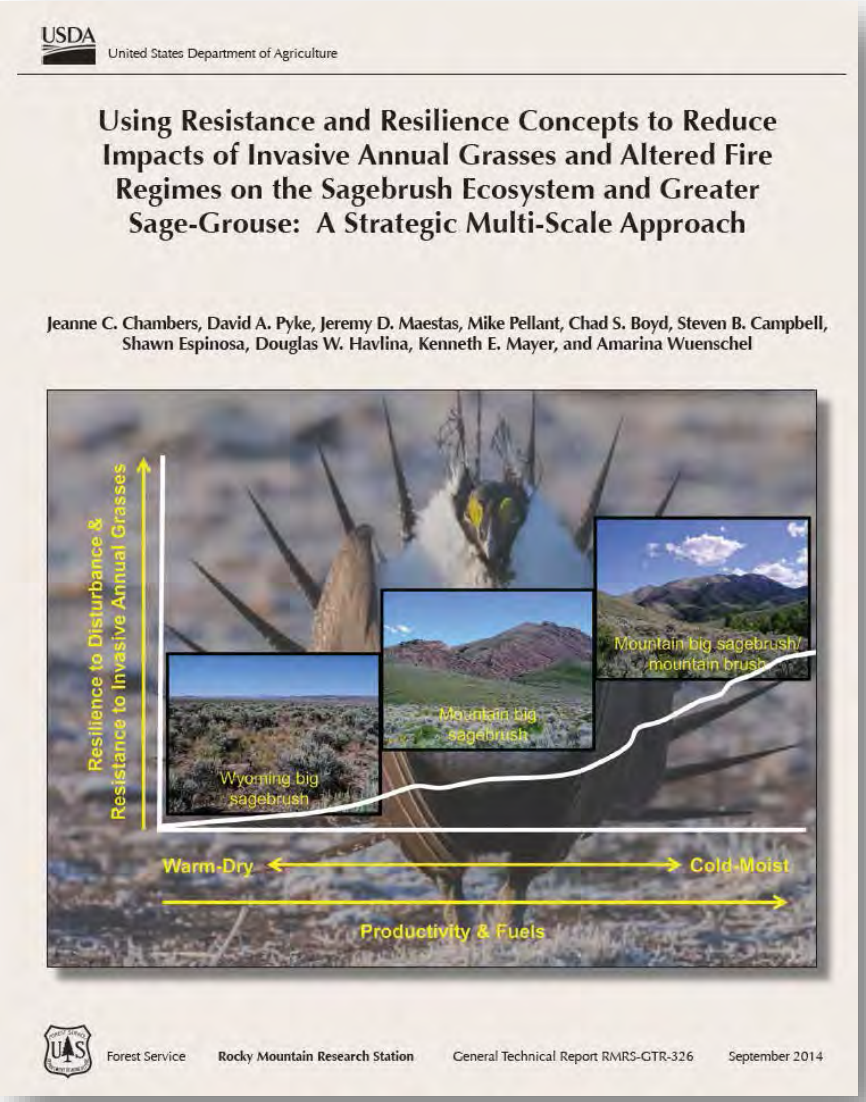
Using Resilience and Resistance Concepts to Manage Threats to Sagebrush Ecosystems, Gunnison Sage-Grouse, and Greater Sage-Grouse

Jeanne C. Chambers, Jeffrey L. Beck, Steve Campbell, John Carlson, Thomas J. Christiansen, Karen Clause, Jonathan B. Dinkins, Kevin E. Doherty, Kathleen A. Griffin, Douglas W. Havlina, Ken Henke, Jacob D. Hennig, Laurie Kurth, Jeremy D. Maestas, Mary Manning, Kenneth E. Mayer, Brian A. Mealor, Clinton W. McCarthy, Marco A. Perea, David A. Pyke

BACKGROUND – WESTERN RANGE


USDA United States Department of Agriculture

Using Resistance and Resilience Concepts to Reduce Impacts of Invasive Annual Grasses and Altered Fire Regimes on the Sagebrush Ecosystem and Greater Sage-Grouse: A Strategic Multi-Scale Approach

Jeanne C. Chambers, David A. Pyke, Jeremy D. Maestas, Mike Pellant, Chad S. Boyd, Steven B. Campbell, Shawn Espinosa, Douglas W. Havlina, Kenneth E. Mayer, and Amarina Wuenschel

Forest Service Rocky Mountain Research Station General Technical Report RMRS-GTR-326 September 2014

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

WAFWA Fire and Invasives Working Group –

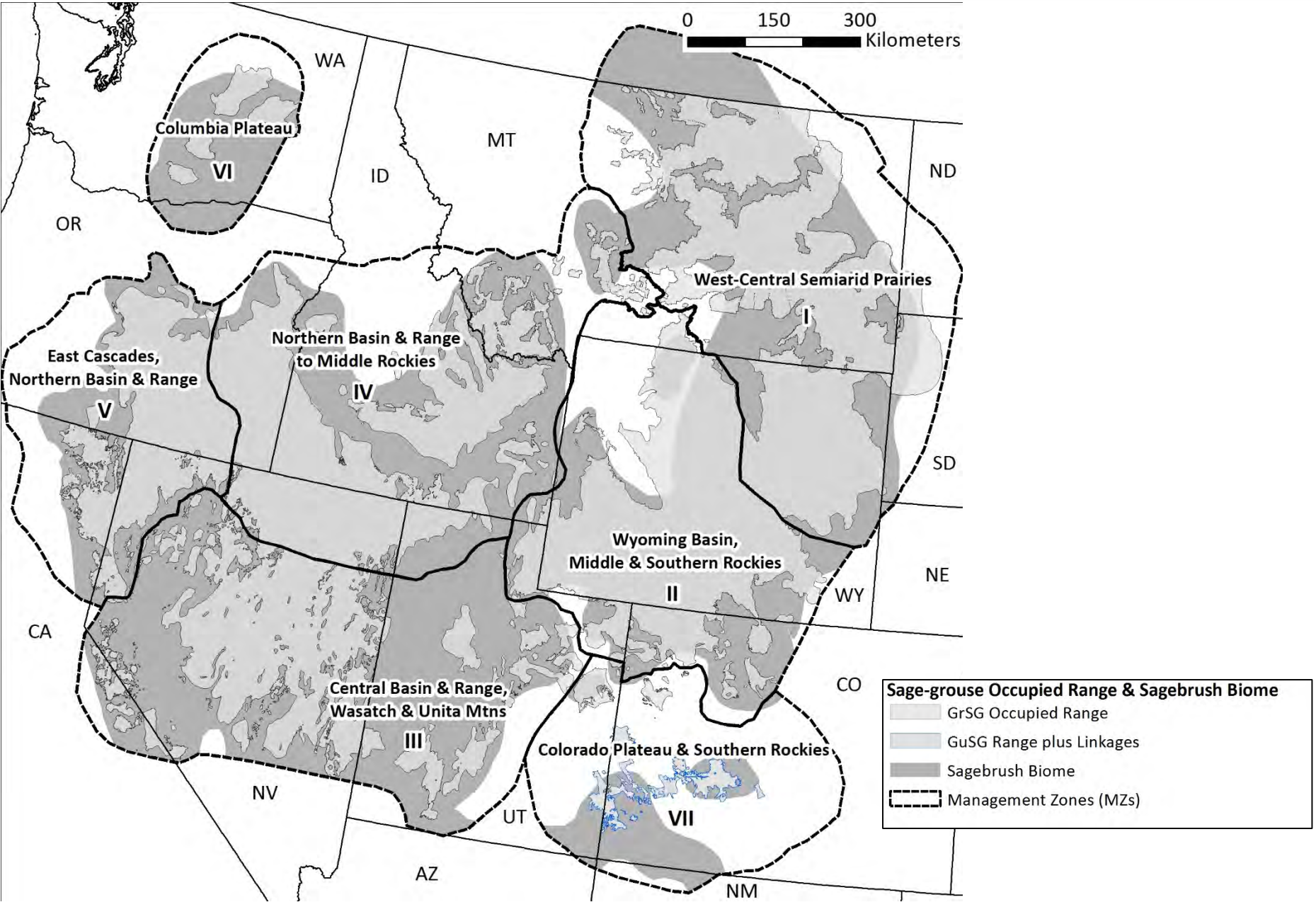
- Developed scientific basis to -
  - Prioritize areas for management in the Great Basin
  - Determine management strategies
- Approach incorporated into-
  - BLM Fire and Invasives Assessment Tool (FIAT)
  - DOI SO 3336 (Rangeland Fire Prevention, Management & Restoration)

Background – Eastern Range

WAFWA Sagebrush Management Resilience & Resistance Working Group -

- Develop similar approach for Gunnison and Greater sage-grouse in eastern range
- Basis for the Science Framework for the Conservation & Restoration and Mitigation Strategies (SO 3336)
- Publish a General Technical Report

Sage-Grouse Management Zones & Ecoregions



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

Management Goals for Sagebrush ecosystems

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

Primary Threats to Sagebrush Ecosystems

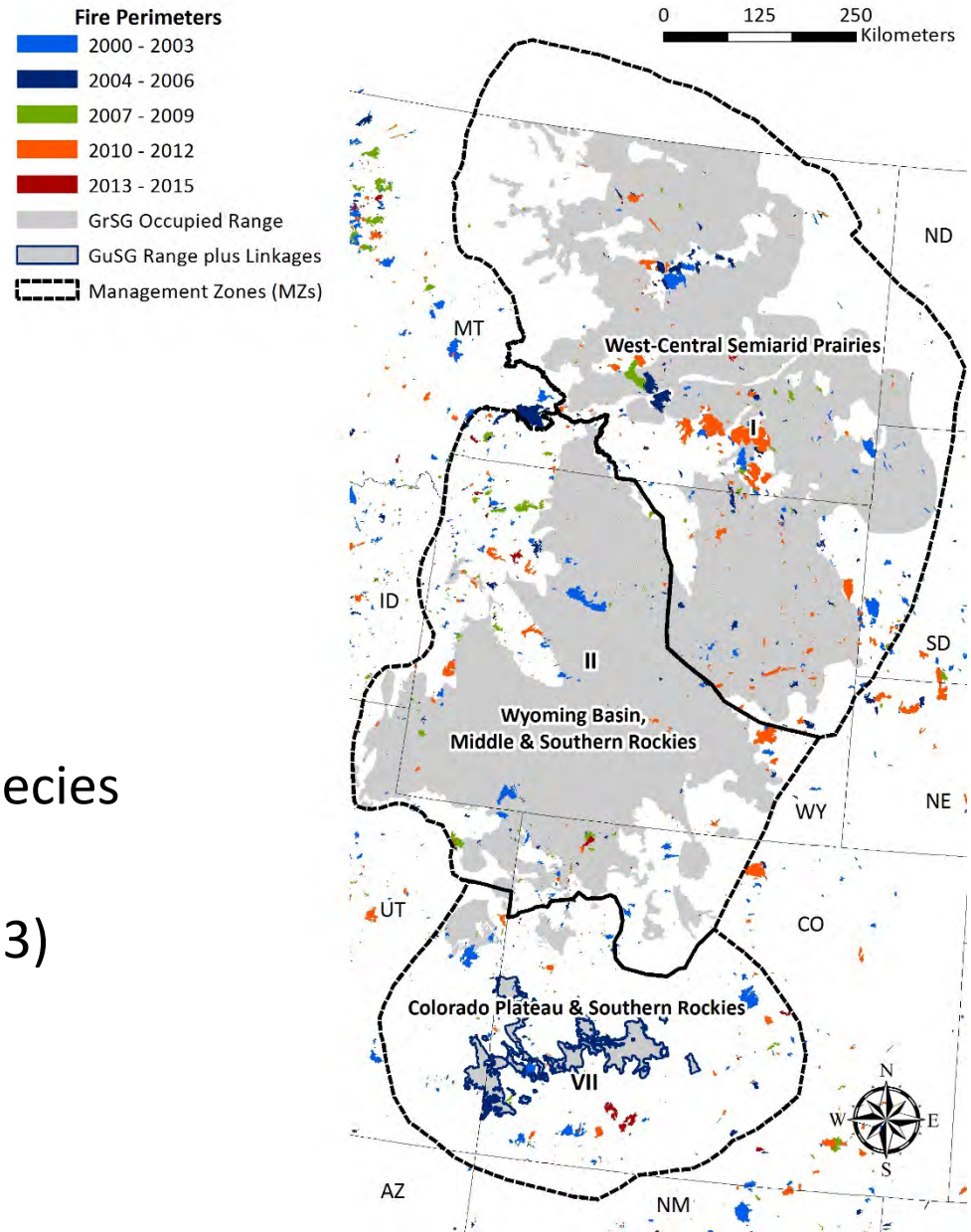
Ecosystem-Based Threats

- Nonnative Invasive Species
- Altered Fire Regimes
- Conifer Expansion

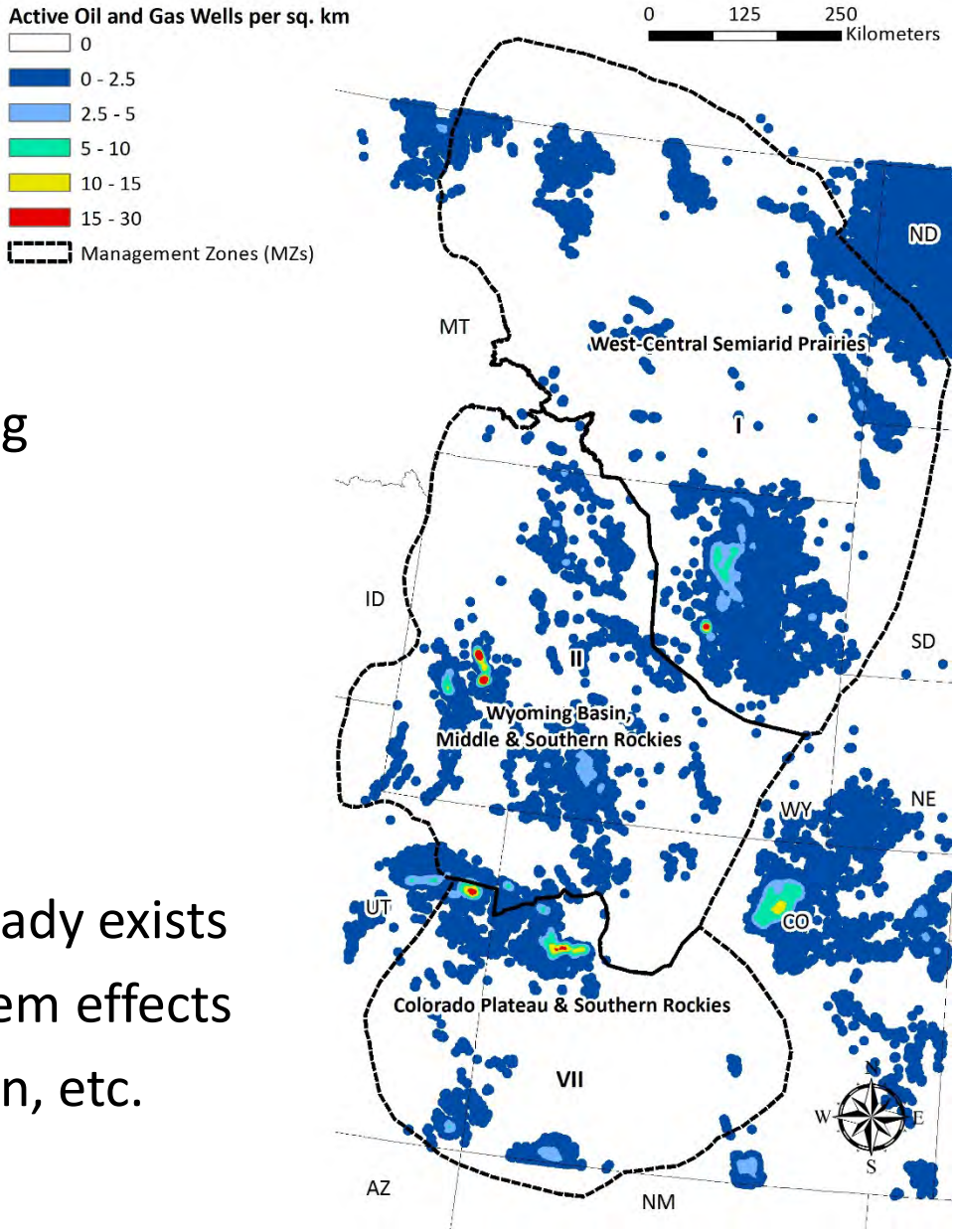
Climate Change

- Effects on Ecosystems and Species

❖ Identified in COT Report (2013)



Primary Threats to Sagebrush Ecosystems

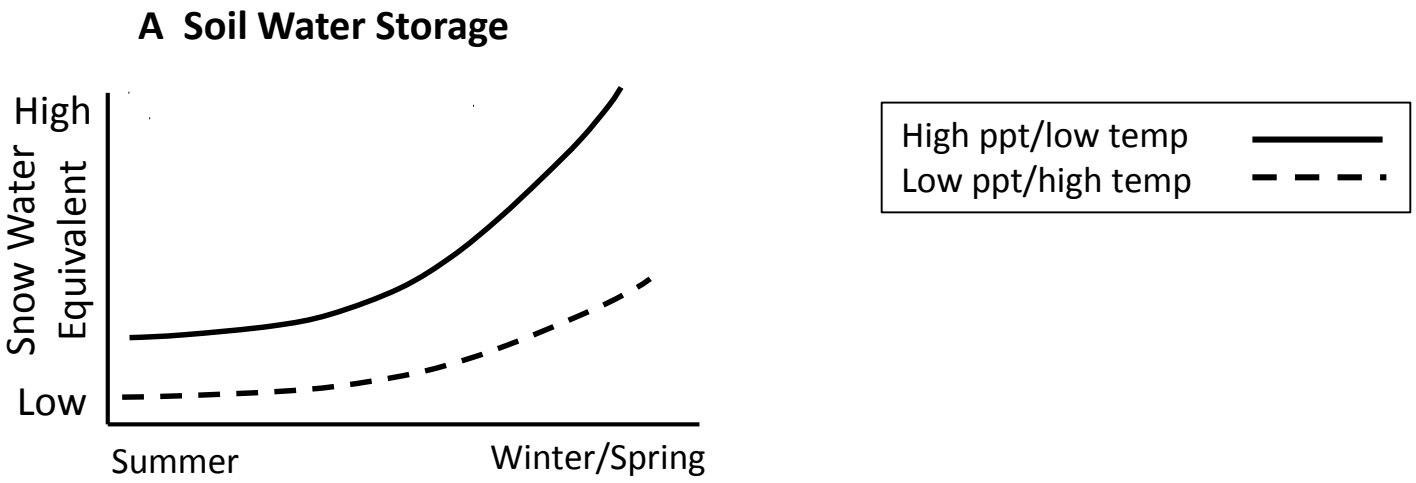


Policy-Regulatable Threats

- Inappropriate Livestock Grazing
- Agronomic Conversion
- Energy Development
- Exurban Development
- Recreation

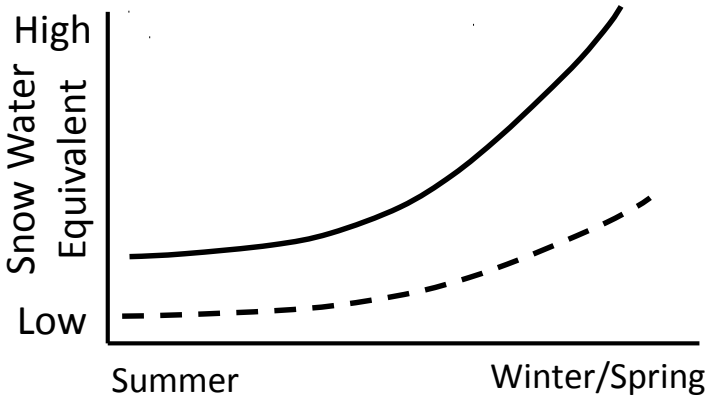
- Documentation of threats already exists
- Focus is on secondary ecosystem effects – fragmentation, weed invasion, etc.

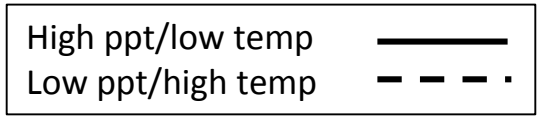
Environmental Differences



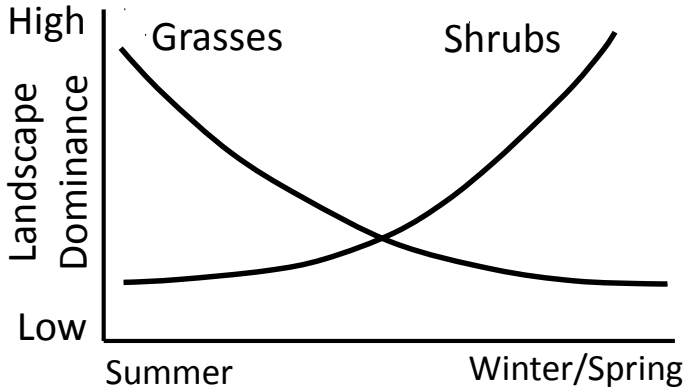
Environmental Differences

A Soil Water Storage



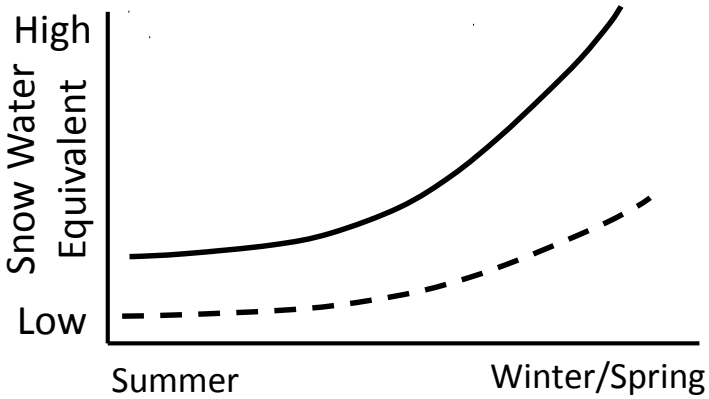


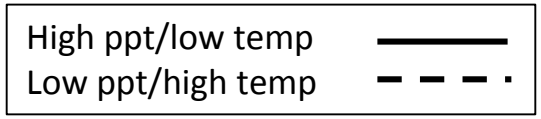
B Life Form Dominance



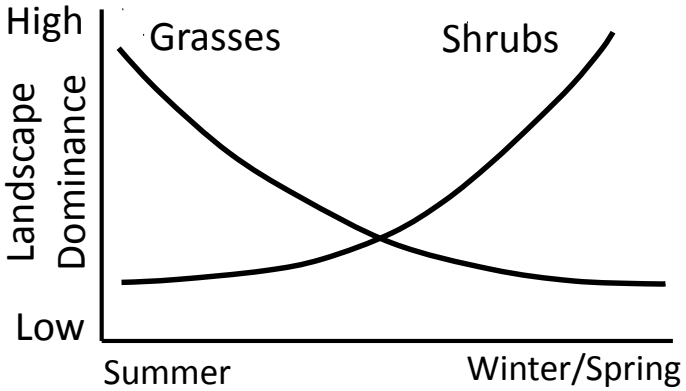
Environmental Differences

A Soil Water Storage

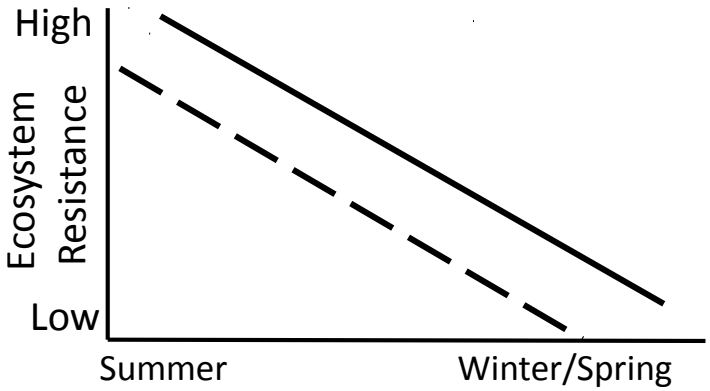




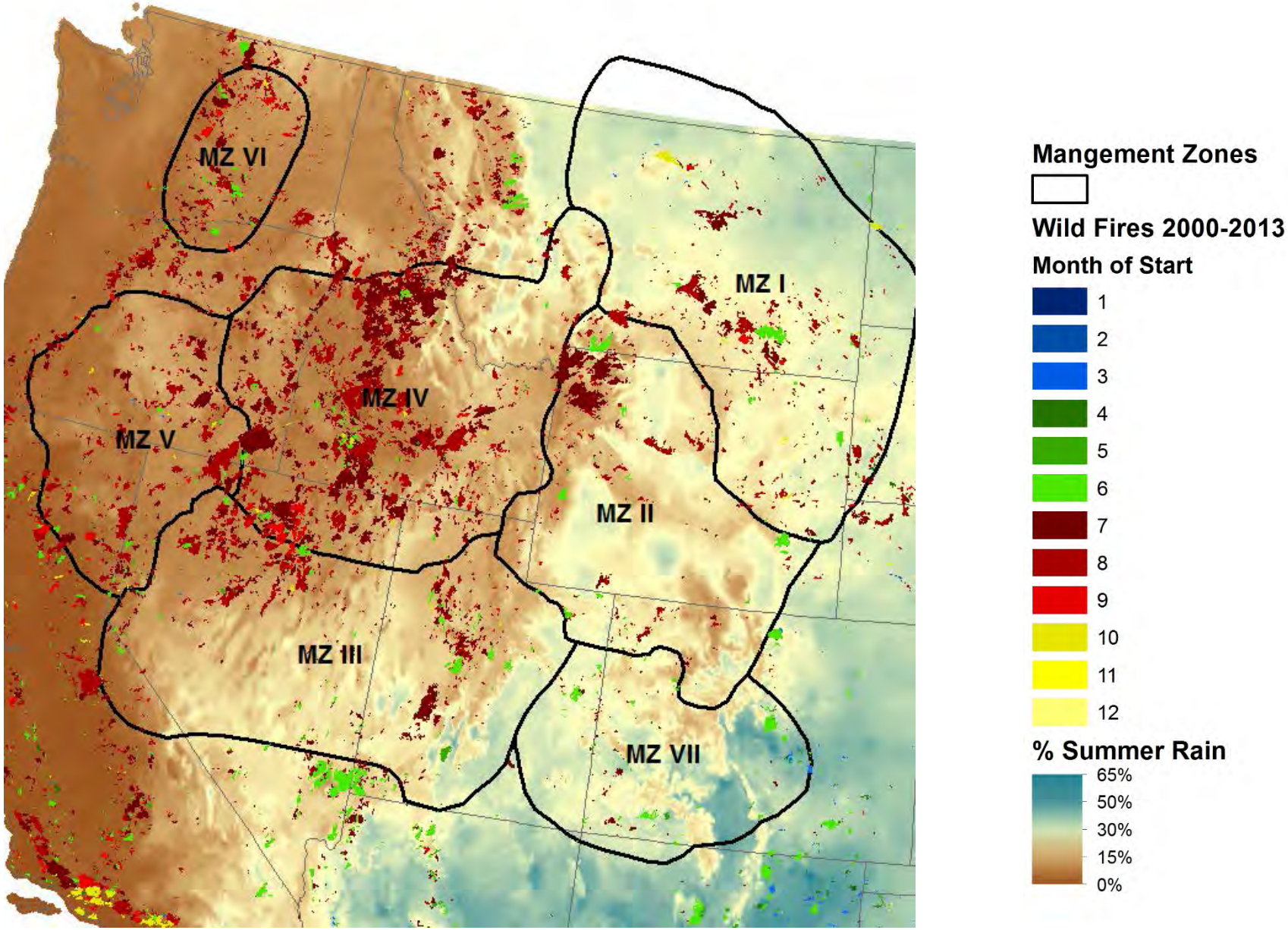
B Life Form Dominance



C Resistance to Annual *Bromus*



Environmental Differences



Components of The Strategic, Multi-Scale Approach

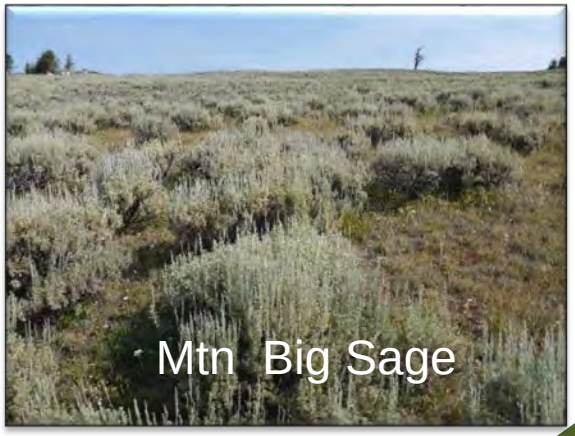
Six Components

1) Develop an understanding of ecosystem resilience and resistance for the planning region
2) Identify key habitat indicators
3) Develop management decision matrices
4) Assess key threats in planning area
5) Delineate focal habitats/areas for management
6) Determine the most appropriate management approach

- Scalable – Landscape to Site

Chambers et al. 2014 GTR-326

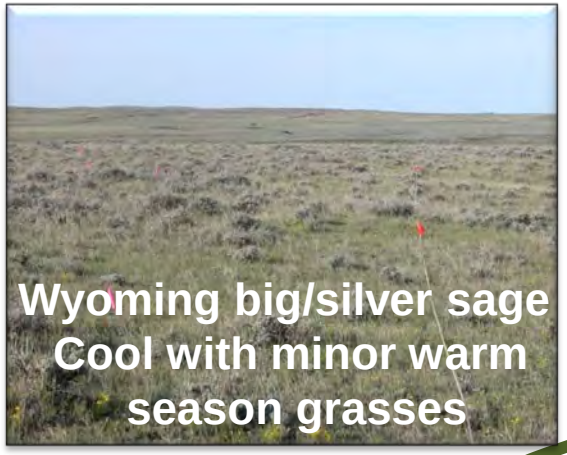
Environmental gradients
Cold Desert



Warm-Dry *to* Warm-Dry bordering on Summer Moist ⟷ **Cold-Wet *to* Cold- Summer Moist**

Productivity →

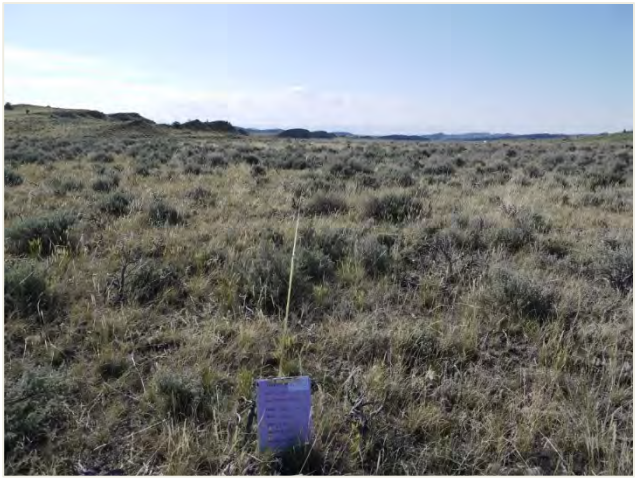
Environmental gradients West-central Semiarid Prairies

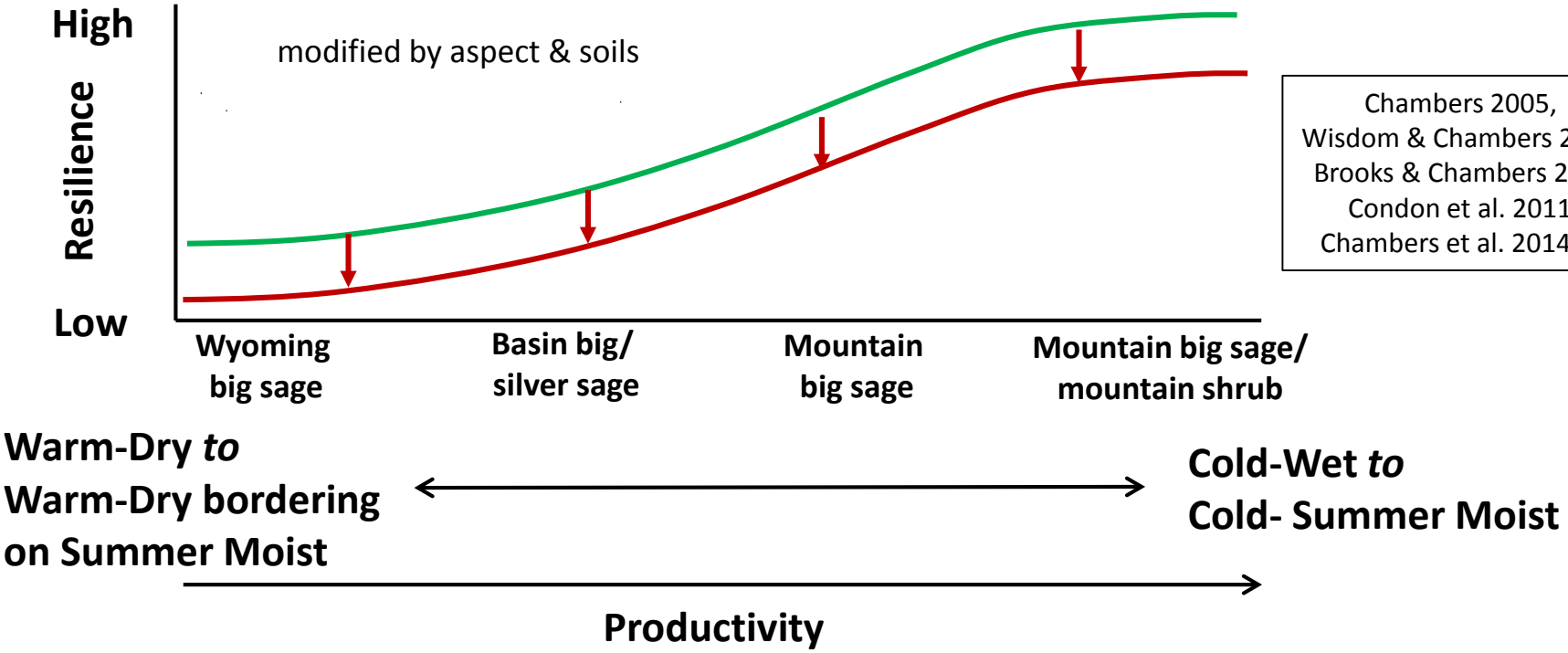


Warm-Summer Moist ⟷ Cold- Summer Moist

Productivity →

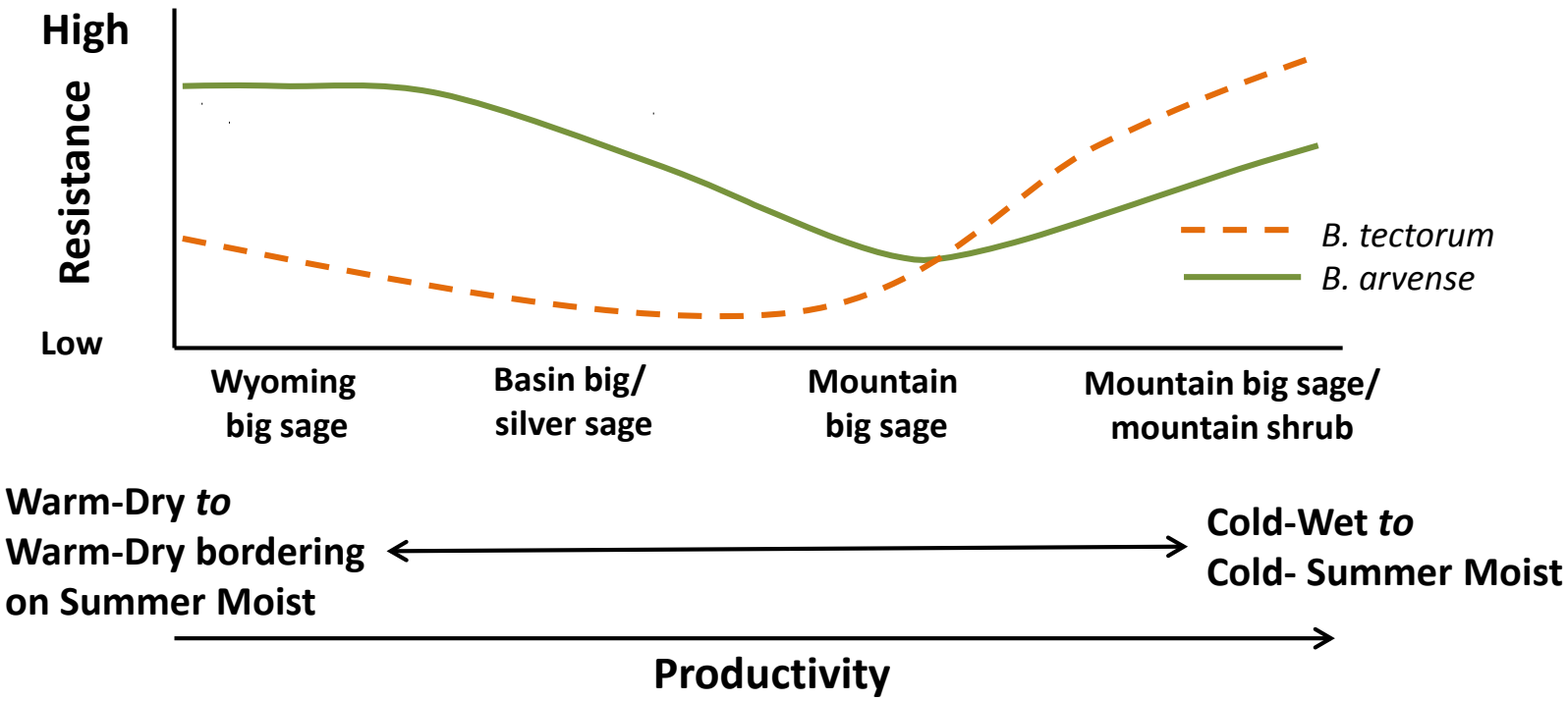
Resilience to Disturbance Cold Deserts





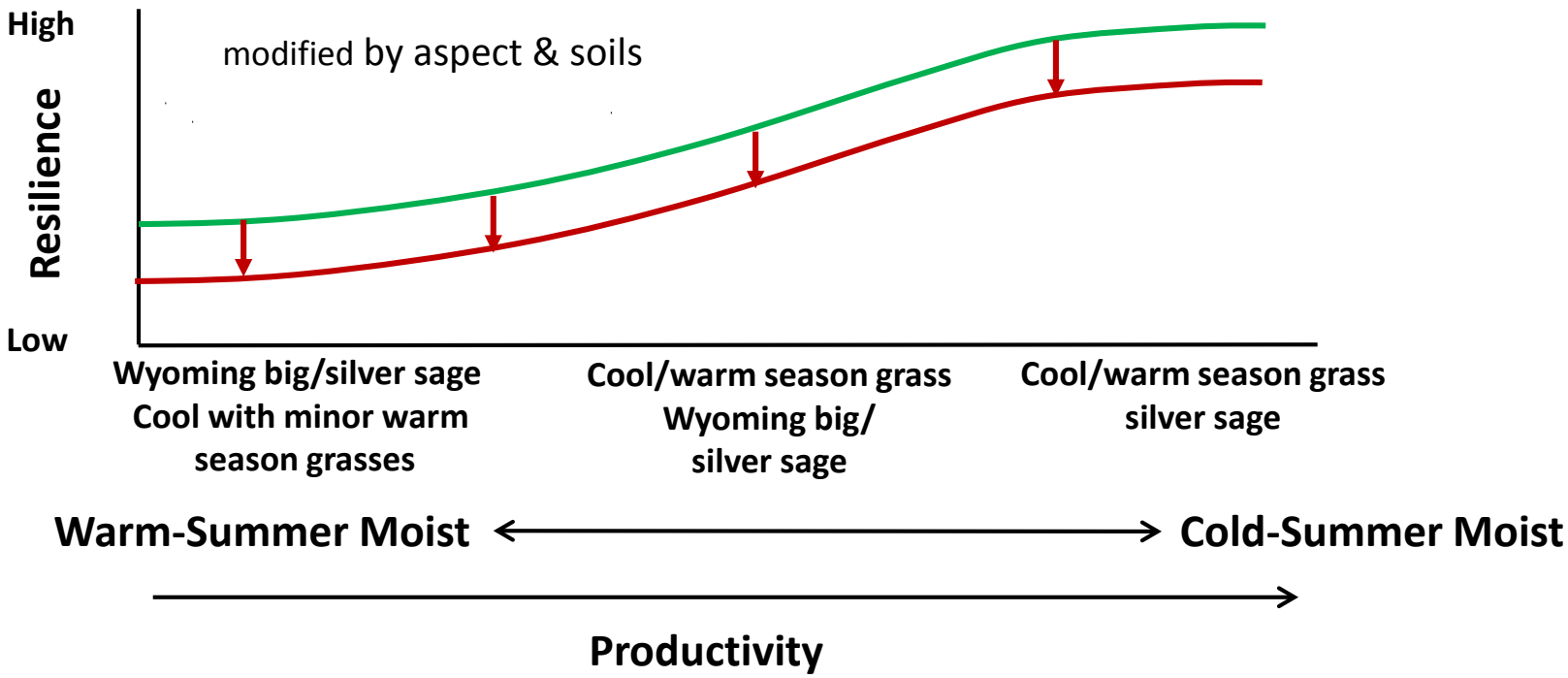
Chambers 2005, Wisdom & Chambers 2009; Brooks & Chambers 2011; Condon et al. 2011; Chambers et al. 2014a,b

Resistance to Brome Grasses Cold Deserts



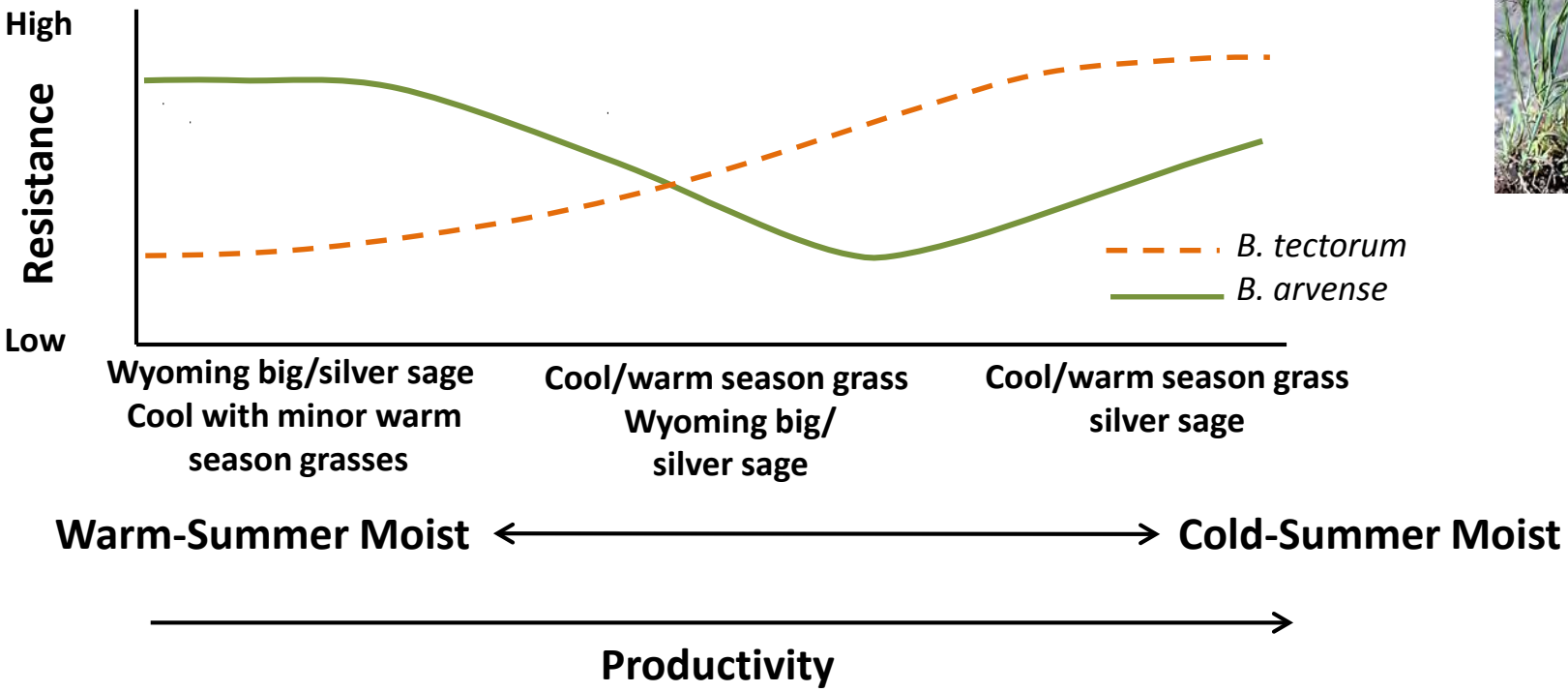
Chambers et al. 2007, 2014a, Brooks et al. 2016)

Resilience to Disturbance West-Central Semiarid Prairies



Chambers et al. 2016 in process

Resistance to Brome Grasses West-Central Semiarid Prairies



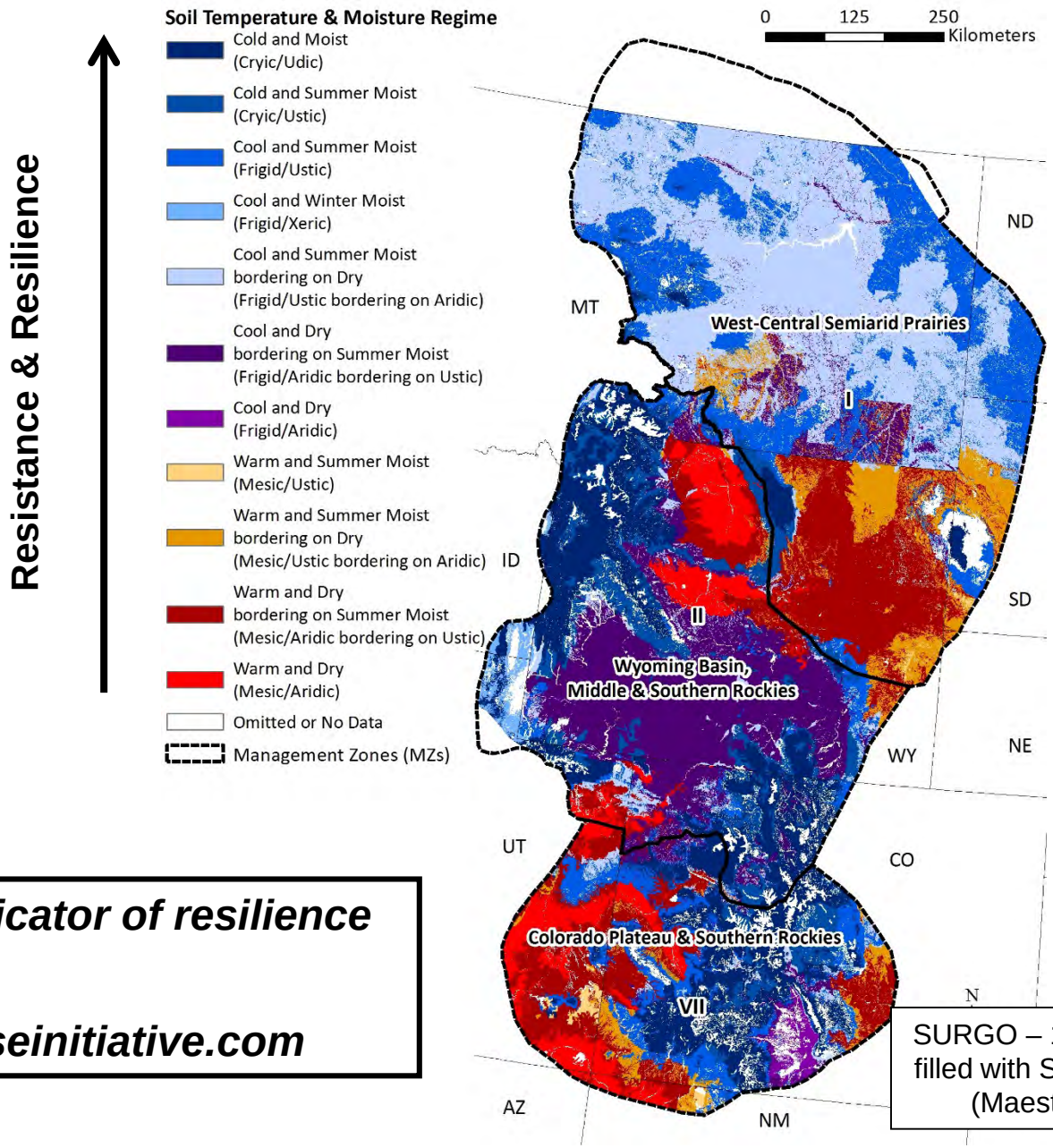
Chambers et al. 2016 in process

Resilience & Resistance of Ecological Types

Relative Resilience & Resistance: Low → High

Ecological Type	Characteristics	Resilience and resistance
Cold & Moist *Cryic (all)*	Ppt: 15-20+' Typical shrubs: Mountain big sagebrush, snowberry, serviceberry, silver sagebrush. Cool season bunch grasses	Resilience – High Resistance– High
Cool & Summer Moist *Frigid/Ustic*	Ppt: 12-22" Typical shrubs: Mountain big sagebrush, bitterbrush, snowberry. Cool season grasses **Piñon pine and juniper potential**	Resilience – Moderate to high Resistance – Moderate to high
Cool & Summer moist bordering on dry *Frigid/Ustic-Aridic*	Ppt: 12-16" Typical shrubs: Wyoming big sagebrush with basin big and silver sagebrush in drainages. Cool season grasses with some warm season grasses **Piñon pine and juniper potential**	Resilience – Moderate Resistance – Moderate
Warm & Summer moist bordering on dry *Xeric/Ustic-Aridic*	Ppt: 10-14" Typical shrubs: Wyoming big sagebrush, fourwing saltbush. Cool season grasses with some warm season grasses **Piñon pine and juniper potential**	Resilience – Moderate to Low Resistance – Low
Warm & Dry *Mesic/Aridic*	Ppt: 5-9"" Typical shrubs: Wyoming big sagebrush, salt desert shrubs. Cool season grasses with some warm season grasses.	Resilience – Moderate to Low Resistance – Low

Soil Temperature and Moisture Regimes

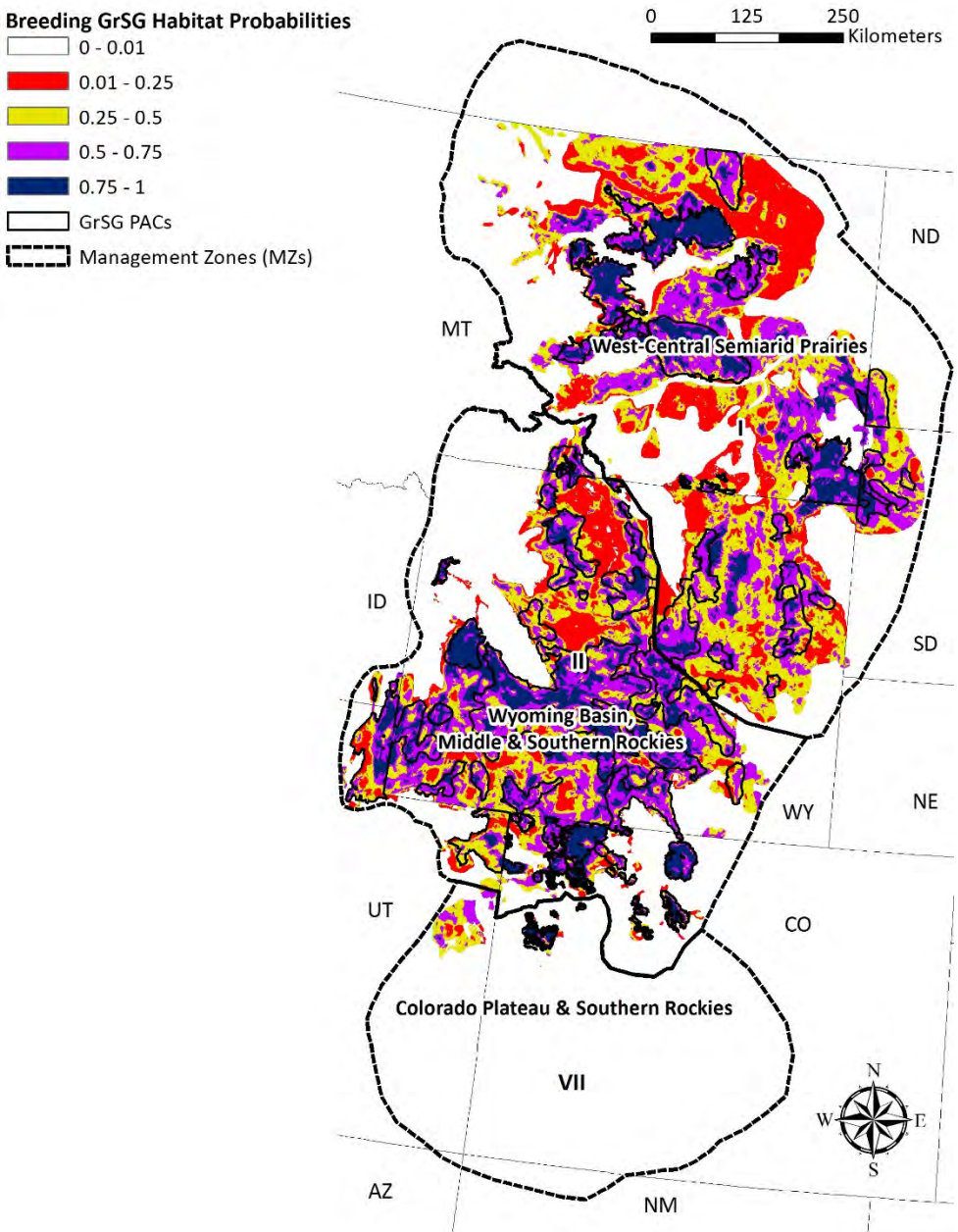


Landscape indicator of resilience & resistance

Map.sagegrouseinitiative.com

SURGO – 1:24,000 with gaps filled with STATCO -1:250:000 (Maestas et al. 2016)

SAGE-GROUSE BREEDING HABITAT PROBABILITIES



Bases Breeding Habitat on multivariate models –

- ***2010 – 2014 BBD data***

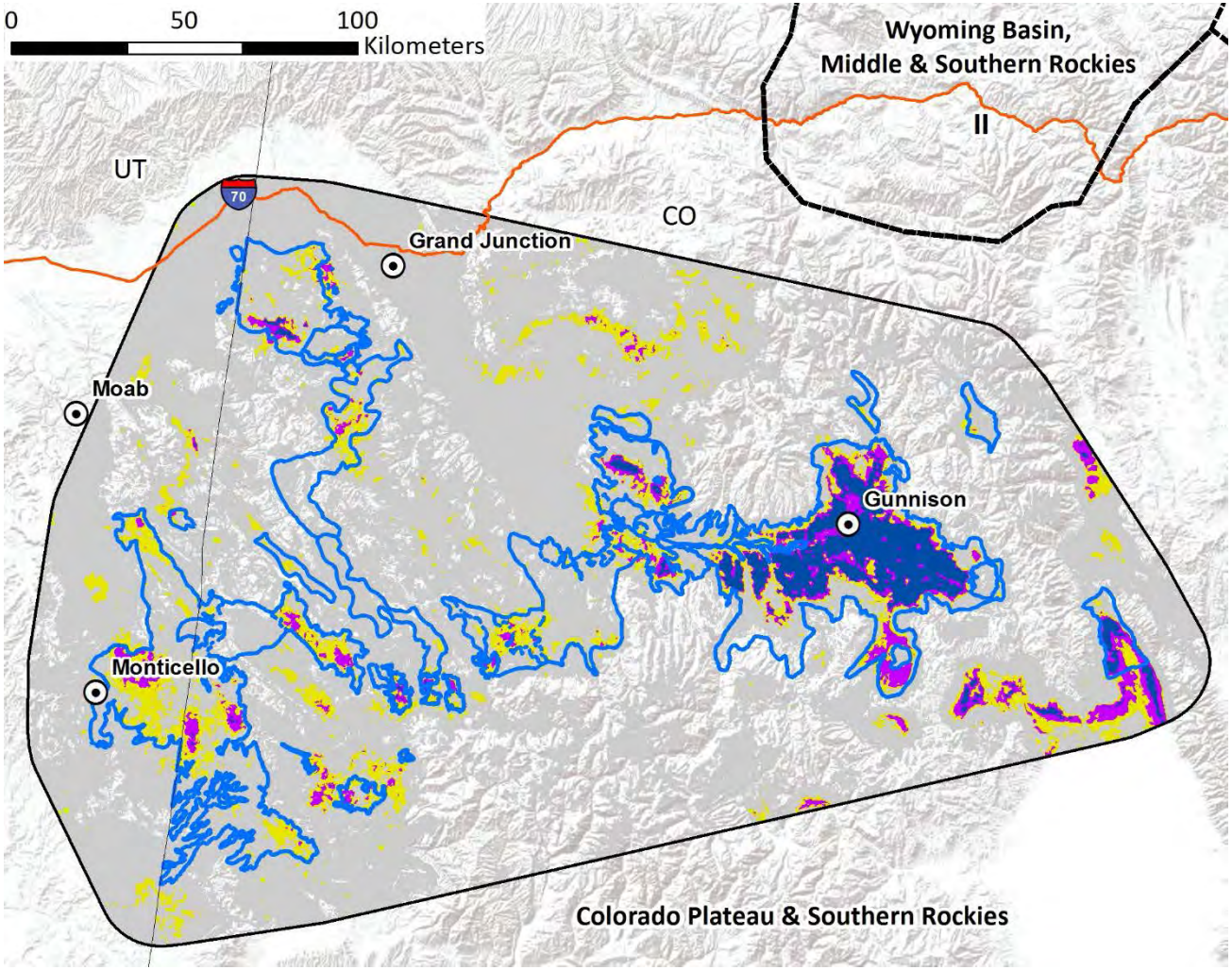
+ ***General Habitat***
+ ***Climate***
+ ***Landform***
+ ***Disturbance***

Doherty et al. 2015

GUNNISON SAGE-GROUSE BREEDING HABITAT PROBABILITIES

Breeding GuSG Habitat Probabilities

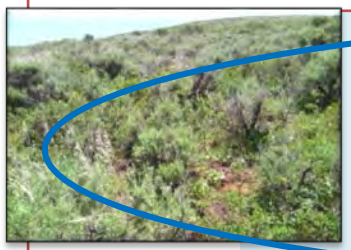
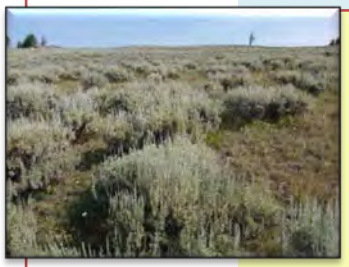
- 0 - 0.01
- 0.01 - 0.25
- 0.25 - 0.5
- 0.5 - 0.75
- 0.75 - 1
- GuSG Range plus Linkages
- GuSG Study Extent
- Management Zones (MZs)



Doherty et al. in process

SAGE-GROUSE HABITAT MATRIX

Probability of Sage-Grouse Habitat

Sagebrush Ecosystem Resilience & Resistance	***Low (0.25-0.75)*** Landscape context is likely limiting habitat suitability - significant restoration may be needed.	***Medium (0.5-0.75)*** Landscape context may be affecting habitat suitability – improve with management.	***High (> 0.75)*** Landscape context is highly suitable to support breeding habitat - maintain and enhance resilience & resistance.
 ***High***	**RESTORATION/RECOVERY POTENTIAL HIGH** *Native grasses and forbs sufficient for recovery* *Annual invasive risk low*		
 ***Moderate***	**RESTORATION/RECOVERY POTENTIAL INTERMEDIATE** *Native grasses and forbs usually adequate for recovery* *Annual invasive risk moderate* *Treatment success depends on site characteristics*		
Low	**RESTORATION/RECOVERY POTENTIAL LOW** *Native grasses and forbs inadequate for recovery* *Annual invasive risk is high* *May require multiple management interventions*		

SAGE-GROUSE HABITAT MATRIX

Probability of Sage-Grouse Habitat

Low (0.25-0.75)
Landscape context is likely limiting habitat suitability - significant restoration may be needed.

Medium (0.5-0.75)
Landscape context may be affecting habitat suitability – improve with management

High (> 0.75)
Landscape context is highly suitable to support breeding habitat - maintain and enhance resilience & resistance.

Sagebrush Ecosystem Resilience & Resistance

High

RESTORATION/RECOVERY POTENTIAL HIGH
Native grasses and forbs sufficient for recovery
Annual invasive risk low

Moderate

RESTORATION/RECOVERY POTENTIAL INTERMEDIATE
Native grasses and forbs usually adequate for recovery
Annual invasive risk moderate
Treatment success depends on site characteristics

Low

RESTORATION/RECOVERY POTENTIAL LOW
Native grasses and forbs inadequate for recovery
Annual invasive risk is high
May require multiple management interventions

Management Strategies

Linked to cells in Matrix & organized by threat

Ecosystem Threats

- Nonnative Invasive Species
- Wildfire
- Conifer Expansion

Policy-Regulatable Threats

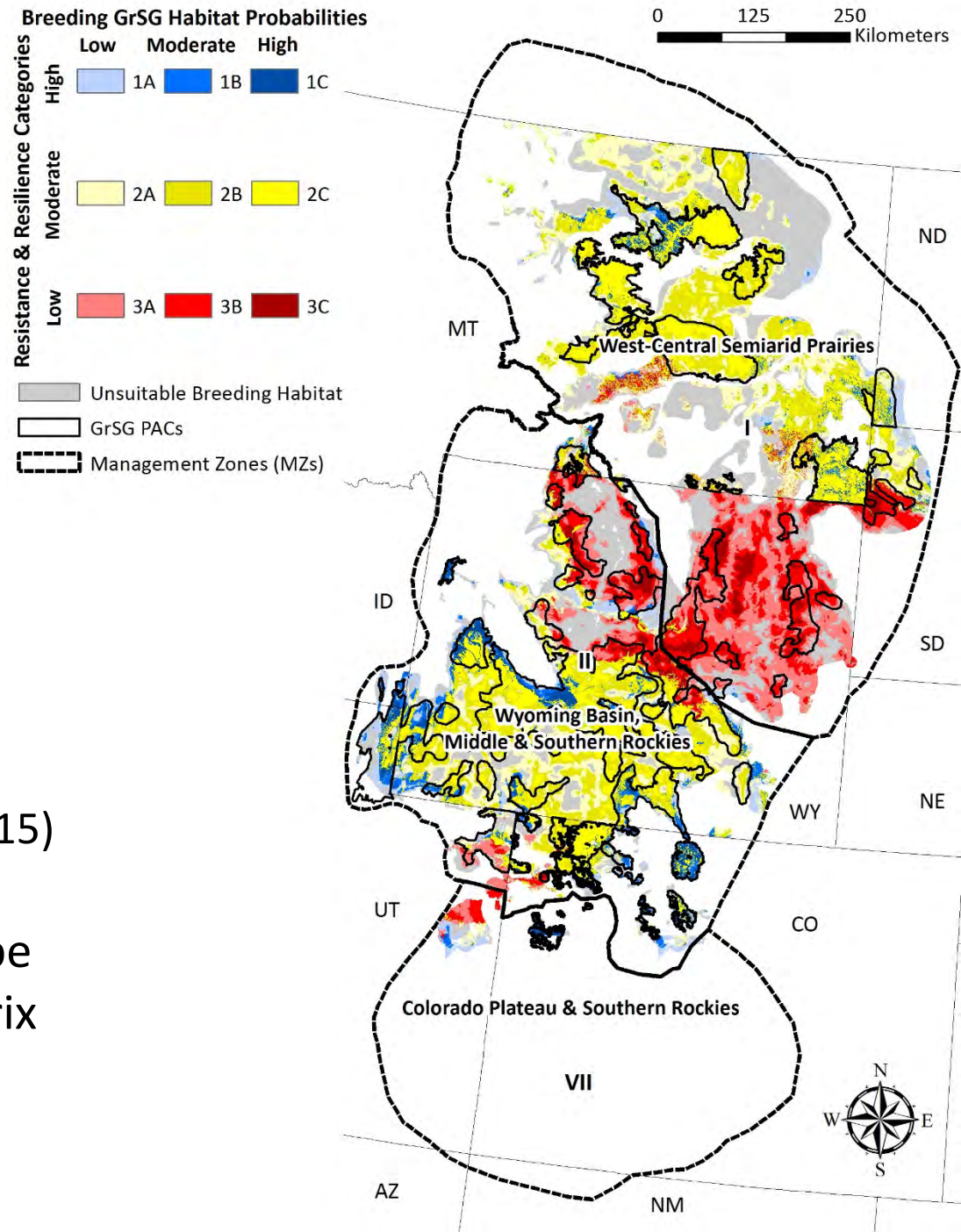
- Livestock Grazing
- Agronomic Conversion
- Exurban Development
- Energy Development
- Recreation

Climate Change

PRIORITIZATION GRSG

Focal areas for management –

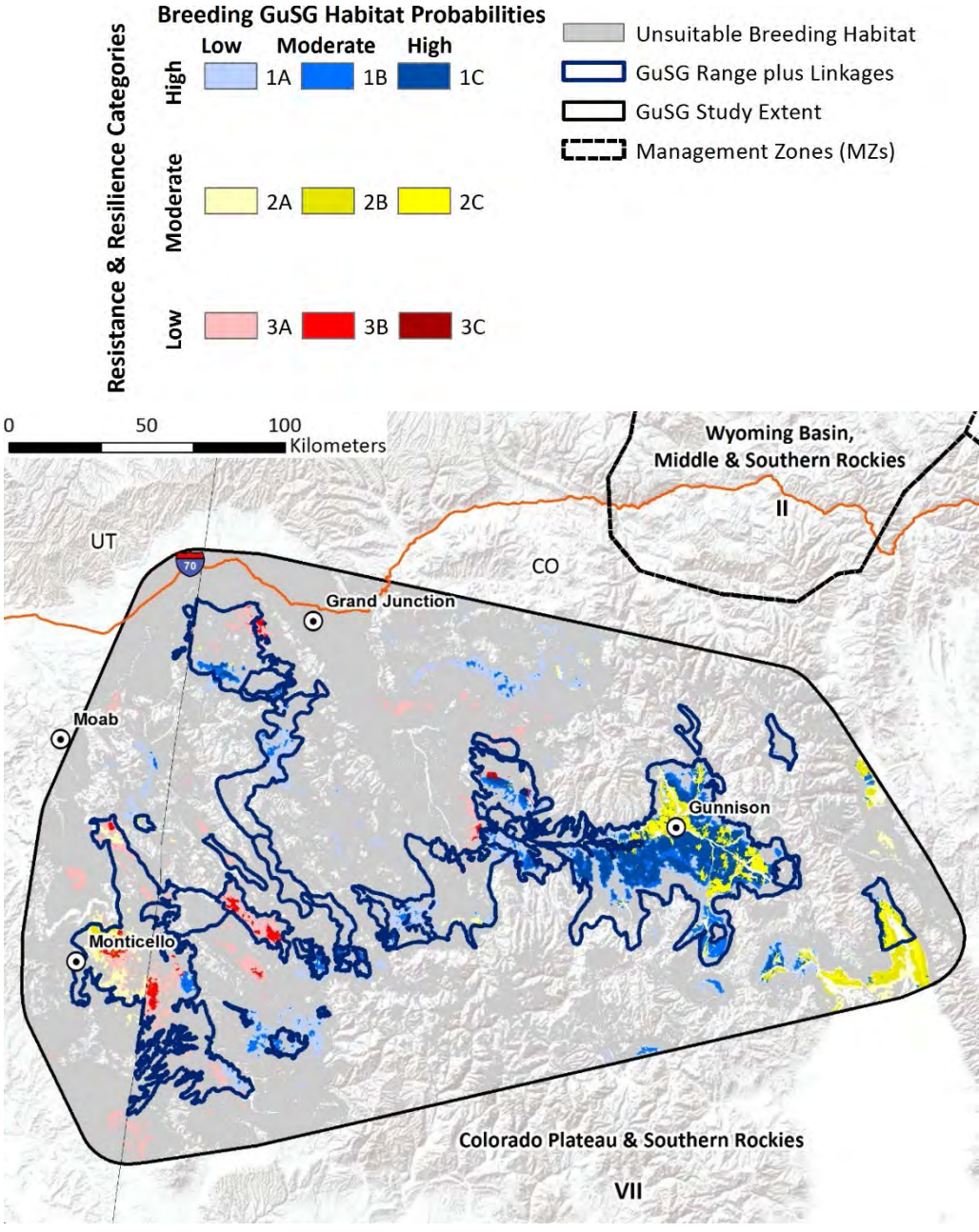
- First filters – GrSG PACS
- \+ Resilience & Resistance
- \+ Sage-grouse breeding habitat probabilities (Doherty et al. 2015)
- ➢ Management strategies can be matched directly to the Matrix



PRIORITIZATION GUSG

Focal areas for management -

- First filters – GuSG Critical Habitat
- \+ Resilience & Resistance
- \+ Breeding Habitat Probabilities
- ➢ Management strategies can be matched directly to the Matrix



PRIORITIZATION GRSG

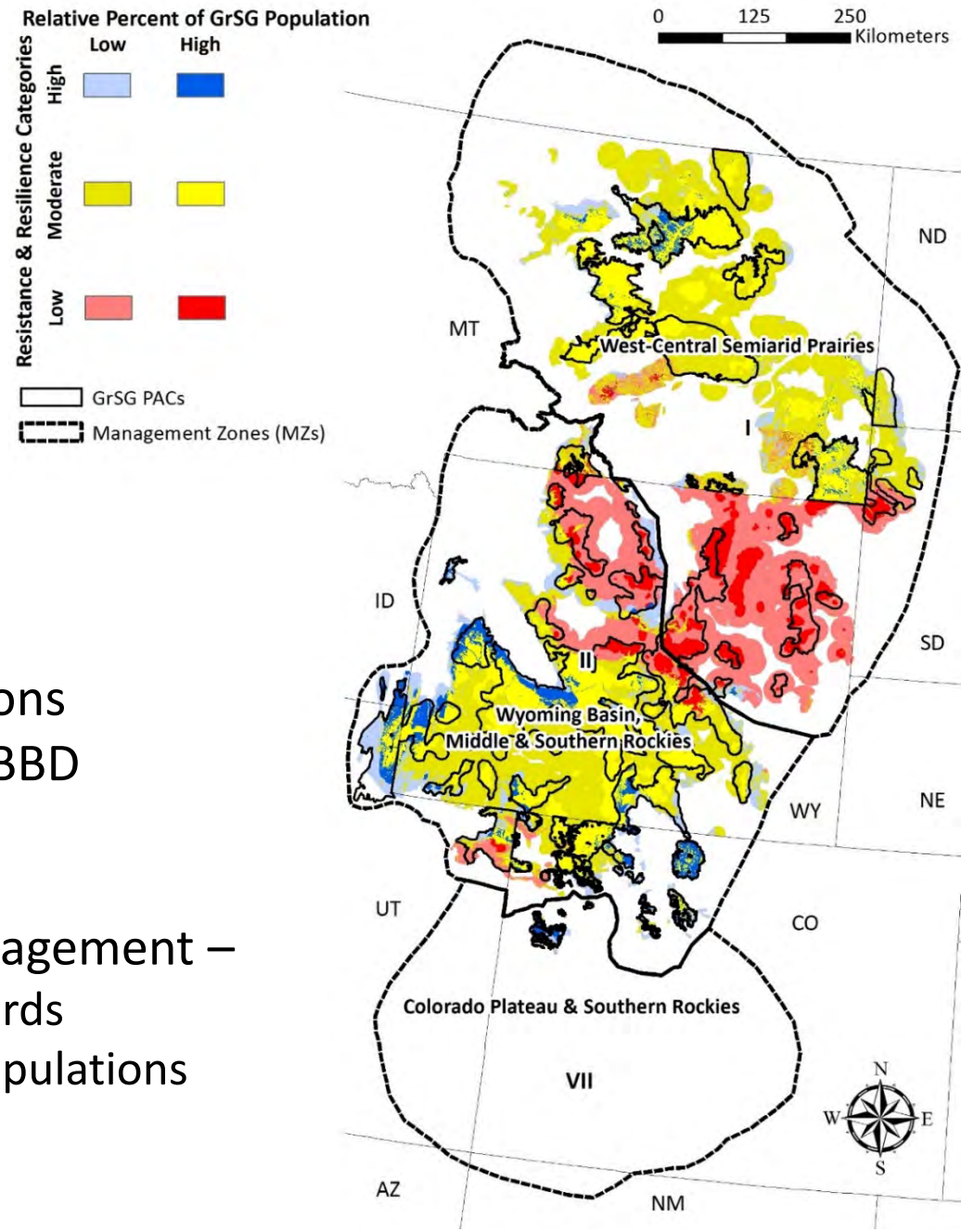
Focal areas for management –

- First filters – GrSG PACS

+ Resilience & Resistance

+ Sage-grouse breeding populations
  High density = areas with 80% BBD
  (Doherty et al. 2015)

➢ Ensures areas selected for management –
  1. Support large populations of birds
  2. Provide connectivity among populations
  3. Are close enough to breeding centers for recolonization

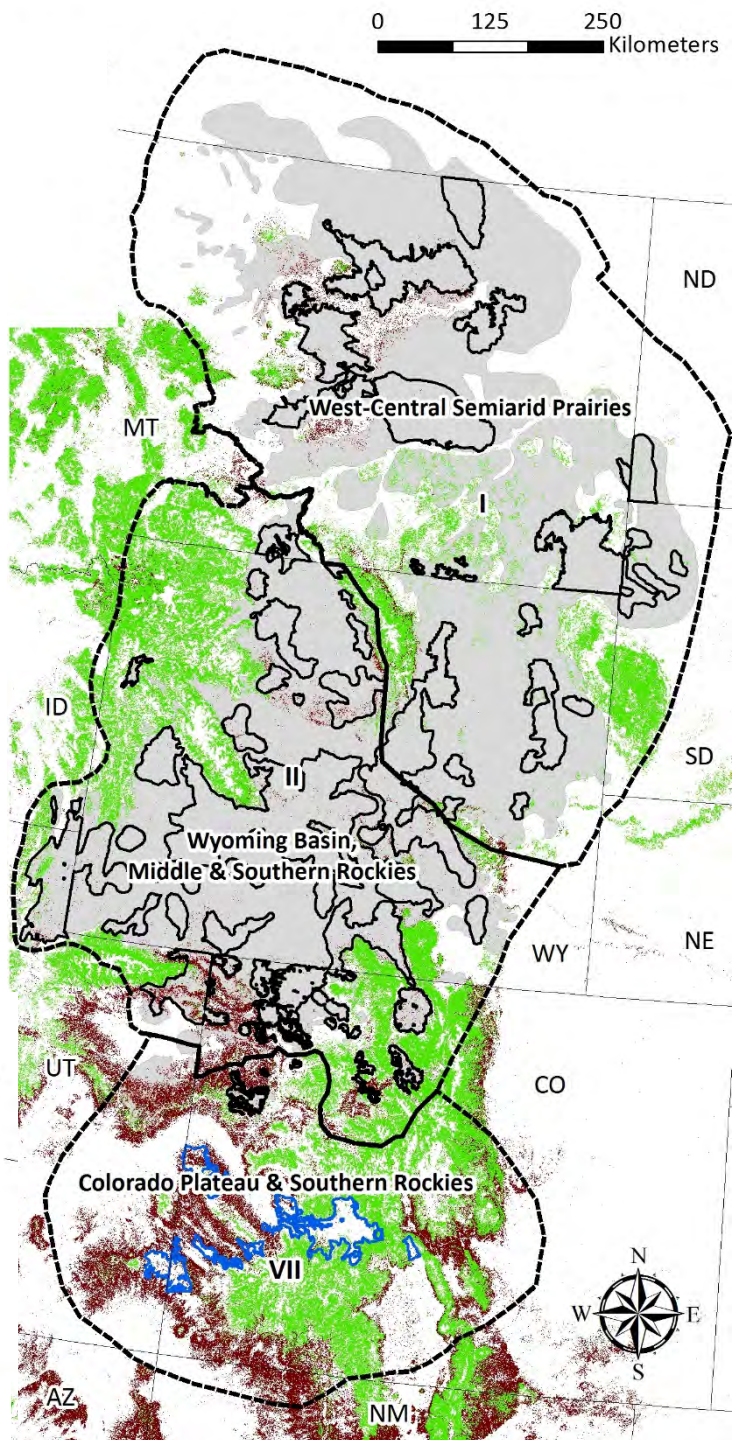


Addressing Threats

Focal areas for management – consider magnitude of threat relative to populations and R&R

- First filters –
  GrSG PACS
  GuSG Critical Habitat

+ Cover of conifers



Conifers

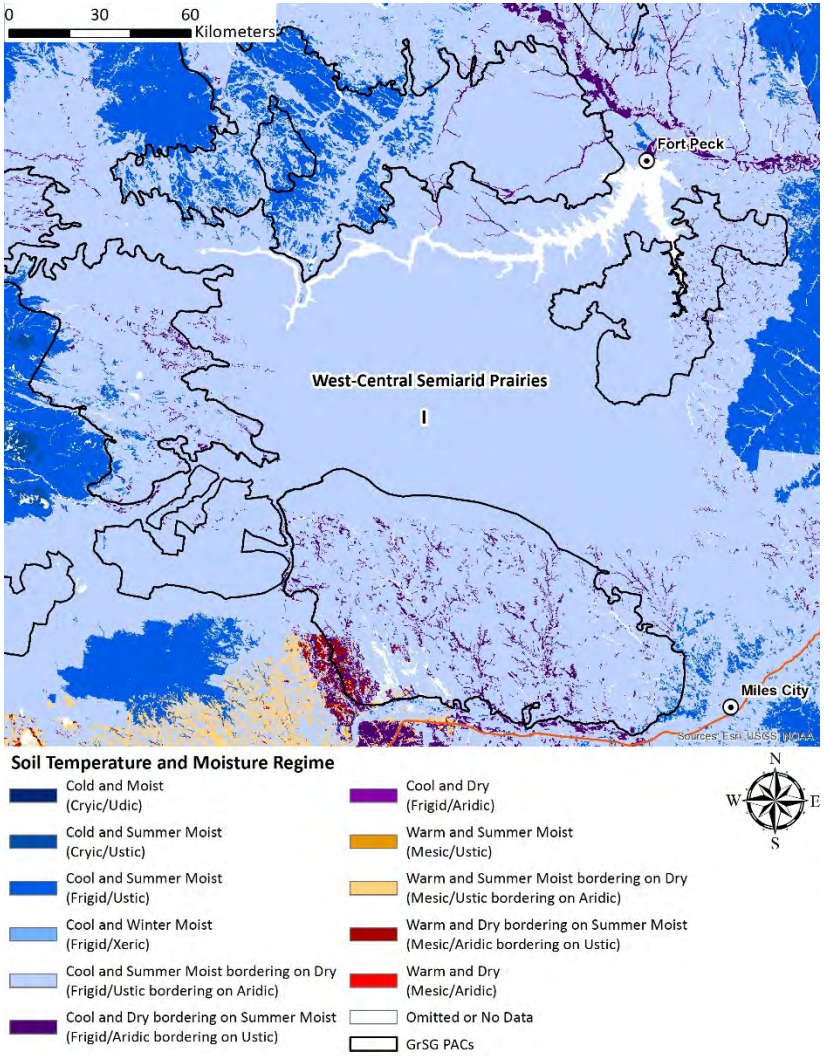
- Conifer dominated sytems with little to no sagebrush
- Conifer dominated systems likely to expand into sagebrush
- GrSG PACs
- GrSG Occupied Range
- GuSG Critical Habitat
- Management Zones (MZs)

Stepping Down to the Land Planning Unit

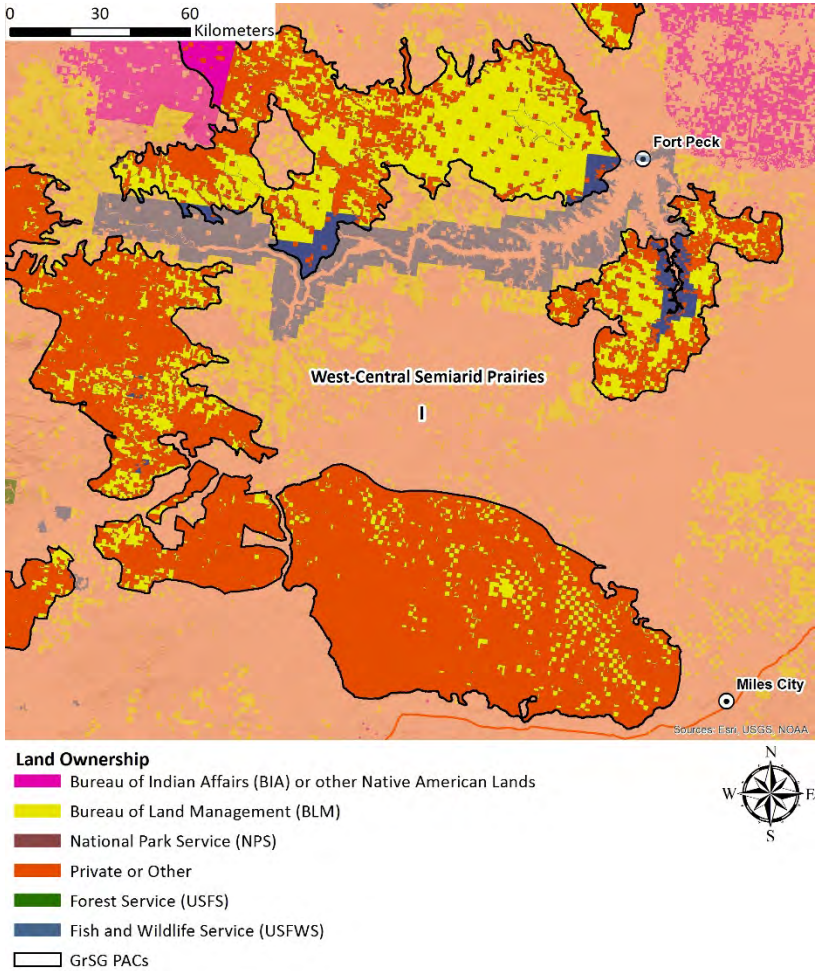
Management activities based on -

- Resilience & Resistance
- Breeding Habitat Probabilities
- Sage-grouse breeding populations
- Dominant threats & land ownership
- Finer scale data
  - High Resolution Vegetation Cover
  - Ecological Condition
  - Seasonal Habitats

East Central Montana – Agronomic Conversion

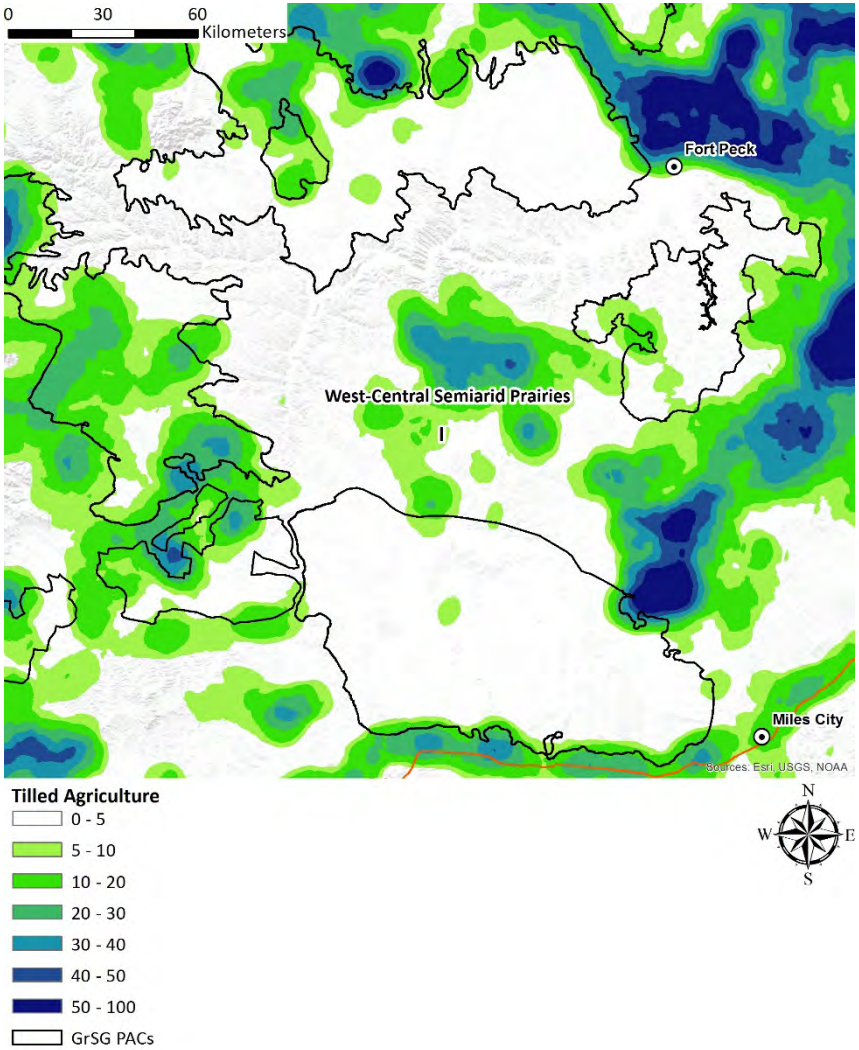


Cool and Summer Moist bordering on Dry
Moderate R&R

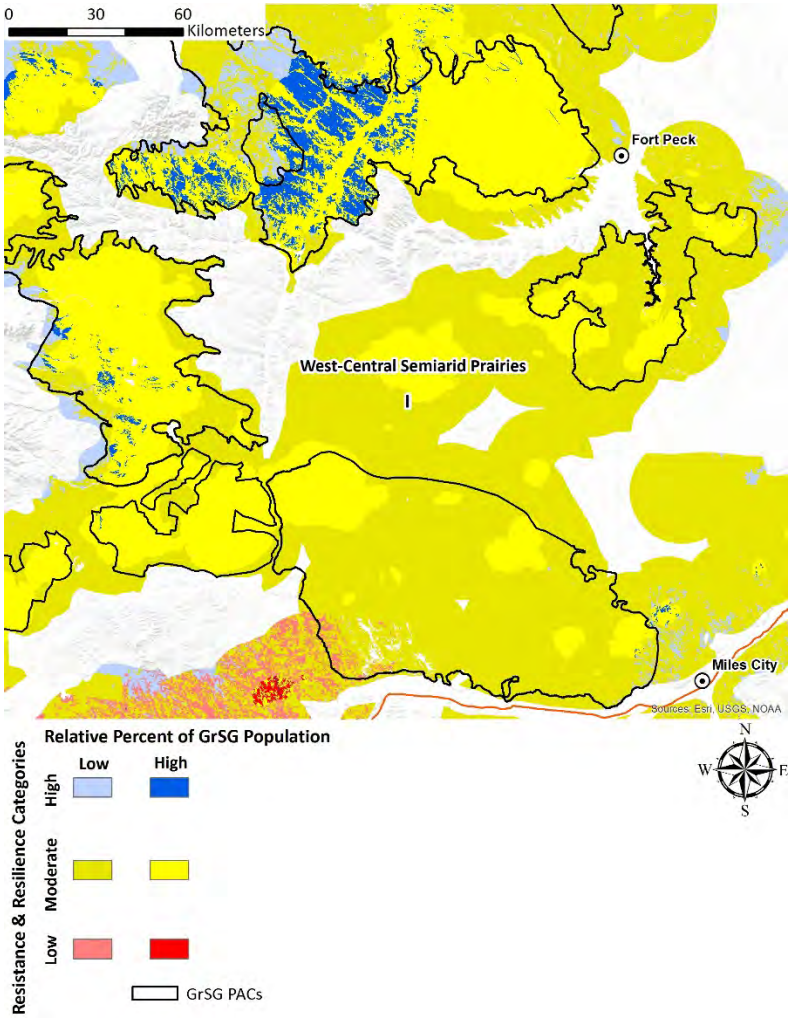


Private, BLM, FWS

East Central Montana – Agronomic Conversion

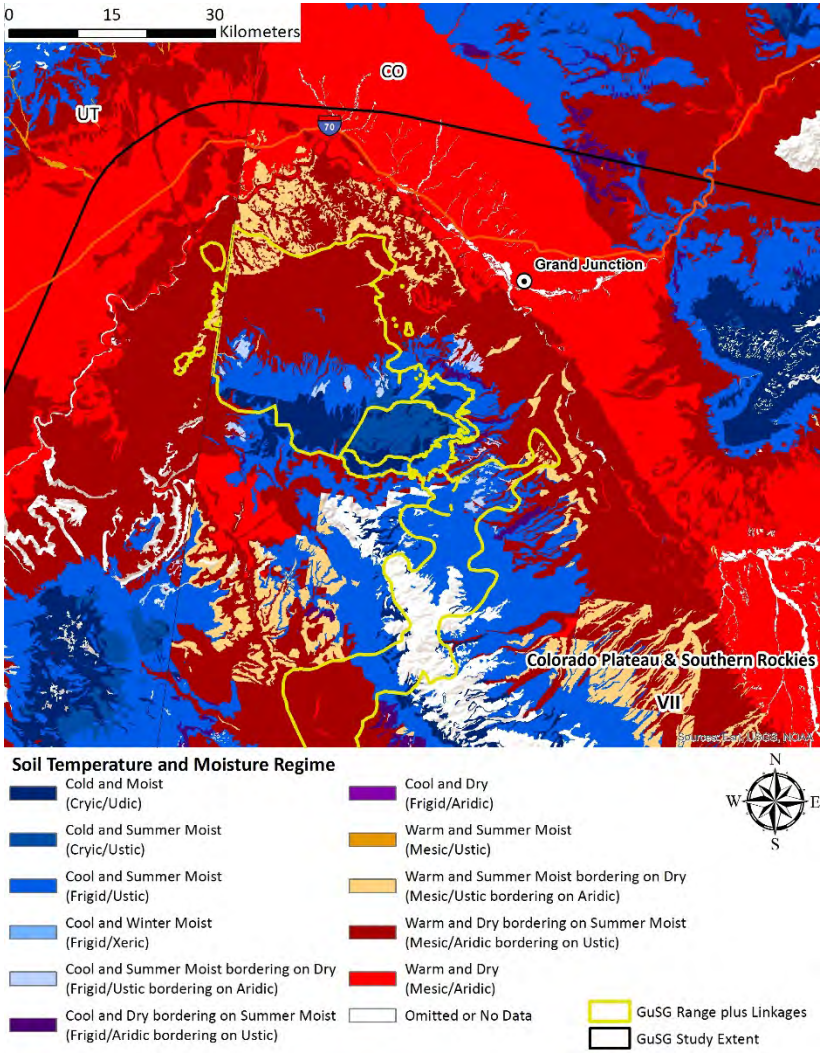


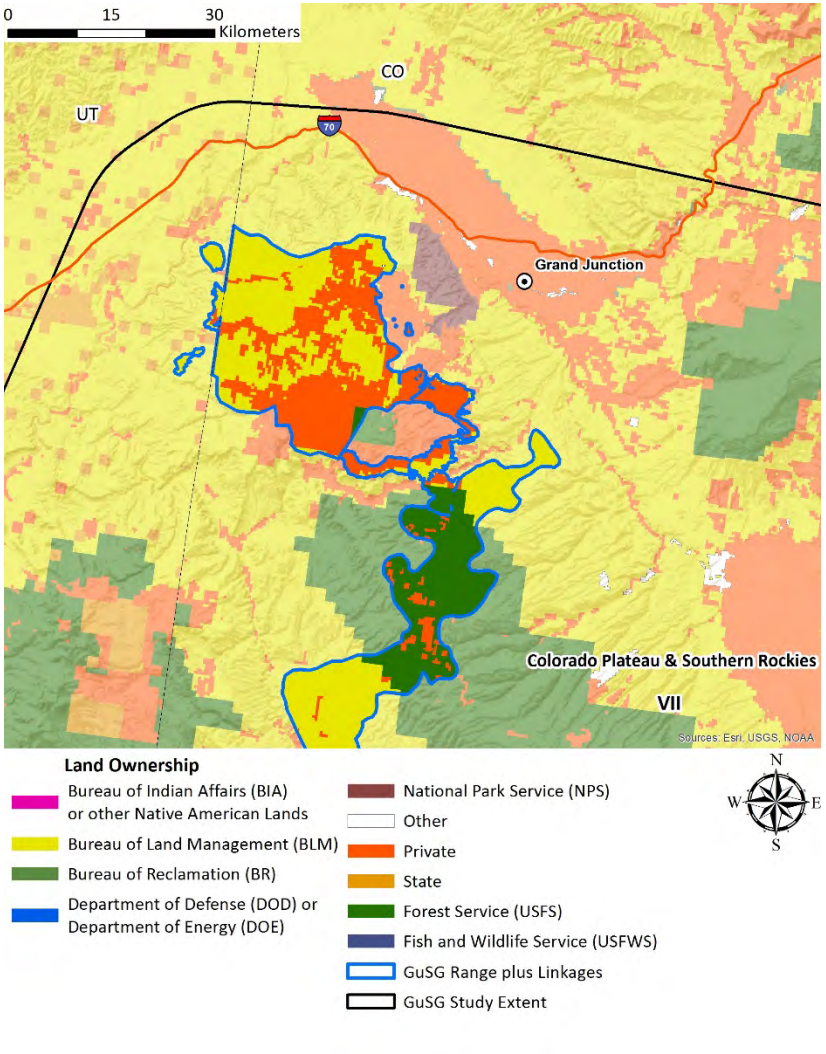
Tilled Agriculture with
Potential for Additional Conversion



High Density Populations
in and Adjacent to Tilled Lands

Northwest Colorado – Conifer Expansion

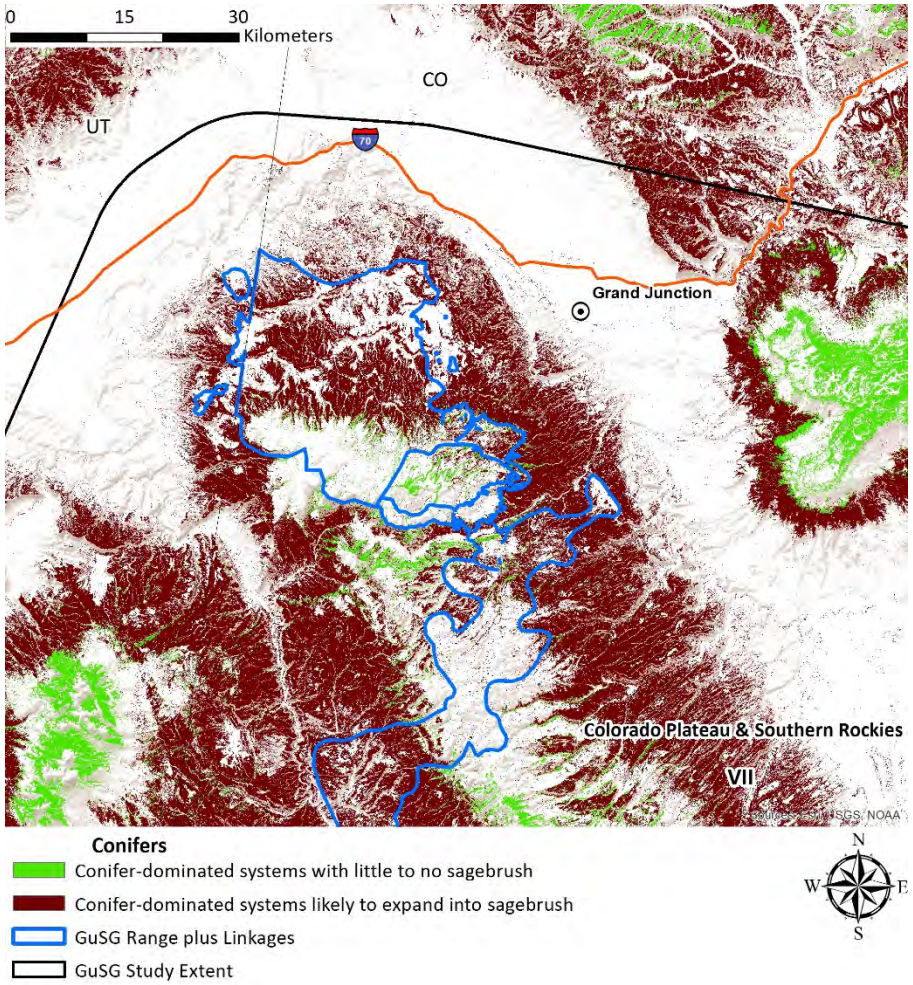




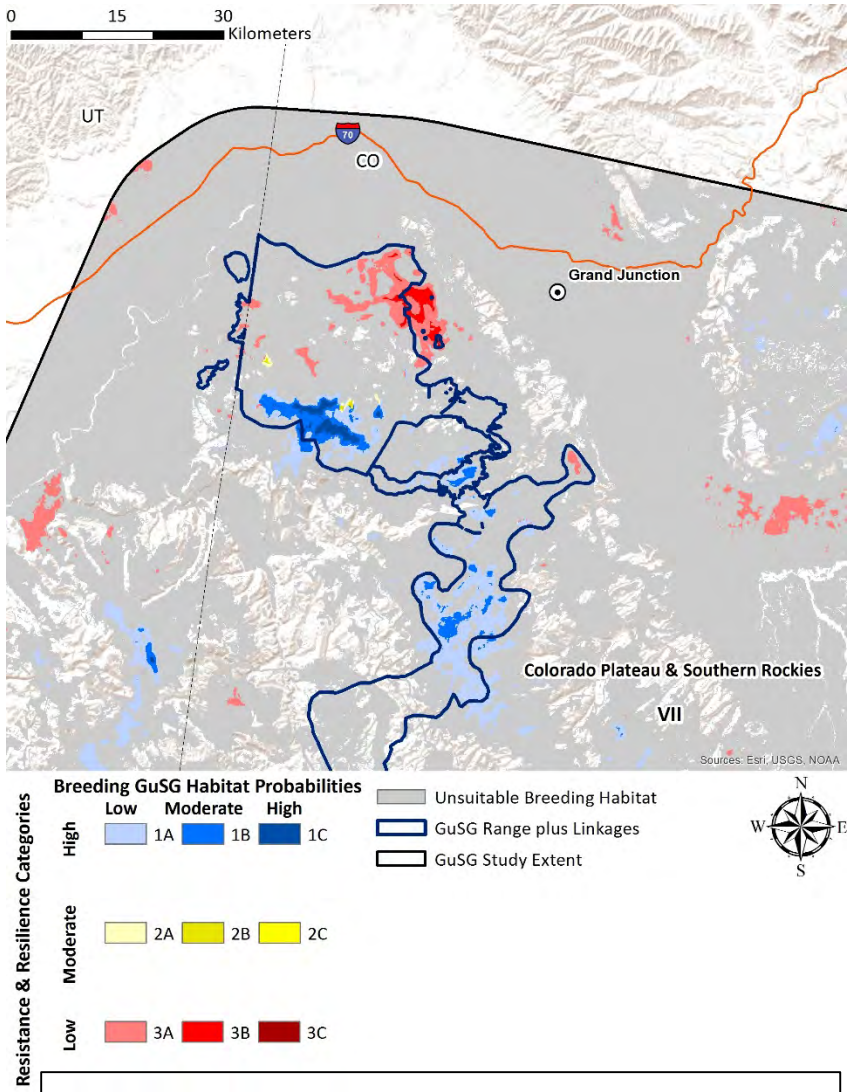
Cold and moist (High R&R) to warm and dry bordering on summer moist (Low R&R)

BLM, Forest Service, Private

Northwest Colorado – Conifer Expansion



Ongoing Conifer Expansion



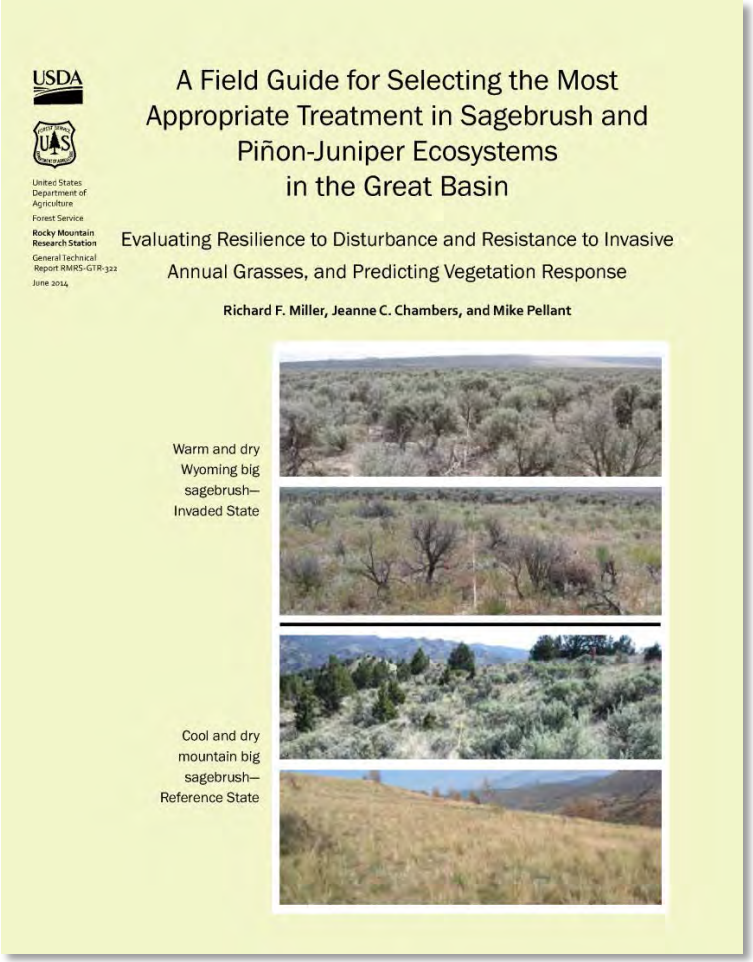
High to Moderate Habitat Probabilities in and Adjacent to Conifer Expansion

Stepping Down to the Land Planning Unit

Management activities based on site response (R&R) and habitat needs -

- Decision Tools
  - Soils and ecological site descriptions
  - State-and-transition models
  - Field guides & restoration handbooks

- Local expertise and information on specific focal habitat like -
  - Sage-grouse brood-rearing habitat
  - Ecological conditions
  - Other values



USDA

United States Department of Agriculture

Forest Service

Rocky Mountain Research Station

General Technical Report RMRS-GTR-322

June 2014

A Field Guide for Selecting the Most Appropriate Treatment in Sagebrush and Piñon-Juniper Ecosystems in the Great Basin

Evaluating Resilience to Disturbance and Resistance to Invasive Annual Grasses, and Predicting Vegetation Response

Richard F. Miller, Jeanne C. Chambers, and Mike Pellant

Warm and dry Wyoming big sagebrush—Invaded State

Cool and dry mountain big sagebrush—Reference State

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

Down the Road

A holistic approach that addresses large-scale persistent threats to sage-grouse habitat should benefit sagebrush ecosystems and most sagebrush obligate species

- A Draft GTR for the eastern range is in review & should be published by mid summer
- This GTR is being combined with GTR-326 in a Science Framework for the Conservation & Restoration Strategies (SO 3336)

QUESTIONS ?

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