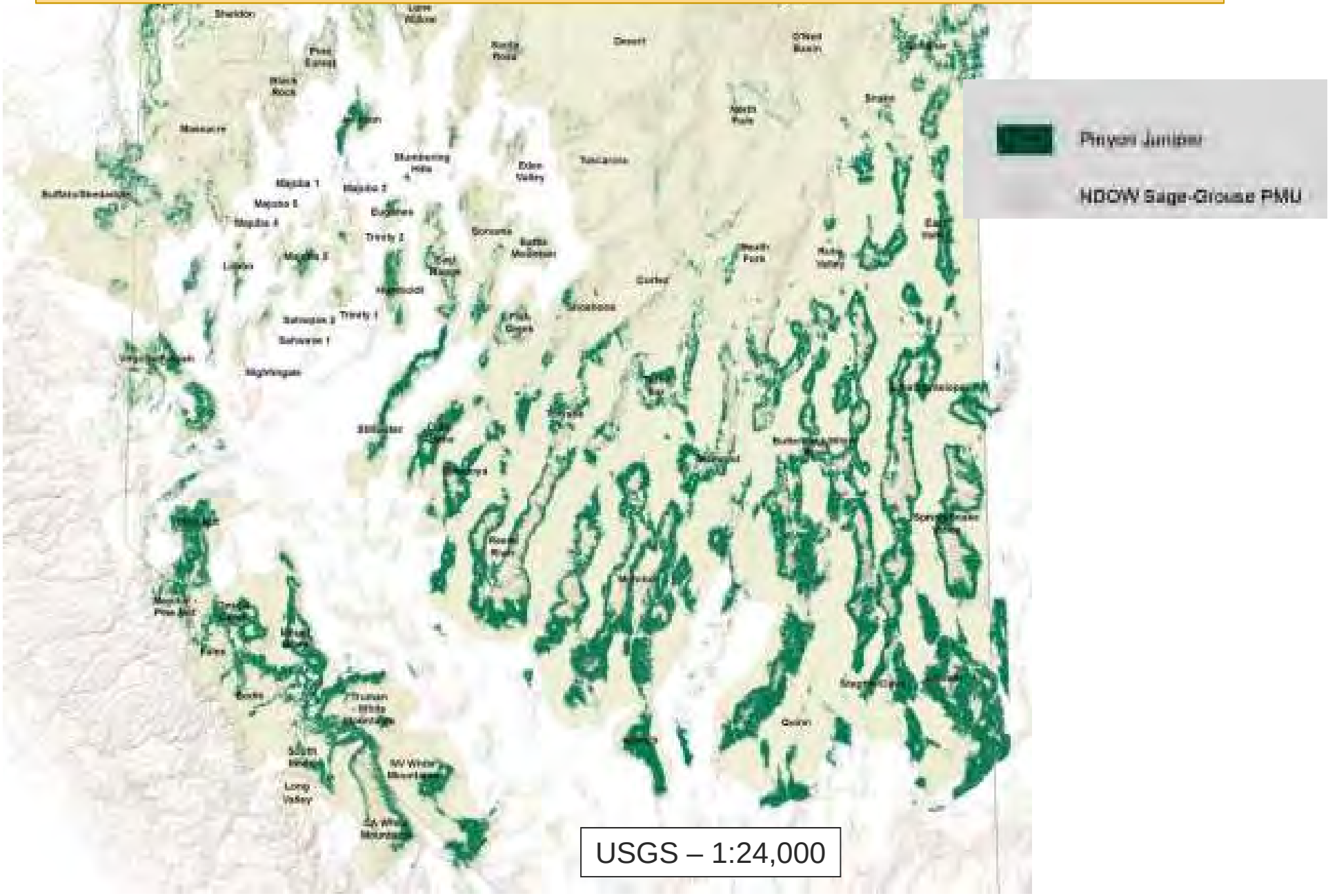
Landscape Cover of Sagebrush



Landscape cover of sagebrush = Indicator of sage-grouse habitat

Proportion sagebrush within each category in 5-km radius
Landfire 2013 Imagery

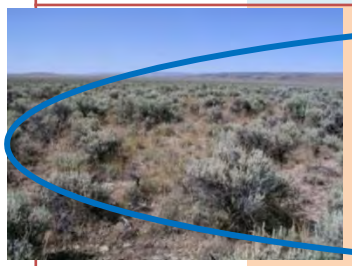
LANDSCAPE COVER OF PIÑON PINE AND JUNIPER



Sage-Grouse Habitat Matrix

Proportion of Landscape Dominated by Sagebrush

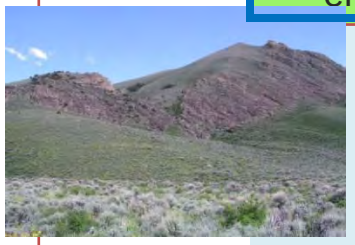
Resilience & Resistance of Sagebrush Community

	***Low* = < 25%**	***Medium* = 25-65%**	***High* = > 65%**
	**RESTORATION/RECOVERY POTENTIAL HIGH** ***Native grasses and forbs sufficient for recovery*** ***Annual invasive risk low***		
High	Requires longer timeframe, enhance connectivity.	Little intervention needed, enhance connectivity.	Little-to-no intervention needed.
	**RESTORATION/RECOVERY POTENTIAL INTERMEDIATE** *Native grasses and forbs usually adequate for recovery* *Annual invasive risk moderate* *Treatment success depends on site characteristics*		
Moderate	Requires longer timeframe and intervention.	Enhance connectivity, minimize risk of invasives.	Little intervention needed, minimize risk of invasives.
	**RESTORATION/RECOVERY POTENTIAL LOW** *Native grasses and forbs inadequate for recovery* *Annual invasive risk is high* *May require multiple management interventions*		
Low	Recovery unlikely.	Long timeframe for recovery, high amount of intervention.	Moderate timeframe for recovery, moderate-high amount of intervention.

Sage-Grouse Habitat Matrix

Proportion of Landscape Dominated by Sagebrush

Resilience & Resistance of Sagebrush Community

	***Low* = < 25%**	***Medium* = 25-65%**	***High* = > 65%**
		**RESTORATION/RECOVERY POTENTIAL HIGH** ***Native grasses and forbs sufficient for recovery*** ***Annual invasive risk low***	
High	Requires longer timeframe, enhance connectivity.	Little intervention needed, enhance connectivity.	Little-to-no intervention needed.
		**RESTORATION/RECOVERY POTENTIAL INTERMEDIATE** *Native grasses and forbs usually adequate for recovery* *Annual invasive risk moderate* *Treatment success depends on site characteristics*	
Moderate	Requires longer timeframe and intervention.	Enhance connectivity, minimize risk of invasives.	Little intervention needed, minimize risk of invasives
		**RESTORATION/RECOVERY POTENTIAL LOW** *Native grasses and forbs inadequate for recovery* *Annual invasive risk is high* *May require multiple management interventions*	
Low	Recovery unlikely.	Long timeframe for recovery, high amount of intervention.	Moderate timeframe for recovery, moderate-high amount of intervention.

MANAGEMENT STRATEGIES

Potential management actions organized within resilience and resistance categories

- Fire Operations – Preparedness, Prevention and Suppression
- Fuels Management
- Post-fire Rehabilitation
- Habitat Recovery/Restoration

LANDSCAPE PRIORITIZATION

Focal areas for management support viable populations of birds

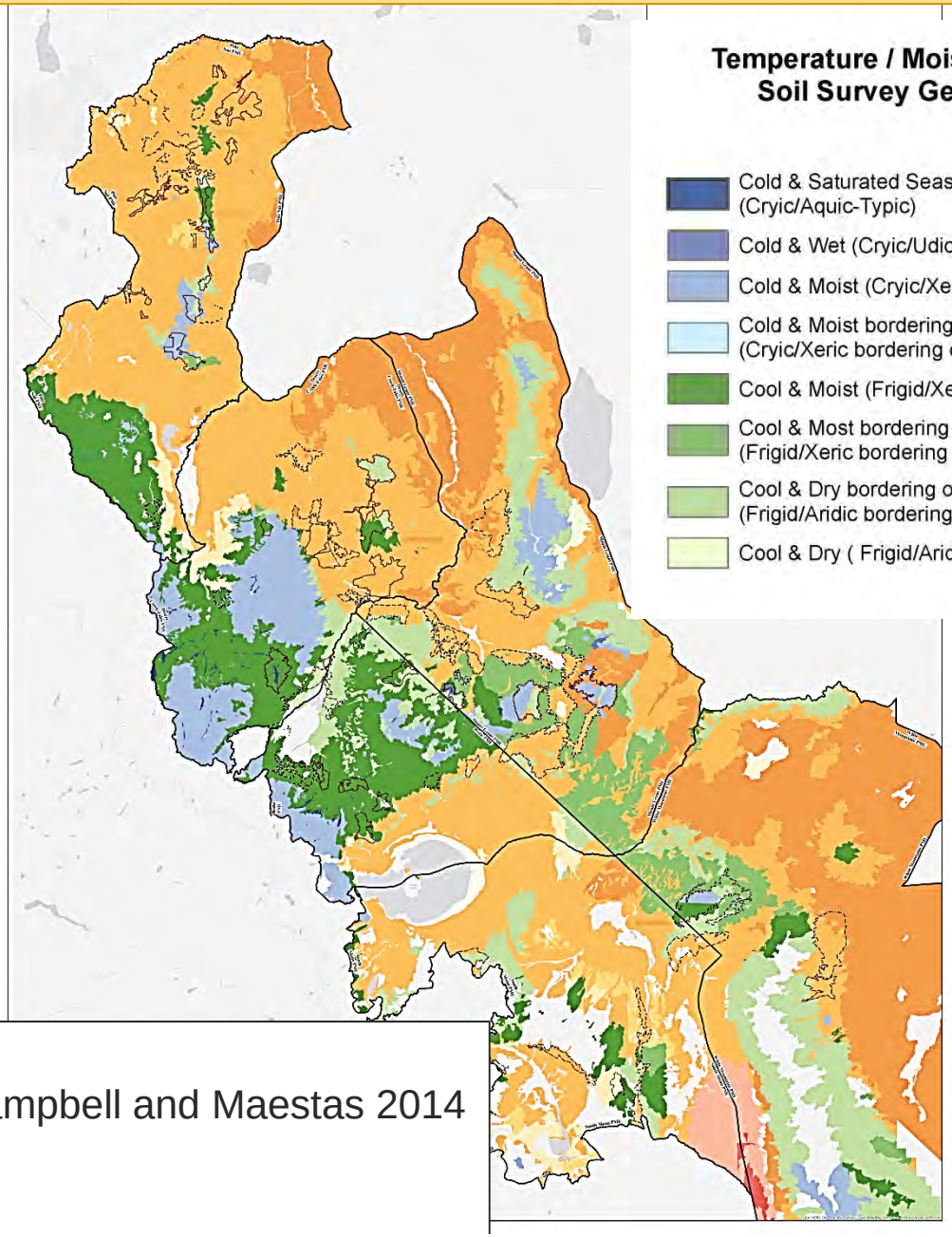
- Priority Areas for Conservation (PACs)
  - Landscape scale cover of sagebrush
  - Soil temperature/moisture regimes
- Threats
  - Pinyon and juniper cover
  - Invasive annual grasses and wildfire

Stepping Down to the Site

Selecting Appropriate Sites and Management Treatments

- Steps in the process
  - ➢ Identify ecological sites & assess potential treatment area
  - o Determine ecological states and plant communities for the different sites (Phase of tree expansion; Cover of shrubs and perennial herbaceous species)
  - o Evaluate relative R&R and select appropriate action(s)
  - o Monitor to determine post-treatment management

Soil Temperature & Moisture Regimes – BiState



Temperature / Moisture Regime - Moisture Subclass
Soil Survey Geographic Database (SSURGO)

- Cold & Saturated Seasonally (Cryic/Aquic-Typic)
- Cold & Wet (Cryic/Udic-Typic)
- Cold & Moist (Cryic/Xeric-Typic)
- Cold & Moist bordering on Dry (Cryic/Xeric bordering on Aridic)
- Cool & Moist (Frigid/Xeric-Typic)
- Cool & Most bordering on Dry (Frigid/Xeric bordering on Aridic)
- Cool & Dry bordering on Moist (Frigid/Aridic bordering on Xeric)
- Cool & Dry (Frigid/Aridic-Typic)
- Warm & Saturated Seasonally (Mesic/Aquic-Typic)
- Warm & Saturated Seasonally but Drier (Mesic/Aquic-Aeric)
- Warm & Moist (Mesic/Xeric-Typic)
- Warm & Moist bordering on Dry (Mesic/Xeric bordering on Aridic)
- Warm & Dry bordering on Moist (Mesic/Aridic bordering on Xeric)
- Warm & Dry (Mesic/Aridic-Typic)
- Hot & Dry bordering on Moist (Thermic/Aridic bordering on Xeric)
- Hot & Dry (Thermic/Aridic-Typic)

Potential Conifer Removal Projects (CPT Rankings)

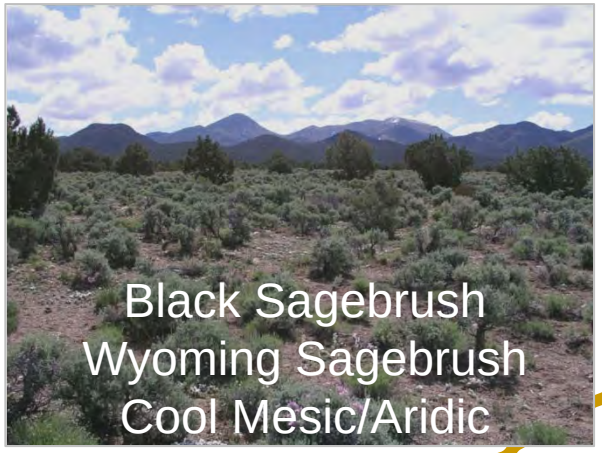
- Top Ranked
- Mid Ranked
- Lowest Ranked

Bi-state Sage-grouse Management

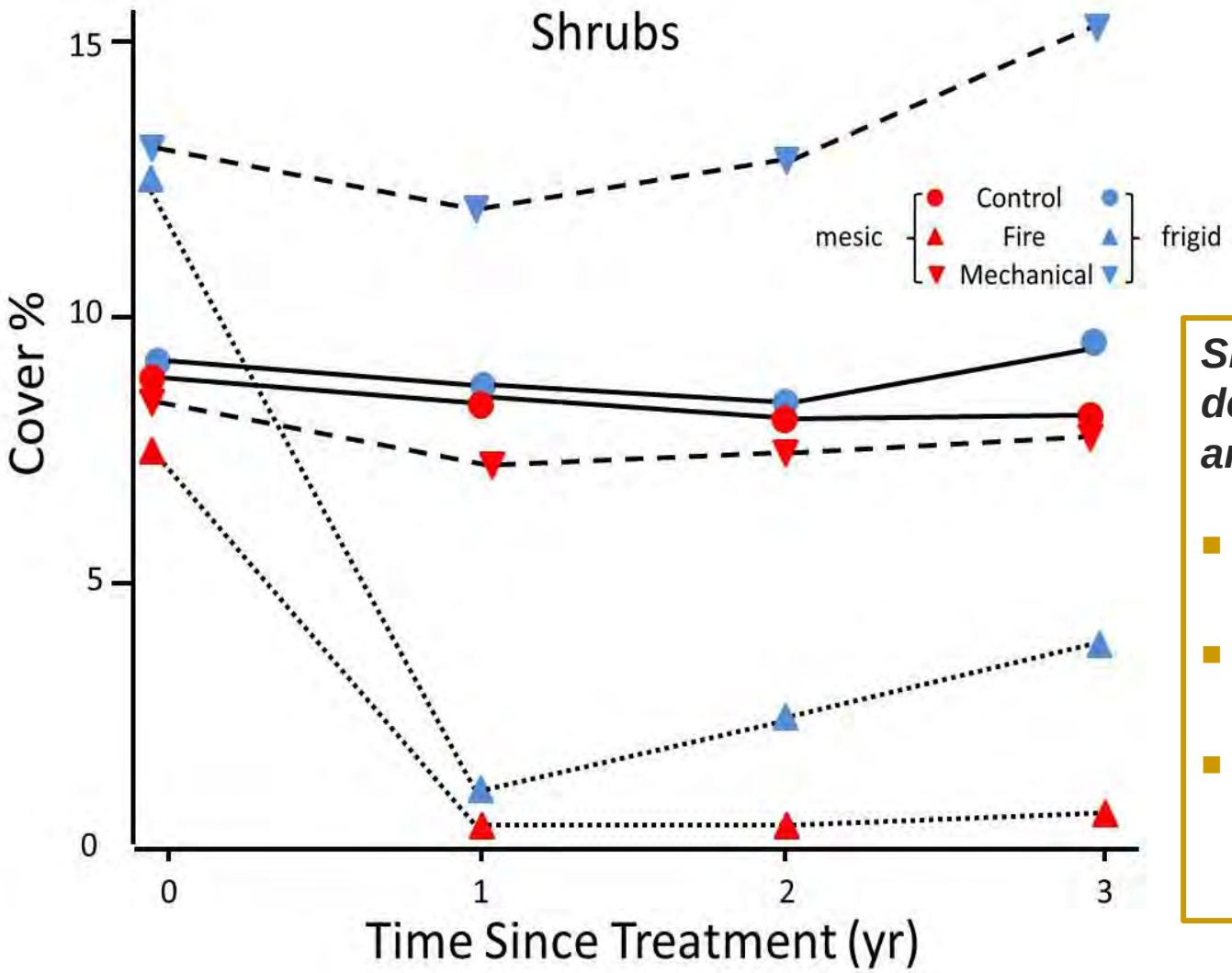
- Population Management Units

Campbell and Maestas 2014

Sagebrush Treatment Evaluation Project



Effect of Fire vs Mechanical Treatments

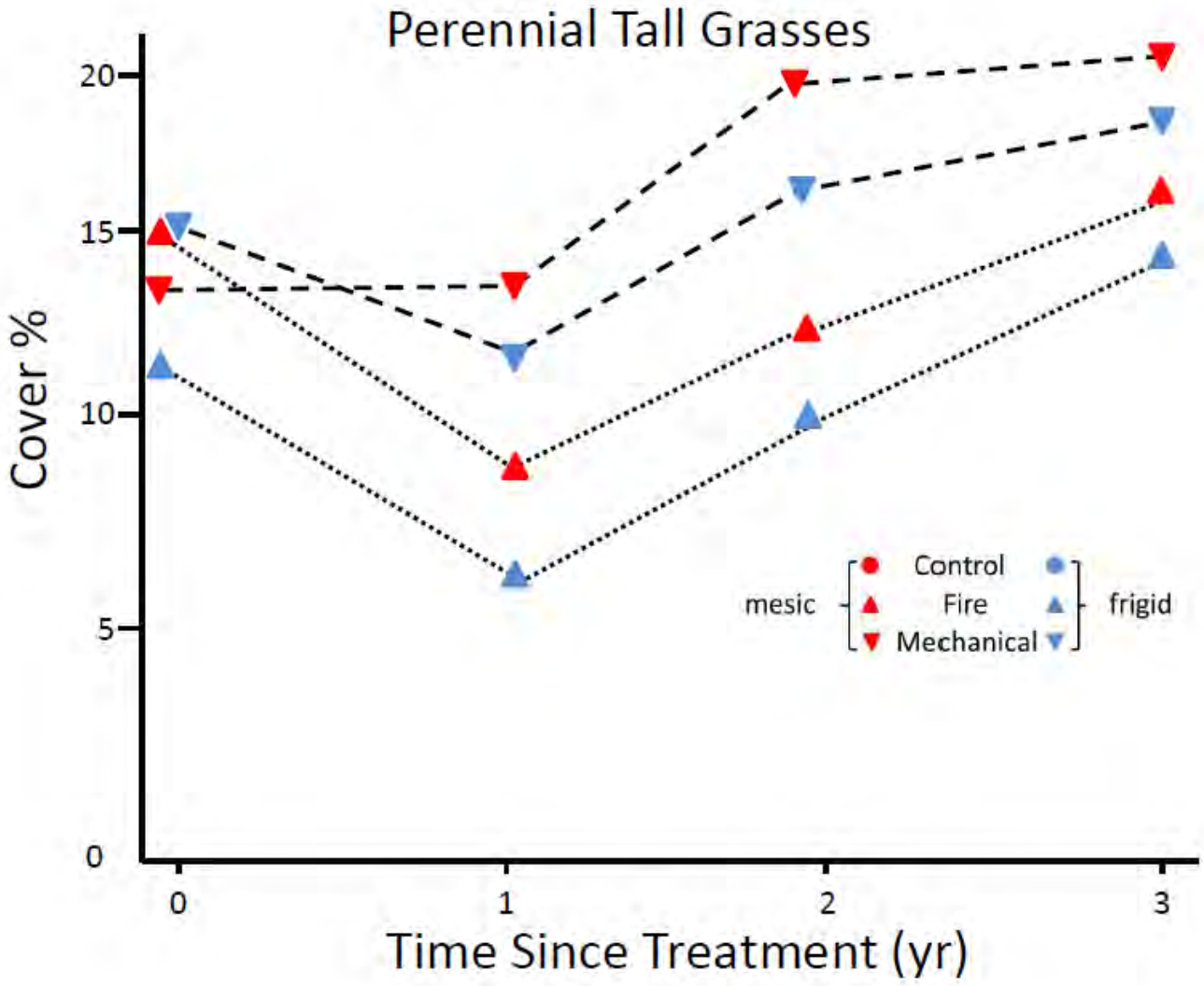


Shrub response depended on treatment and site type

- Large decrease after fire
- No increase on mesic after mechanical or fire
- Some increase on frigid after both mechanical and fire

Miller et al. 2014
Chambers et al. 2014

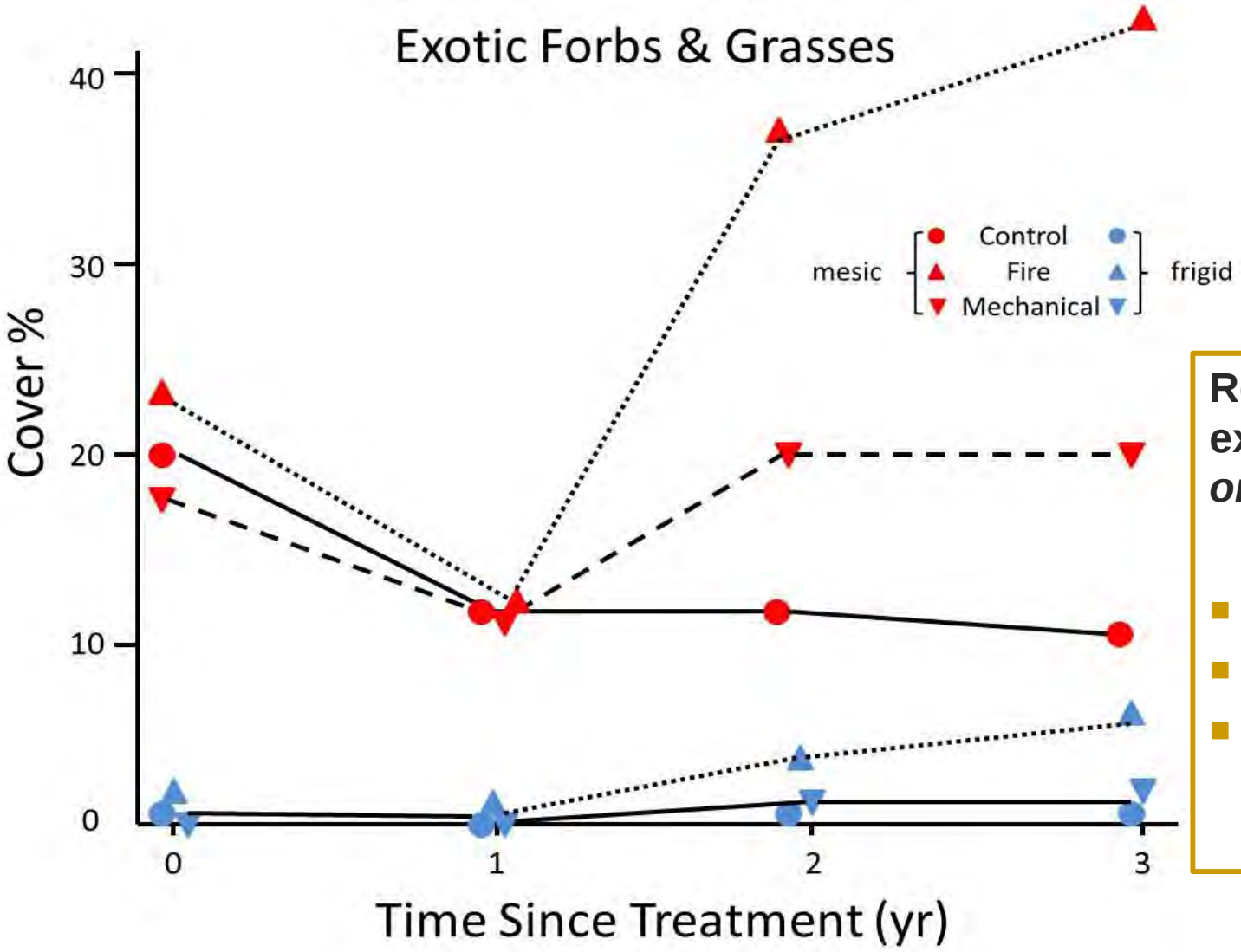
Effect of Fire vs Mechanical Treatments



Grass response to depended on treatment and site

- Temporary decrease after fire
- Longer-term increase for frigid with fire and mechanical
- Longer term increase for mesic only with mechanical

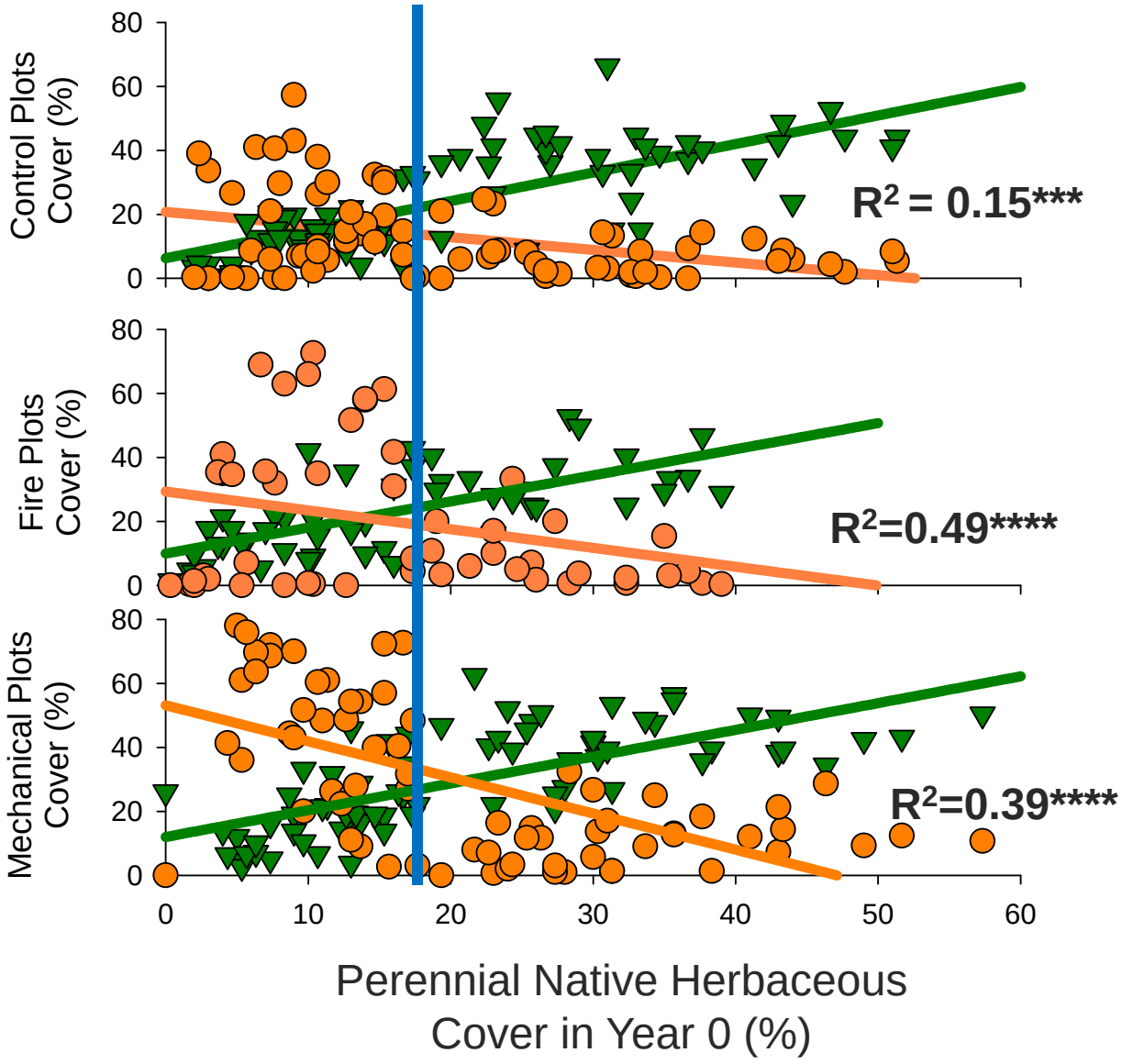
Effect of Fire vs Mechanical Treatments



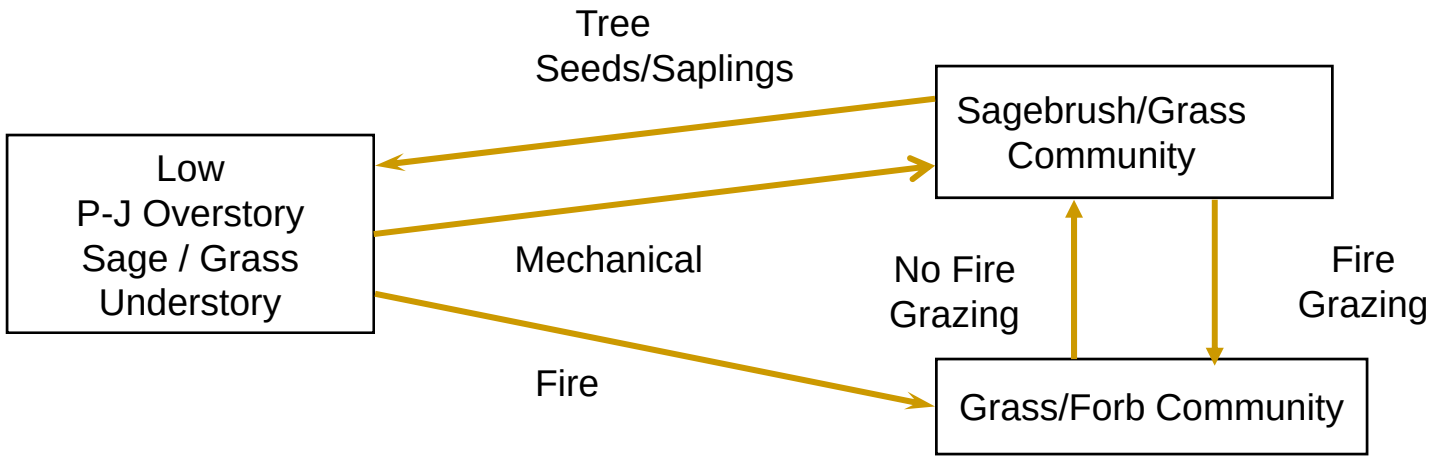
Resistance to exotics *depended on site*

- Low risk on frigid
- High risk on mesic
- Highest risk after fire on mesic

Perennial Native Herbs VS Cheatgrass



States and Transitions – State I (all types)



Variable resilience and resistance

- Lower treatment severity
- Sufficient native perennial grasses and forbs to facilitate recovery

Caveats

- Cheatgrass will probably always occur on Wyoming sage (Mesic/aridic bordering on xeric) and warmer mountain big sage (Frigid/xeric bordering on aridic) sites given a seed source
- Wyoming sage highest risk of cheatgrass dominance after fire
- Inappropriate grazing post treatment can result in cheatgrass dominance

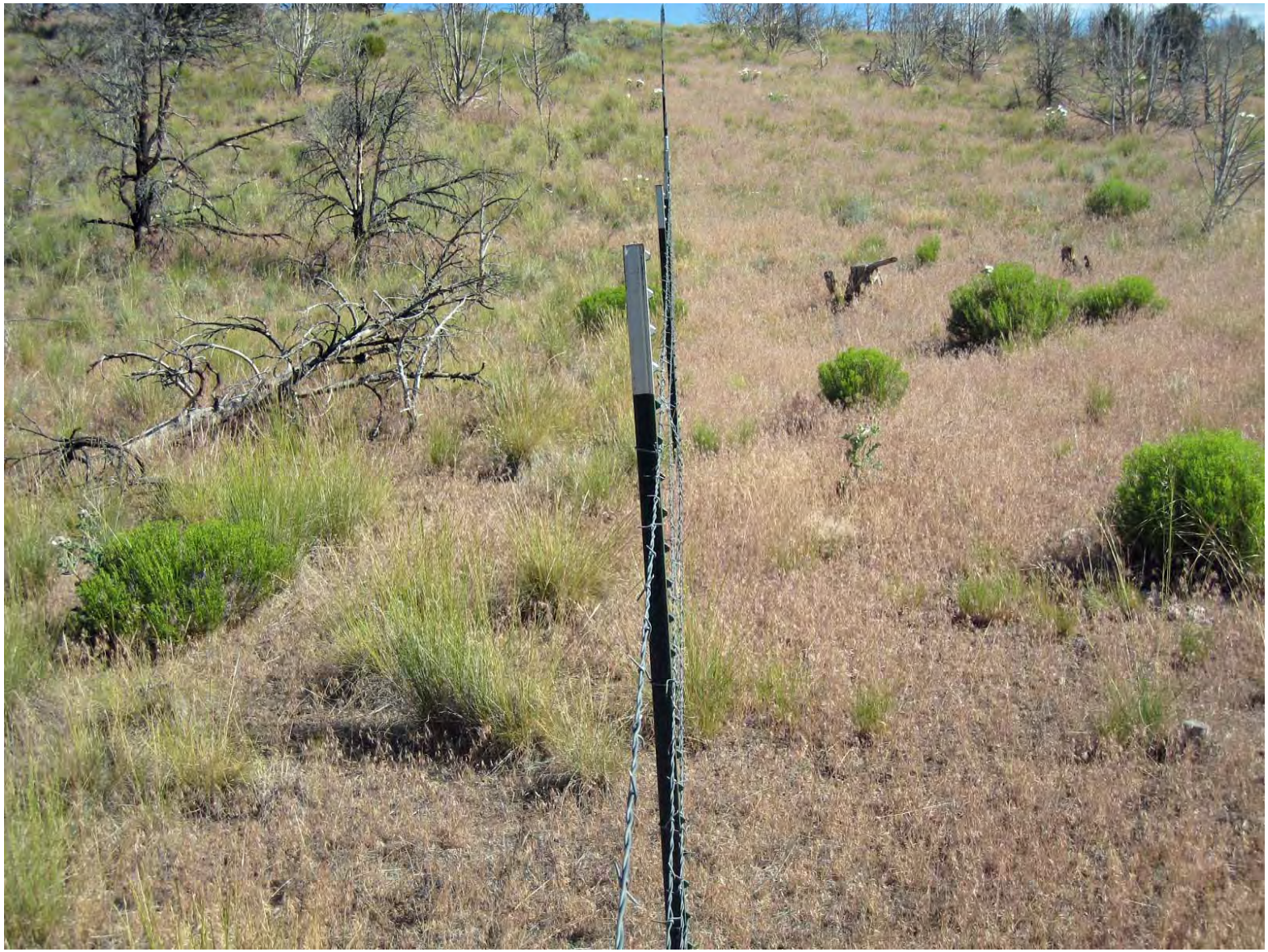
Mesic/Xeric basin big sagebrush and bluebunch wheatgrass site

3 years post-treatment

Cold Frigid/Xeric mountain big sagebrush and Idaho fescue site

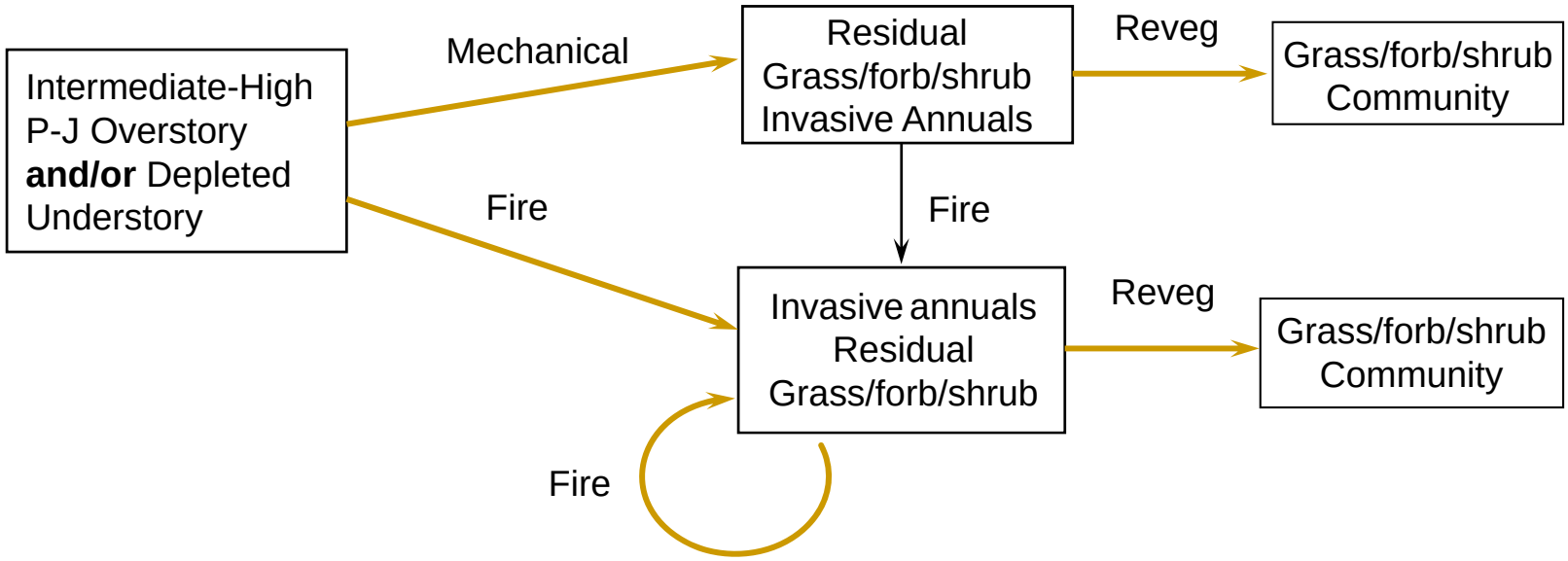
3 years post-burn

Cool Mesic/Aridic black sagebrush/
mountain big sagebrush/bluebunch wheatgrass site
5 years post-treatment



Cool Mesic/Aridic black sagebrush/
Wyoming sagebrushand bluebunch wheatgrass site
5 years post-treatment

State II – Wyoming sage (Mesic/Aridic) to Warmer and Drier Mountain Sage (Frigid/Xeric)



Low to moderate resilience and resistance

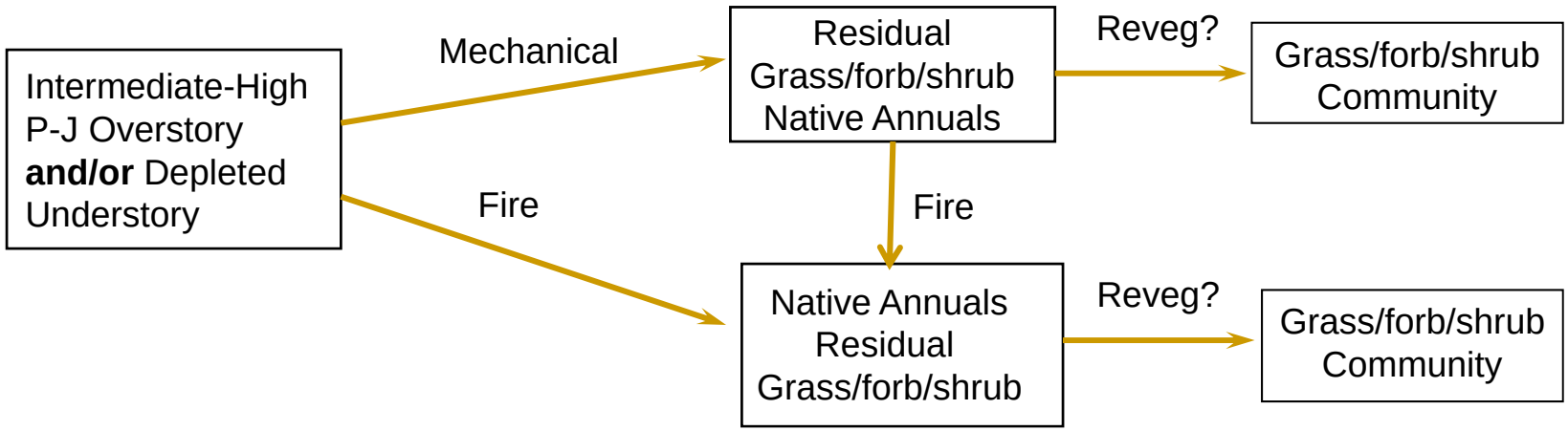
- High treatment severity
- Insufficient perennial grasses and forbs to facilitate recovery
- Most difficult to revegetate; may need repeated intervention

Caveats

- Effects of mechanical vs fire will depend on site conditions
- Livestock management necessary

Frigid/Xeric mountain big sagebrush/needle grass site

State II – Mountain Sage (Frigid/Xeric) to Mountain Brush (Cryic/Xeric)



Moderate to high resilience and resistance

- High treatment severity
- Recovery slow due to limited perennial grasses and forbs
- Risk of cheatgrass low

Caveats

- Reveg probably not be required to prevent site conversion; stabilization?
- Livestock management necessary

Cryic/xeric mountain brush/Idaho fescue-June grass site

DECISION TOOLS

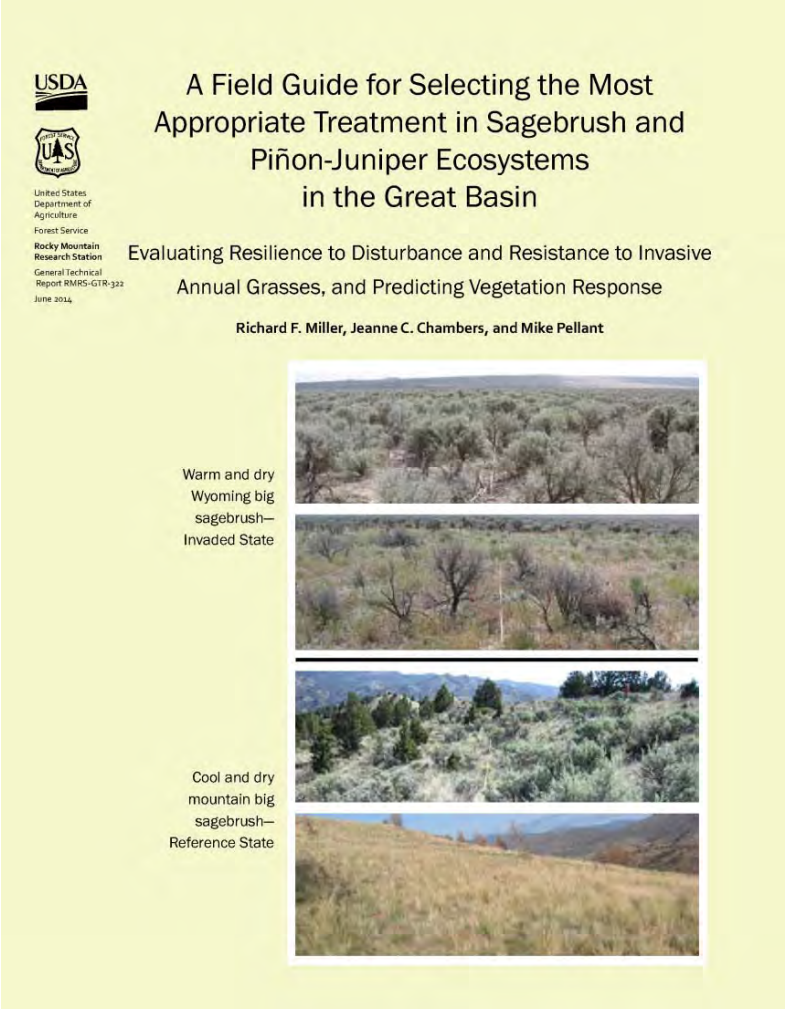
Field Guides

- Selecting the most appropriate treatments (Miller, Chambers, & Pellant)

- Evaluating site recovery potential after wildfire (Miller, Chambers, & Pellant)

Management Briefs

- Explanations of management activities to help managers implement best practices
  - Post-fire rehabilitation
  - Fuels management
  - Restoration and recovery



http://www.treesearch.fs.fed.us/pubs/45771

Value Added By Incorporating Resilience and Resistance

- *USGS Habitat Suitability/Decision Models*
  - *Sage-grouse populations and movements*
  - *General habitat suitability based on sage-grouse occupancy*
  - *Pinyon and juniper threat*
  - ✓ *Potential treatment areas for maintaining viable sage-grouse populations*

- *Resilience and Resistance Information*
  - *Potential for recovery and invasion following disturbance or management treatments*
  - *Integration with habitat requirements*
  - ✓ *Increased ability to prioritize treatment areas and select appropriate treatments*

FIRE & INVASIVES WORKING GROUP & ASSESSMENT TEAM

Fire Ecology and Fire Suppression

Pete Anderson - NV State Forester
Laurie Kurth – USFS
†Tim Metzger - USFS
Ted Milesneck - BLM
*†Doug Havlina - BLM

Wildlife Management and Sage-grouse Ecology

†*Lou Ballard – USFWS-NIFC*
Tom Christiansen - WYGF
Dawn Davis - ODFW
*Shawn Espinosa – NDOW
†Mike Greg - FWS
Don Kemner – IDFG
†Steve Knick - USGS
*†Jeremy Maestas – NRCS
*Ken Mayer – WAFWA
†Clint McCarthy - FS
†Tom Rinkes - BLM

Restoration Ecology, Range Management, Invasive Species

*† Chad Boyd - ARS
*† Jeanne Chambers - USFS, RMRS
Mike Ielmini - USFS
Brian Mealor - UWY
*† Mike Pellant - BLM
*†David Pyke - USGS
Jason Vernon - UTDW

Federal Land Management And Planning

†Joe Tauge – BLM
†Randy Sharp – FS

†Todd Hopkins – FWS (GB LCC)
*† Amarina Wuenschel – GB LCC

- *GTR Authors
- †FIAT Development Team