“Overview of Rangeland Fire in the Great Basin Sagebrush Steppe”

The Next Steppe Conference

Wednesday, November 5, 9:45 a.m. -11:30 a.m.

Anne Kinsinger, Moderator

Presenters:

Dr. Rick Miller, Oregon State University

Dr. Jeff Beck, University of Wyoming

Dr. Matt Germino, USGS

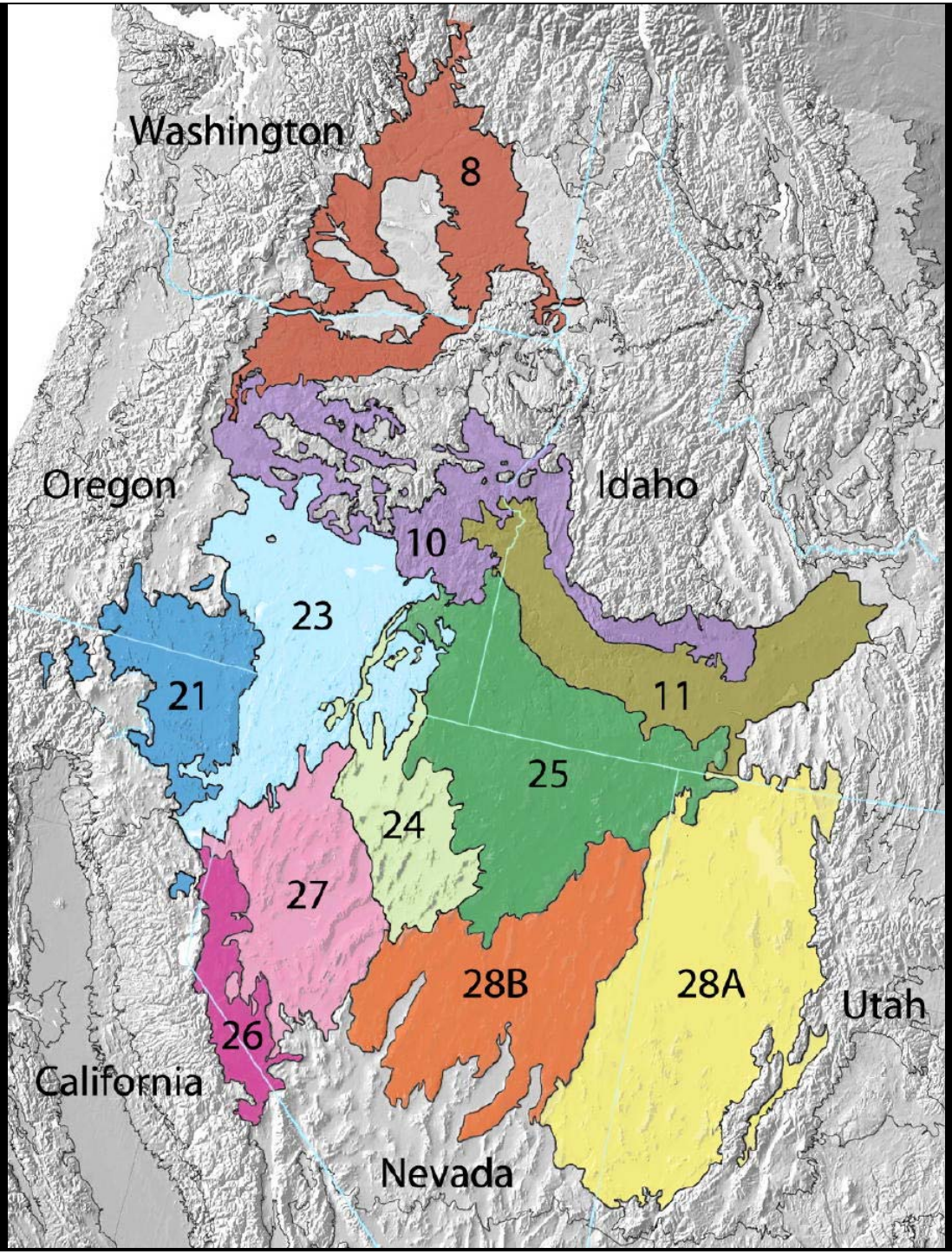
Issues, Concerns, and Challenges Related to Fire In Intermountain Sagebrush

Rick Miller, Professor Emeritus Oregon State University

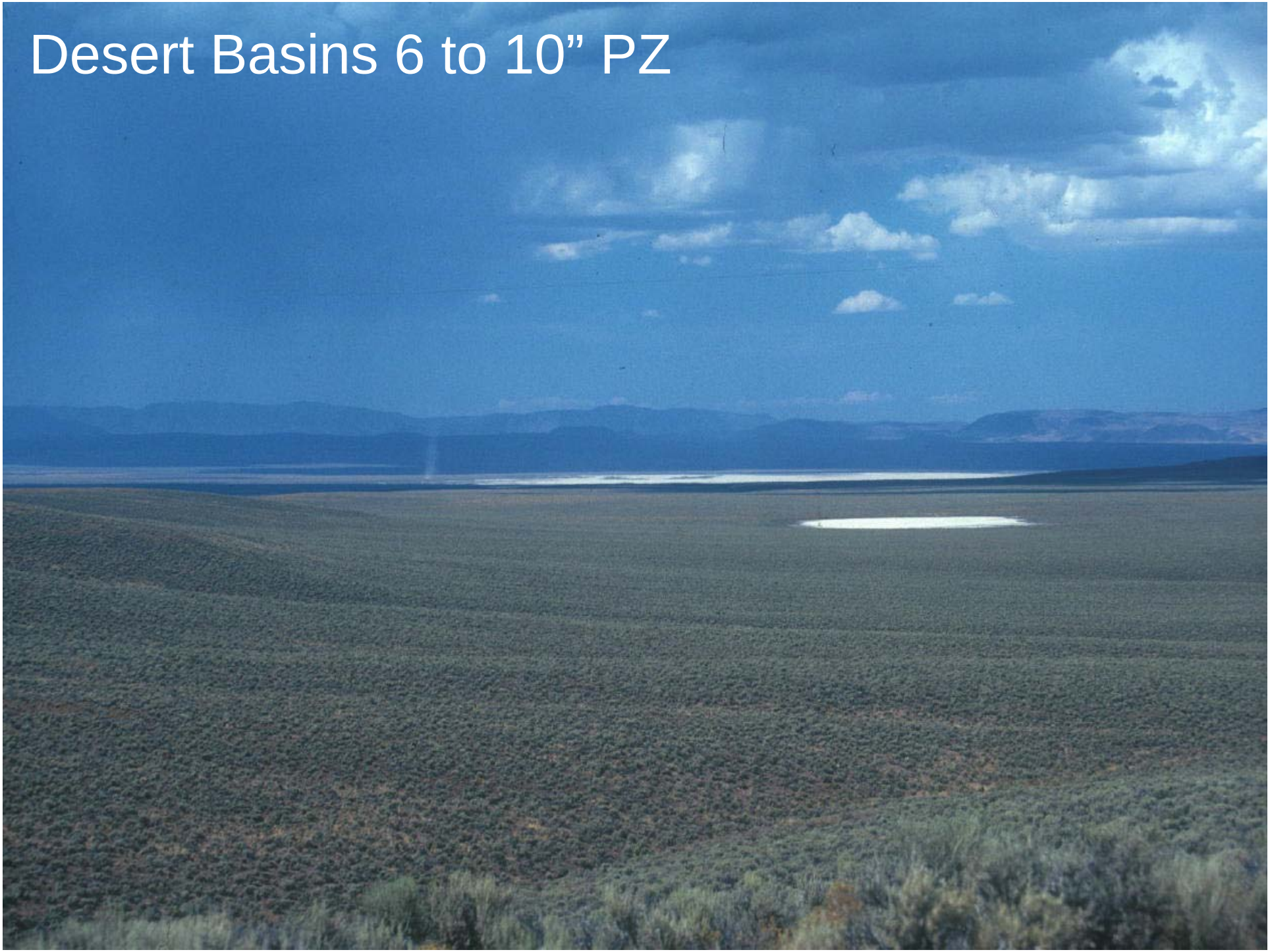
Intermountain Sagebrush-steppe, is a semi-arid region composed of highly complex landscapes that vary in both time and space and are constantly impacted by the intertwining of natural and human caused disturbances.

Intermountain Sagebrush Region

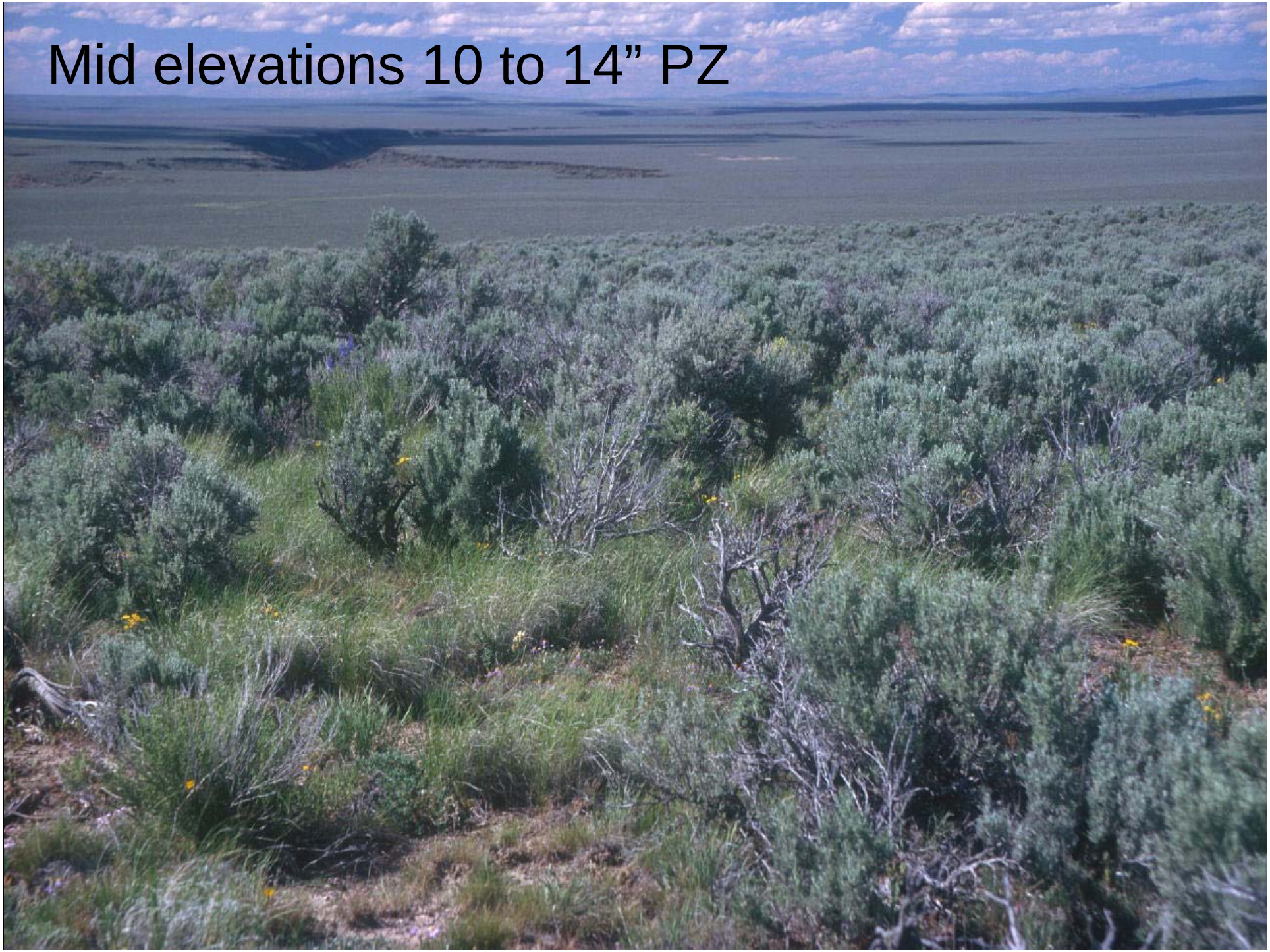
200,000 mi^2



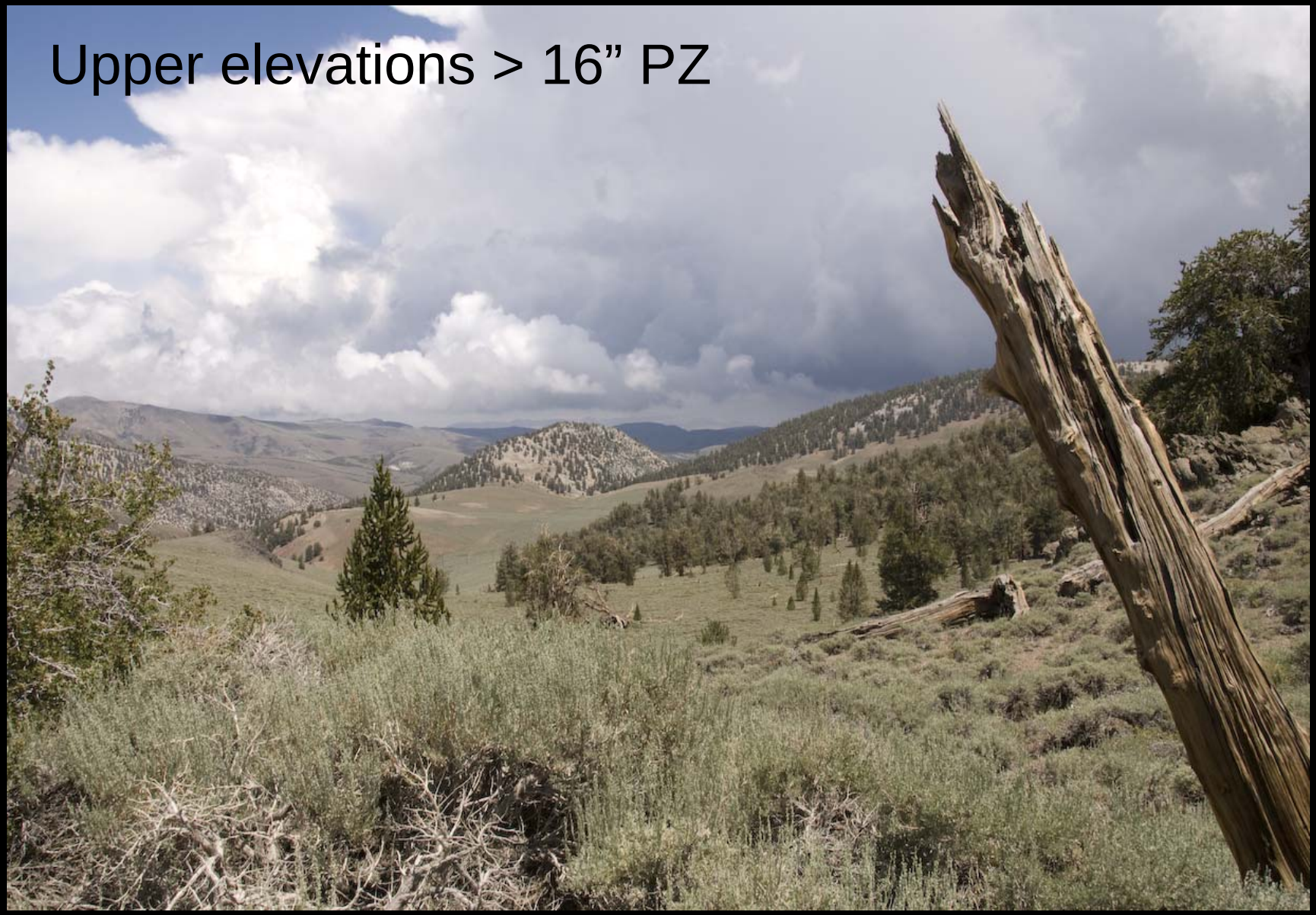
Desert Basins 6 to 10” PZ



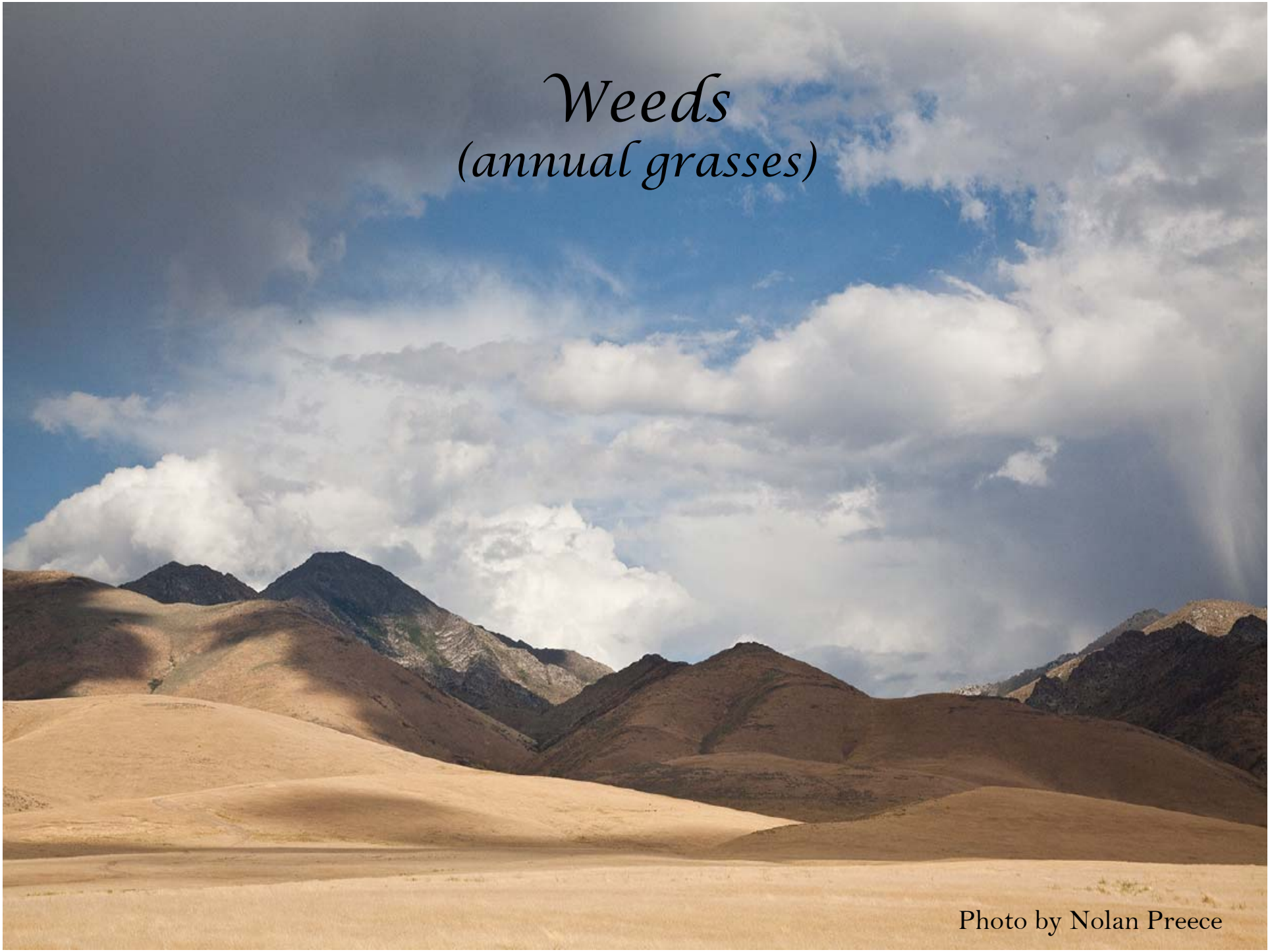
Mid elevations 10 to 14” PZ



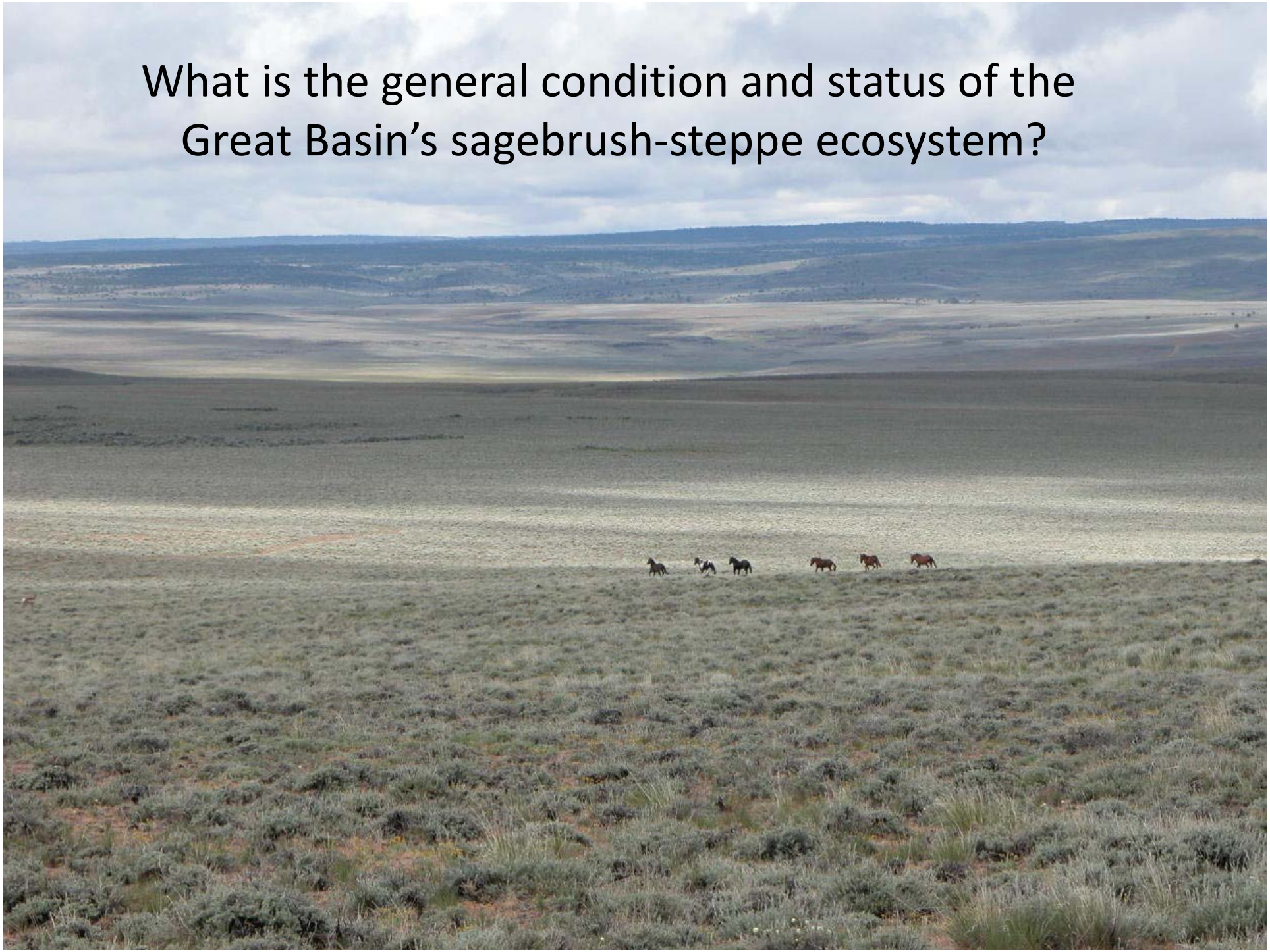
Sagebrush Desert Mountains

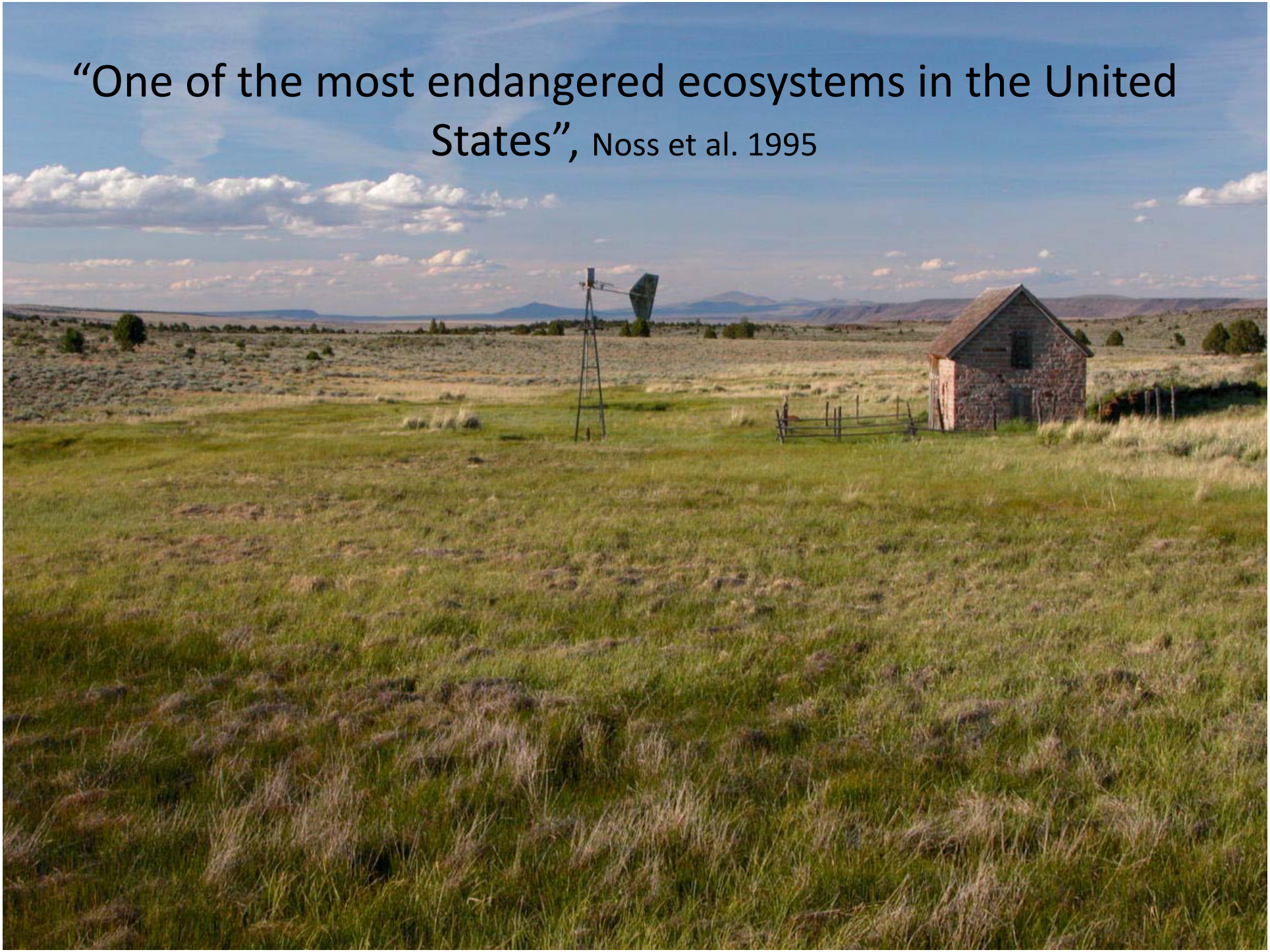


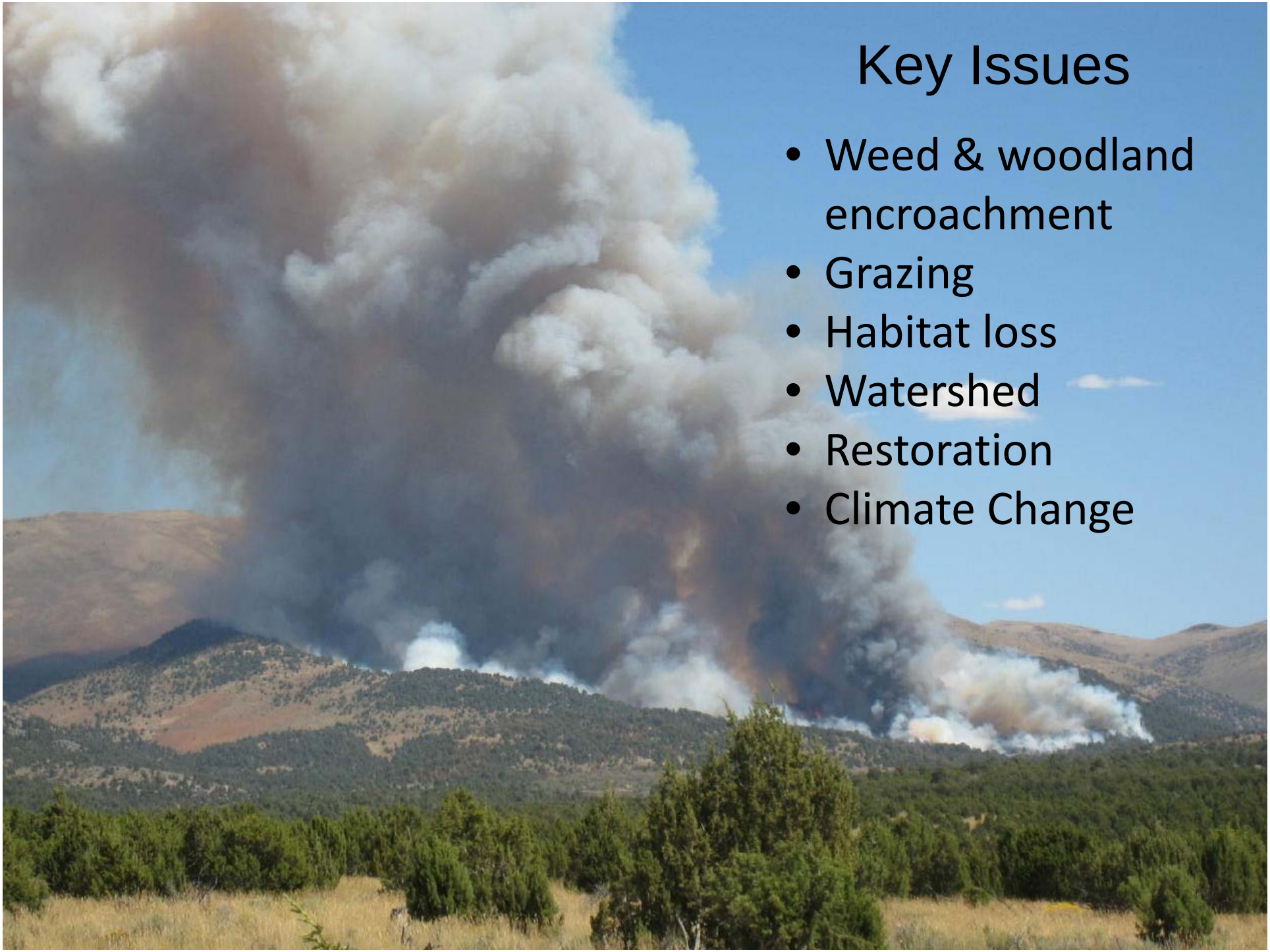
Pinyon and Juniper Woodlands


Weeds
(annual grasses)
Photo by Nolan Preece

What is the general condition and status of the Great Basin's sagebrush-steppe ecosystem?



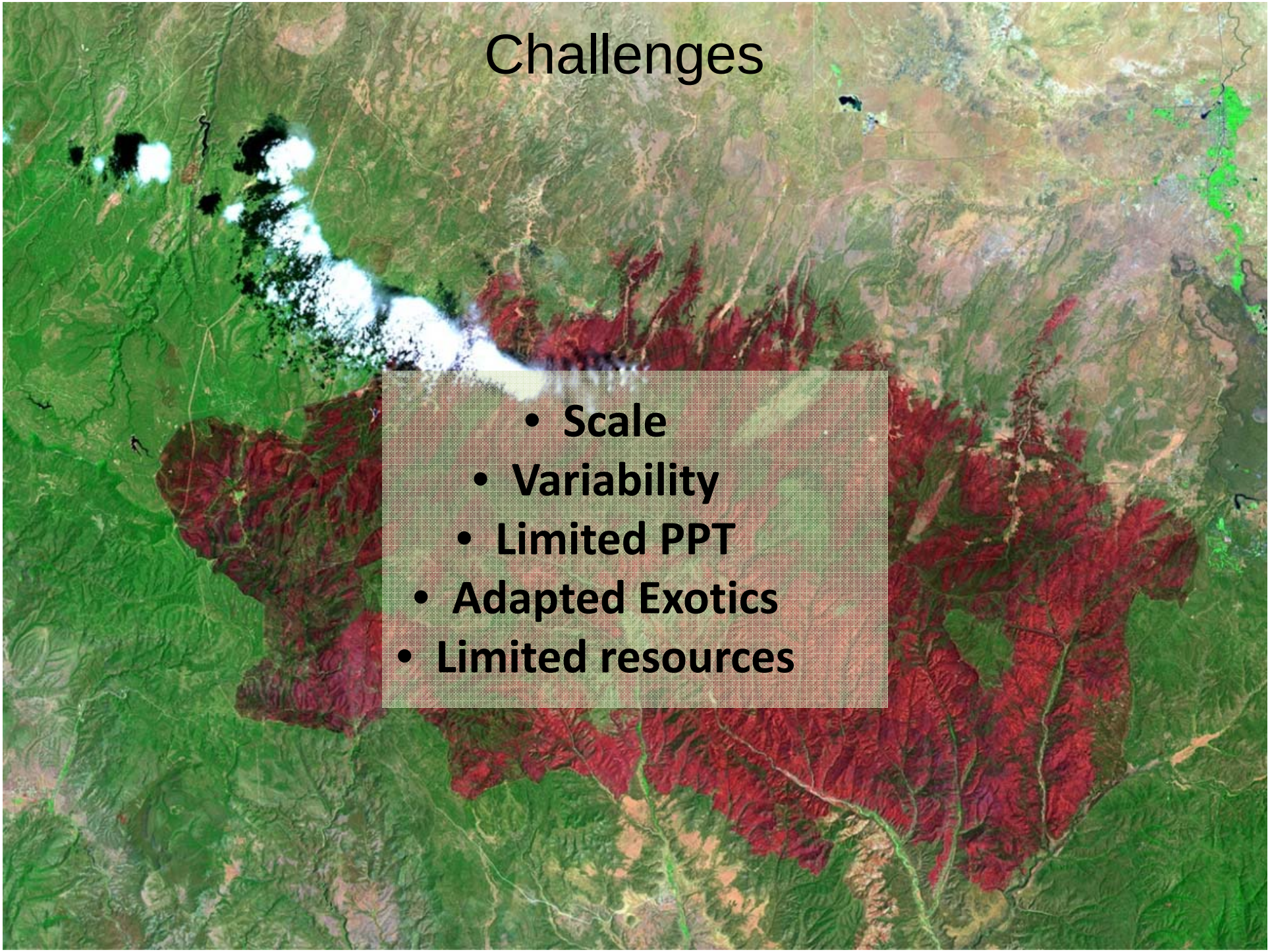

"One of the most endangered ecosystems in the United States", Noss et al. 1995



Key Issues

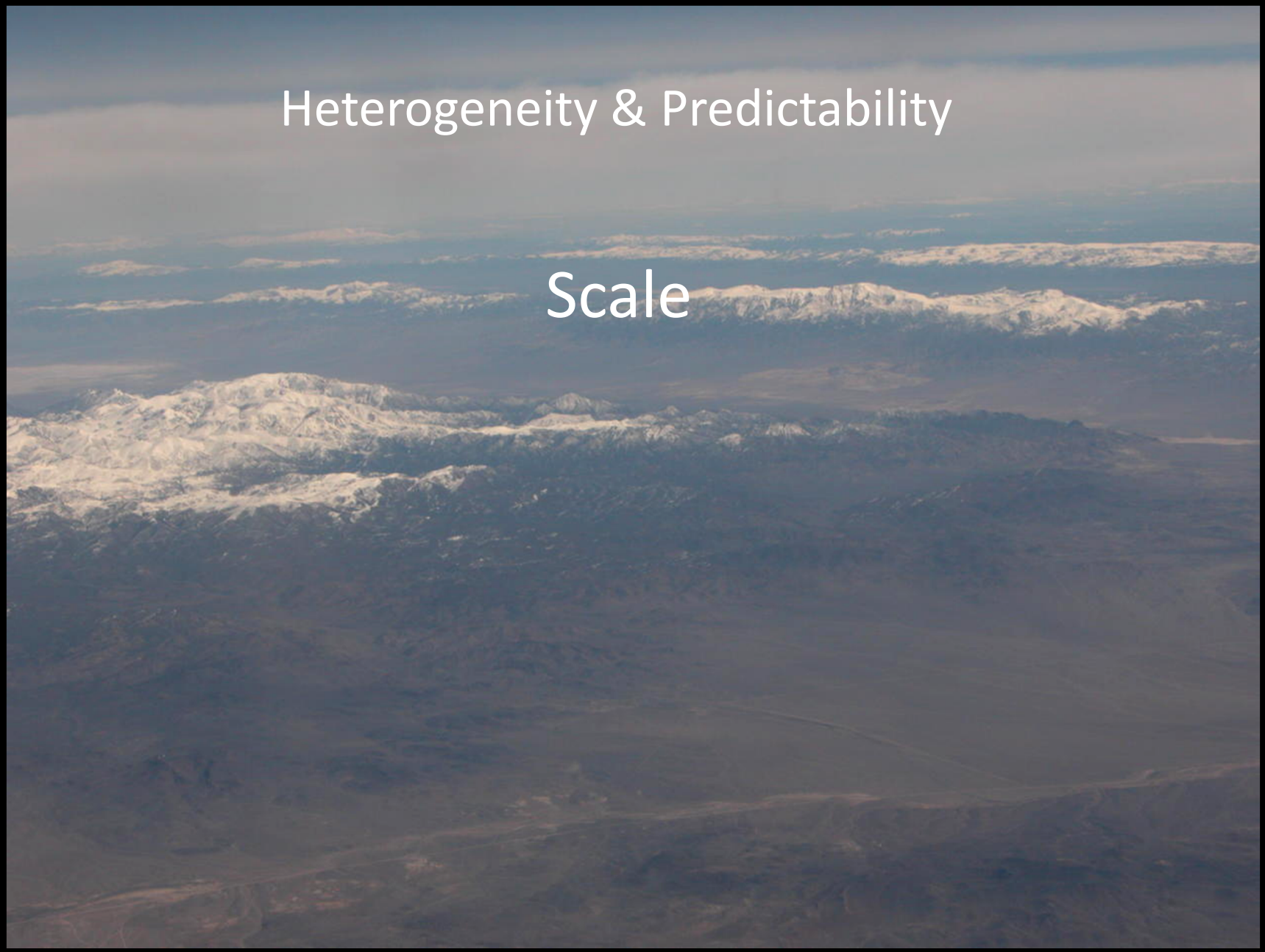
- Weed & woodland encroachment
- Grazing
- Habitat loss
- Watershed
- Restoration
- Climate Change

Challenges



- **Scale**
- **Variability**
- **Limited PPT**
- **Adapted Exotics**
- **Limited resources**

Environmental Gradients



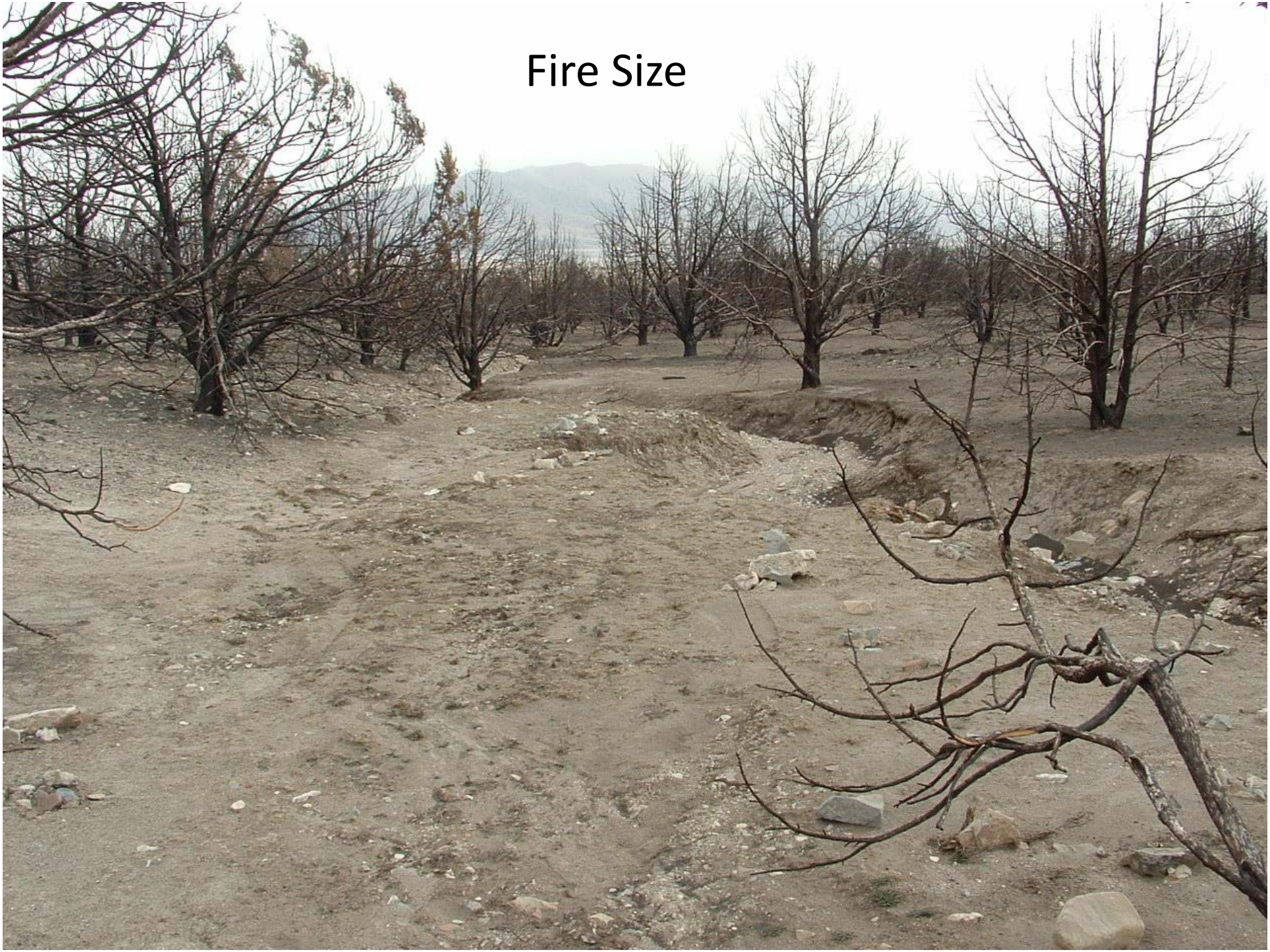
Scale

Buzzard Complex Fire = 400,000+ acres

Fire effects in the future?

2009 Year-3

Fire Size



New Steady States?

Species of Concern/Habitat Loss

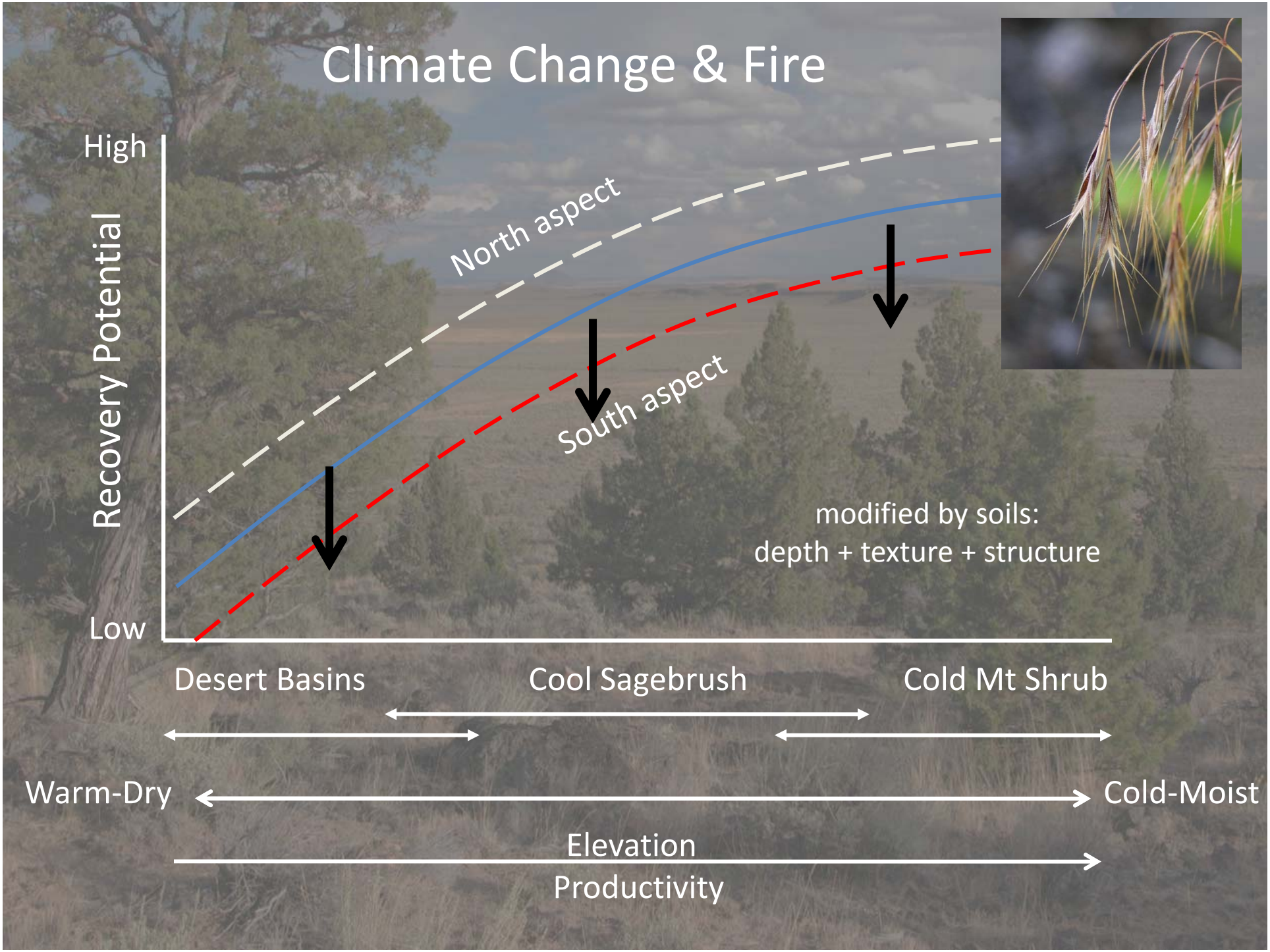
Avian Photos by: Peter LaTourrette

Post-Fire Grazing

Restoration

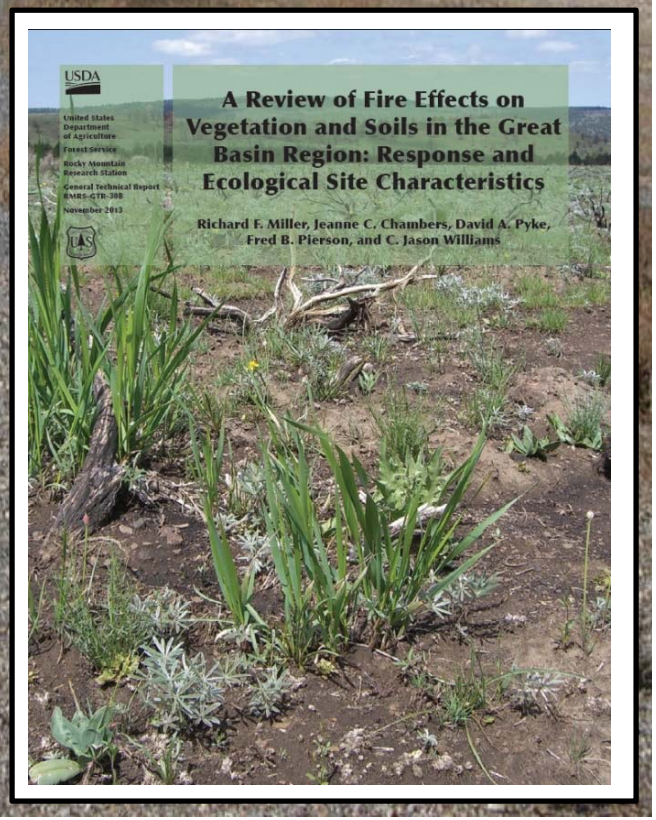
Crested Wheatgrass

Natives


Climate Change & Fire
High
Recovery Potential
Low
North aspect
South aspect
modified by soils:
depth + texture + structure
Desert Basins
Cool Sagebrush
Cold Mt Shrub
Warm-Dry
Cold-Moist
Elevation
Productivity

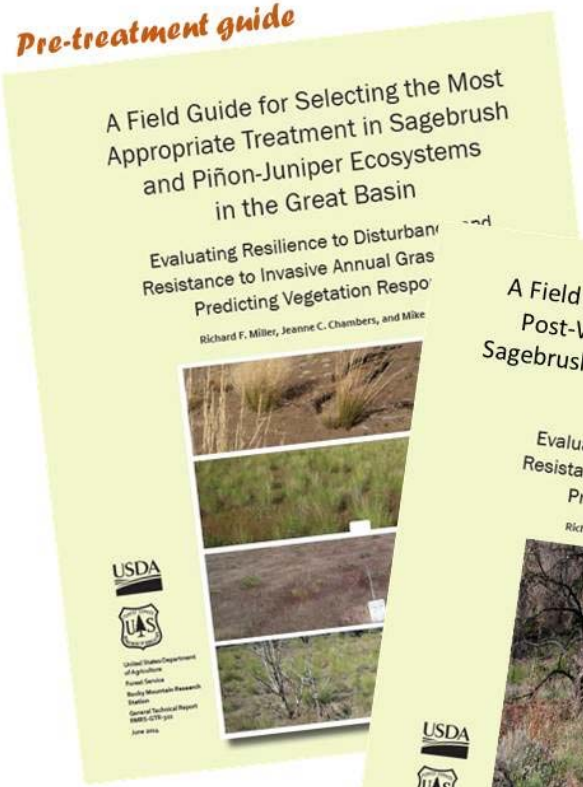
Science?

- **Long-term measurements**
- **Conditions following the study**
  - **Repeated fires**
  - **Reseeding**

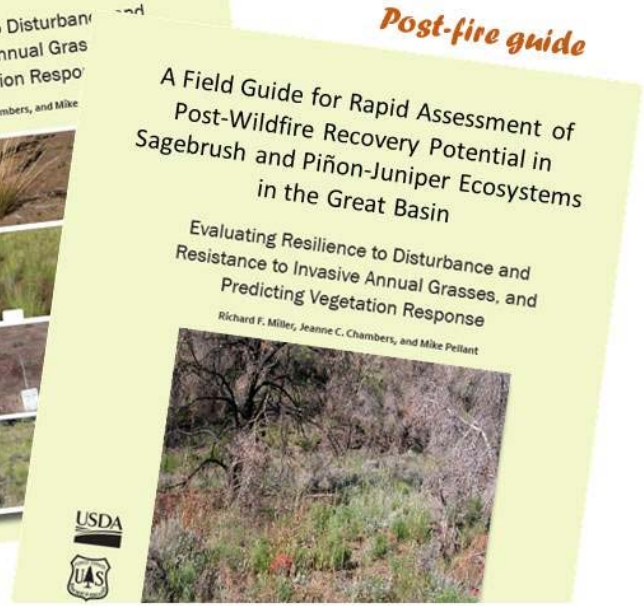


Two new field guides including treatment area score sheets will be published this year:

Pre-treatment guide



Post-fire guide



Sign up at this booth to receive these and other fire and fuels information from Great Basin Fire Science Delivery! www.gbfiresci.org

INSERT BECK

Climate, wildfire, and sagebrush-steppe ecosystems

Matthew J Germino

US Geological Survey

Forest & Rangeland Ecosystem Science Center;

Great Basin Landscape Conservation Cooperative

USGS science for a changing world

Great Basin LANDSCAPE CONSERVATION COOPERATIVE

Climate effects are central to:

- Landscape vulnerability assessments (eg. Rapid Ecol Assessments)
- Landscape prioritization of conservation or development efforts
- Rehabilitation or restoration in sagebrush steppe

Outline:

- What is the climate of the Great Basin (sagebrush steppe) and how is it changing?
- What are key points of sensitivity in the climate system?
- How are ecosystem components influenced by climate change?
    - -Climate responses
    - -Ways we are affecting climate responses

Key point: Uncertainty in relationship of ecosystem to current climate, compounds uncertainty in forecasts.

Retrospect:
(Beiswenger 1991)

Plants like sagebrush have been dominant on our landscapes for millenia, including large climate changes.

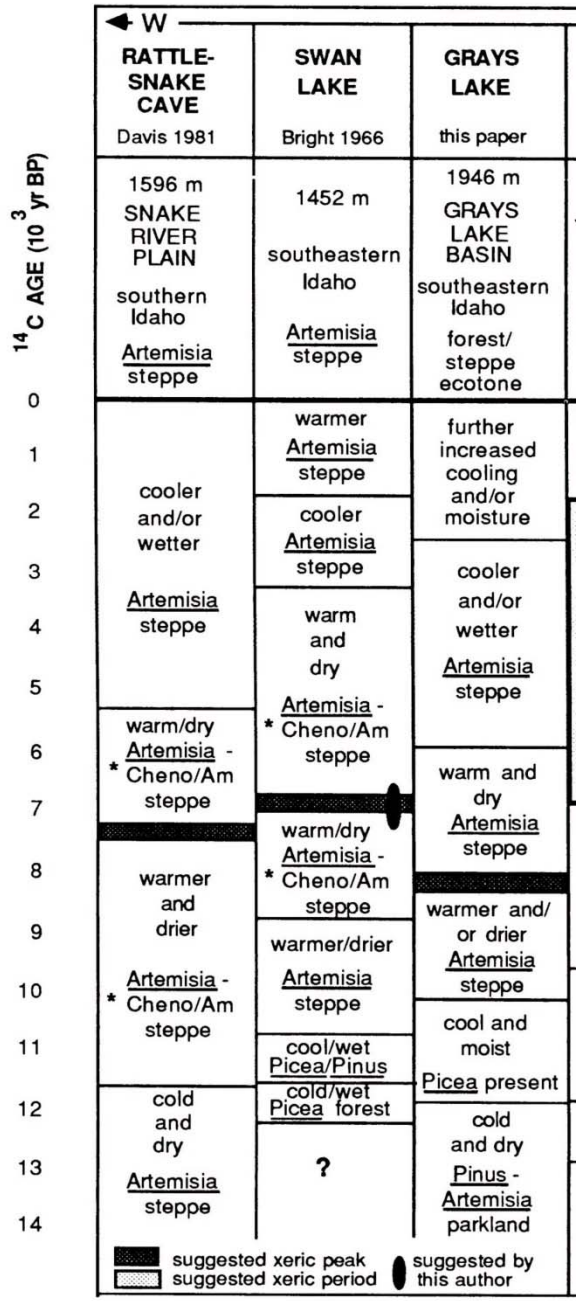
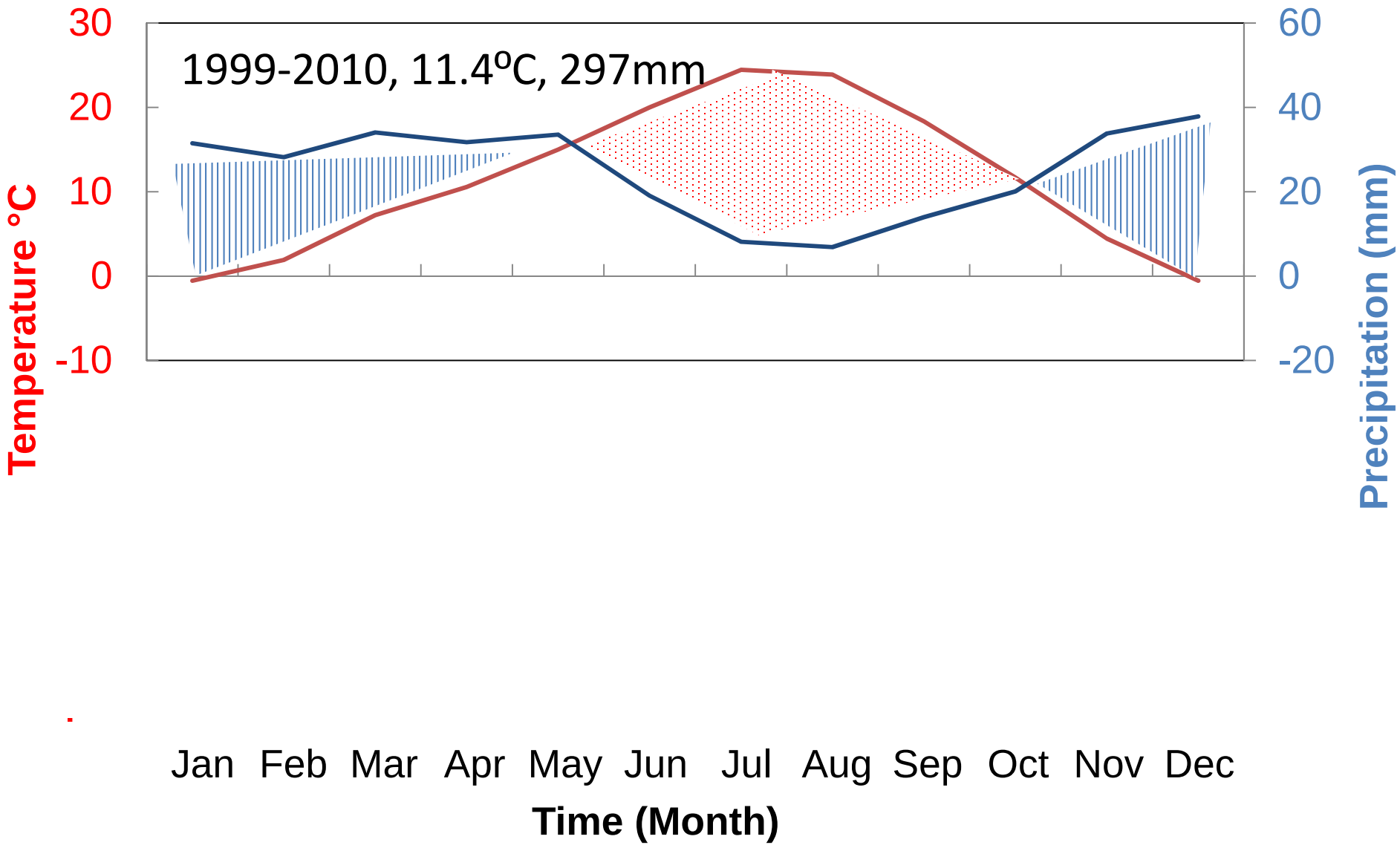


FIG. 8. Comparisons of vegetational and climatic history for low
and Wyoming.

I. Climate of sagebrush steppe: *Cold desert!*

For Boise airport:



Past Variability:

Trends for Boise (NOAA):

1980-2014:

Avg. temperature: +2ºC

Min. temperature: +4ºC

(0.86ºC/decade, r^2=0.65)

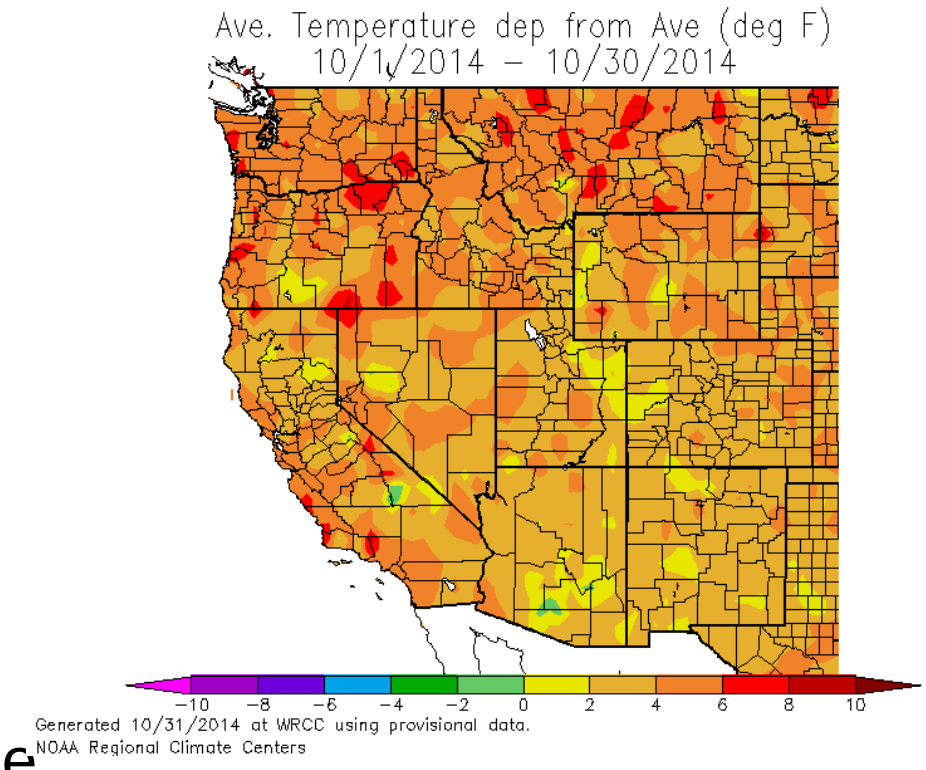
Precipitation: no change

1940-2014:

Avg. temperature: +0.2ºC/decade

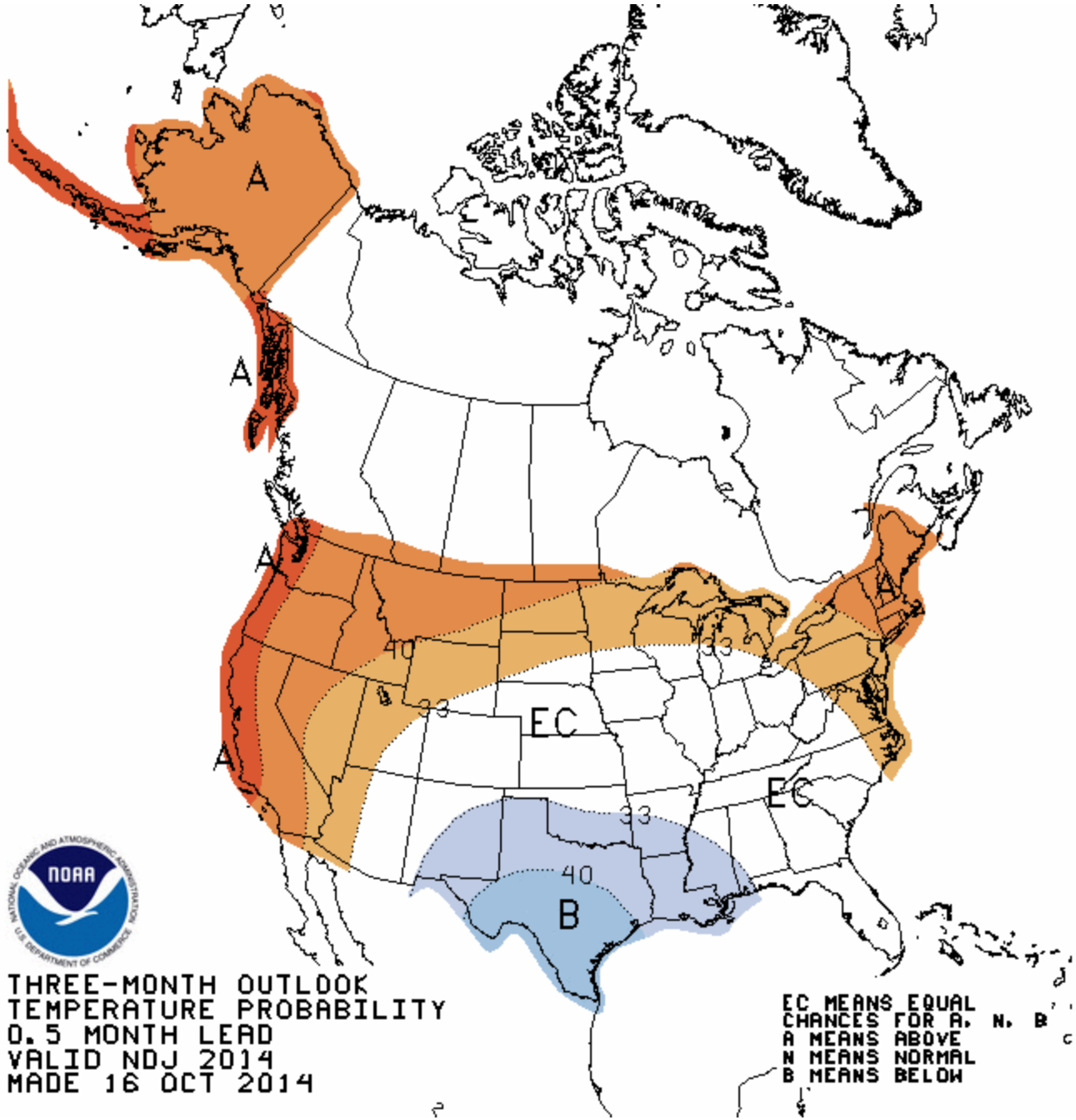
Min. temperature: +0.25ºC/decade

Precipitation: no change

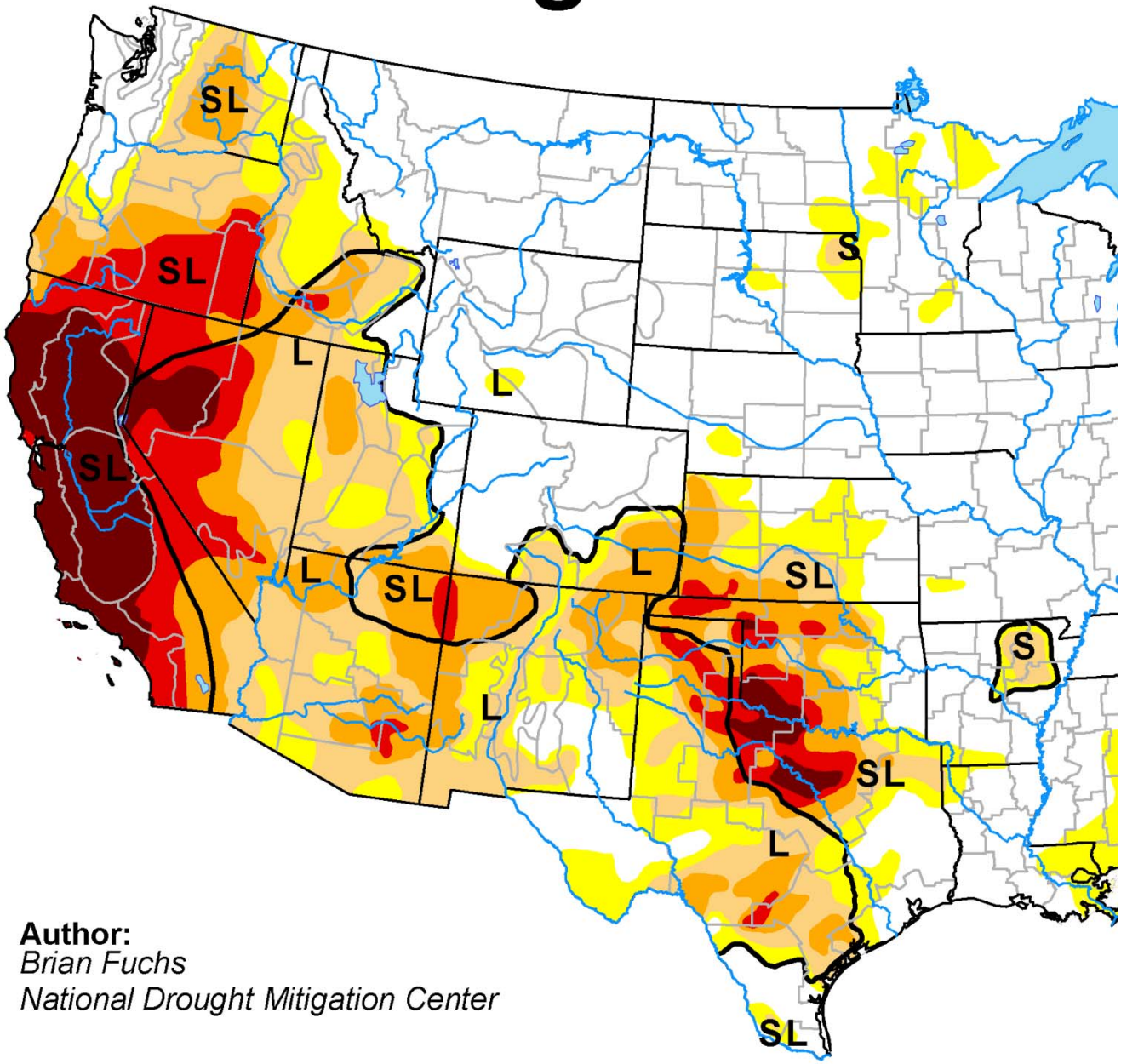


A +2ºC increase in min. temperatures would cause # surface freezing nights to decrease from 182 to 107 (Nov'12 – July'14)

Future.
Variability:



U.S. Drought Monitor



October 28, 2014

(Released Thursday, Oct. 30, 2014)

Valid 8 a.m. EDT

Drought Impact Types:

Delineates dominant impacts

S = Short-Term, typically less than 6 months (e.g. agriculture, grasslands)

L = Long-Term, typically greater than 6 months (e.g. hydrology, ecology)

Intensity:

- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

Author:
Brian Fuchs
National Drought Mitigation Center

http://droughtmonitor.unl.edu/

What is forecasted for Great Basin:

IPCC 2013, “RCP4.5” simulates 4.5x more radiative forcing by 2100 (650 ppm CO_2)

Temperature more predictable than precipitation, winter weather more predictable than summer.

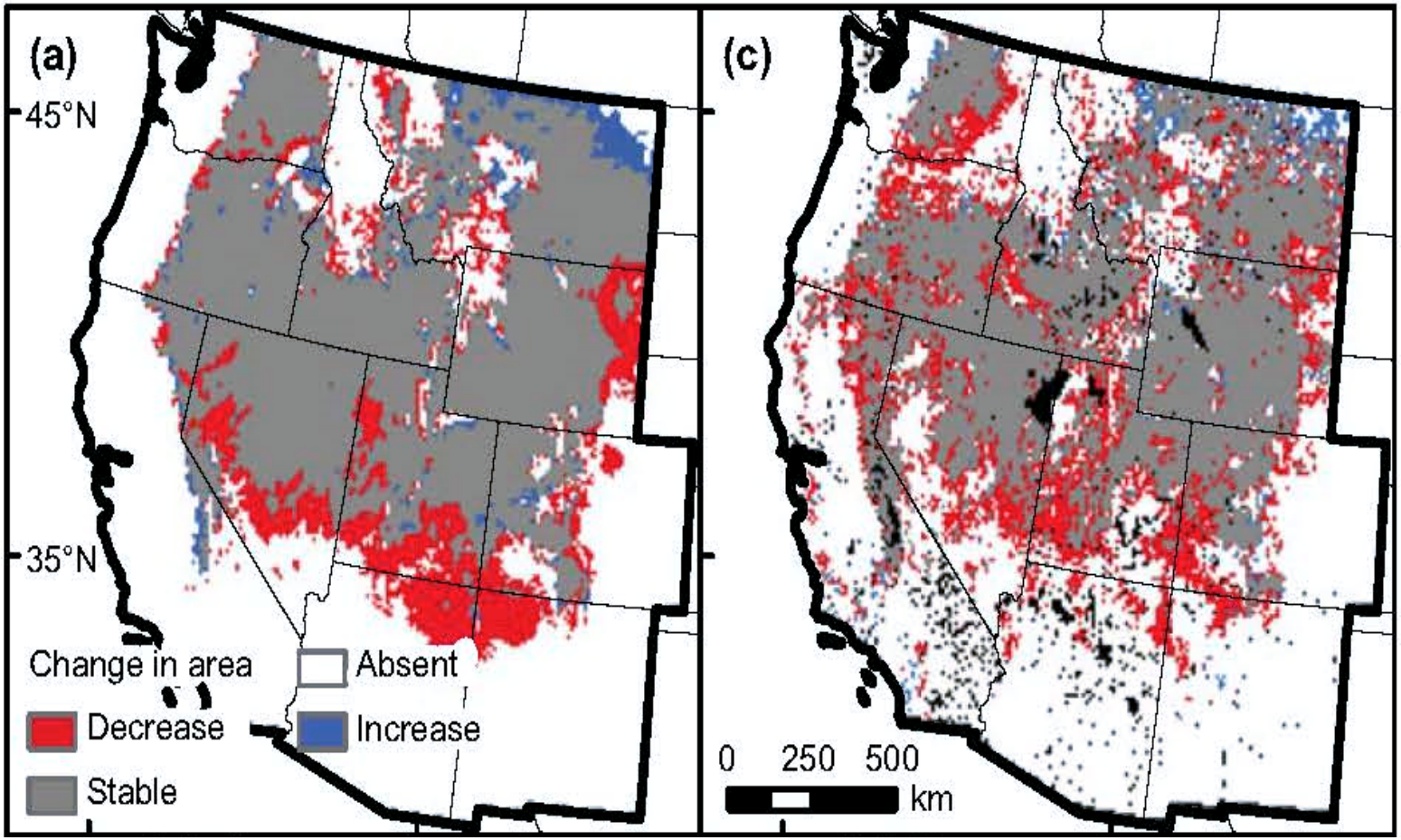
- Warming: +1-3°C by 2050, +2-4°C by 2100
- More winter warming in N latitudes.
- Winter precipitation:
  +0-10% by 2050 or +0-20% by 2100 for Northwest
- Soil moisture predicted to decline throughout.

II. *Plant responses*: Distribution models

Big sagebrush, from Schlaepfer et al. 2012

Maxtent model of suitable climate space, ensemble climate for 2040-2069

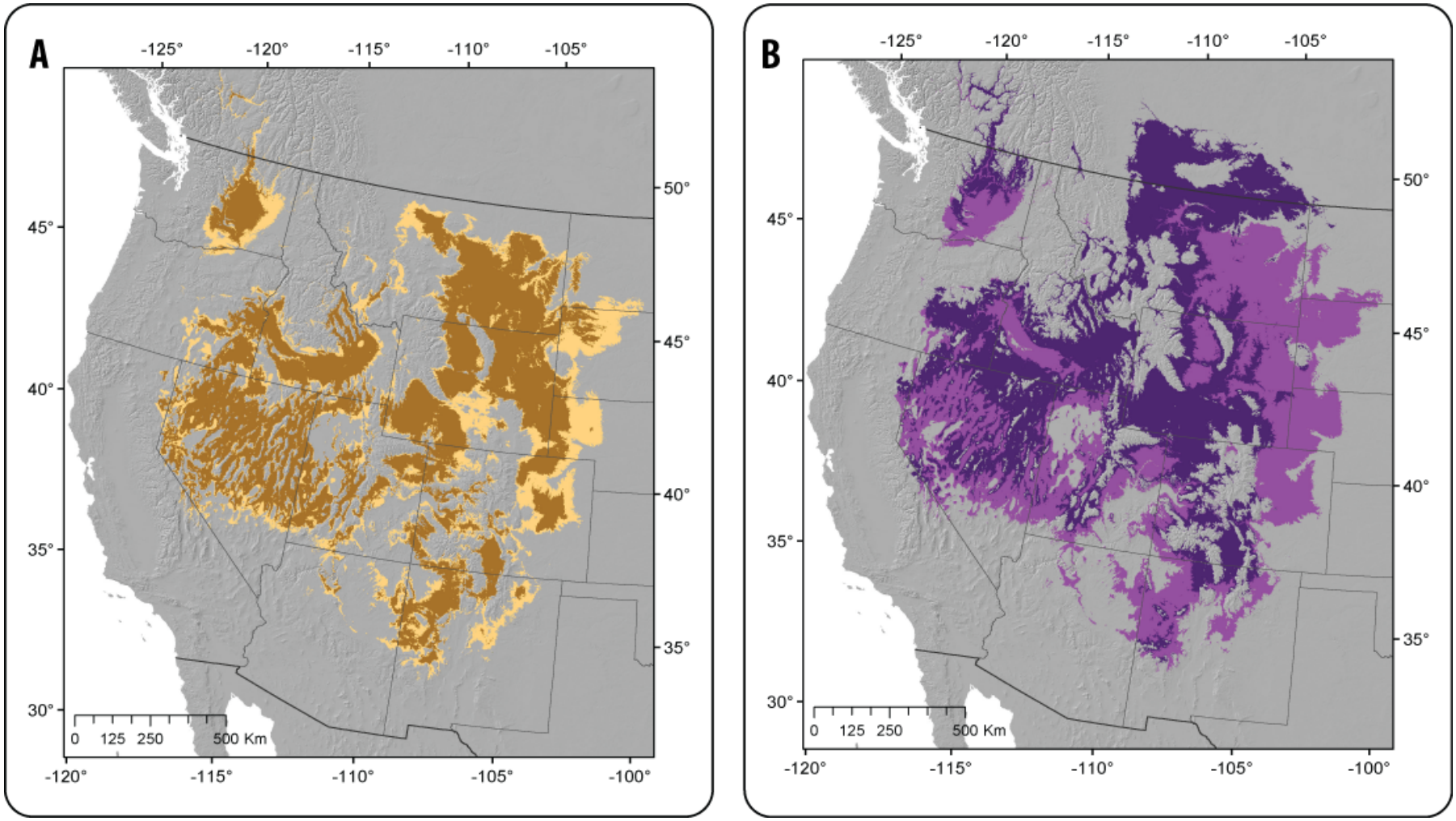
Species Distribution Model Ecohydrological model



<u>Wyoming</u> Big Sagebrush, from Still and Richardson, 2014

Target-group model, darker=more favorable climate (>75% probability)

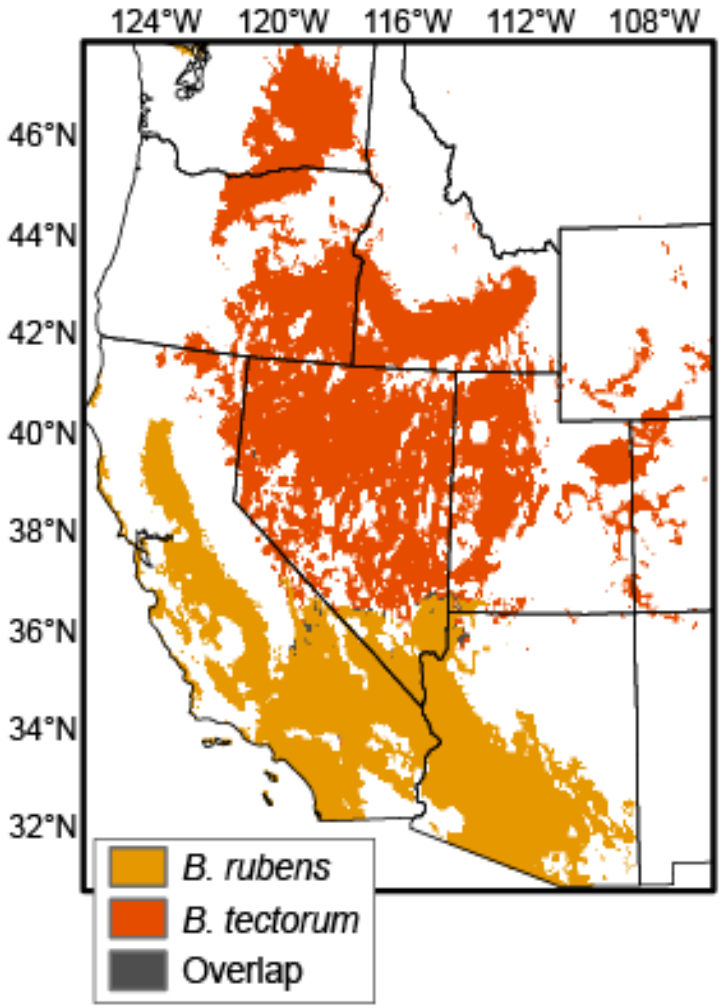
CURRENT **FORECAST FOR 2050**



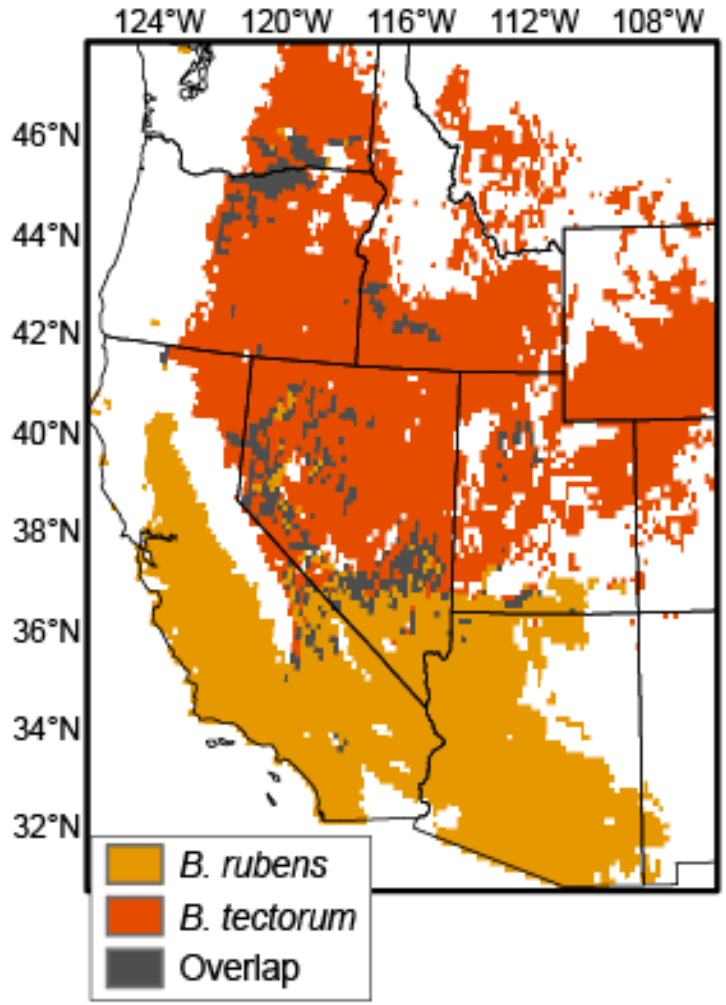
Cheatgrass and red brome, from Bradley et al. in revision

Maxtent model, ensemble climate for 2040-2069

CURRENT



FUTURE



Fire regime departure forecast for 2060

Crist/Comer et al. 2013, Central Basin & Range REA

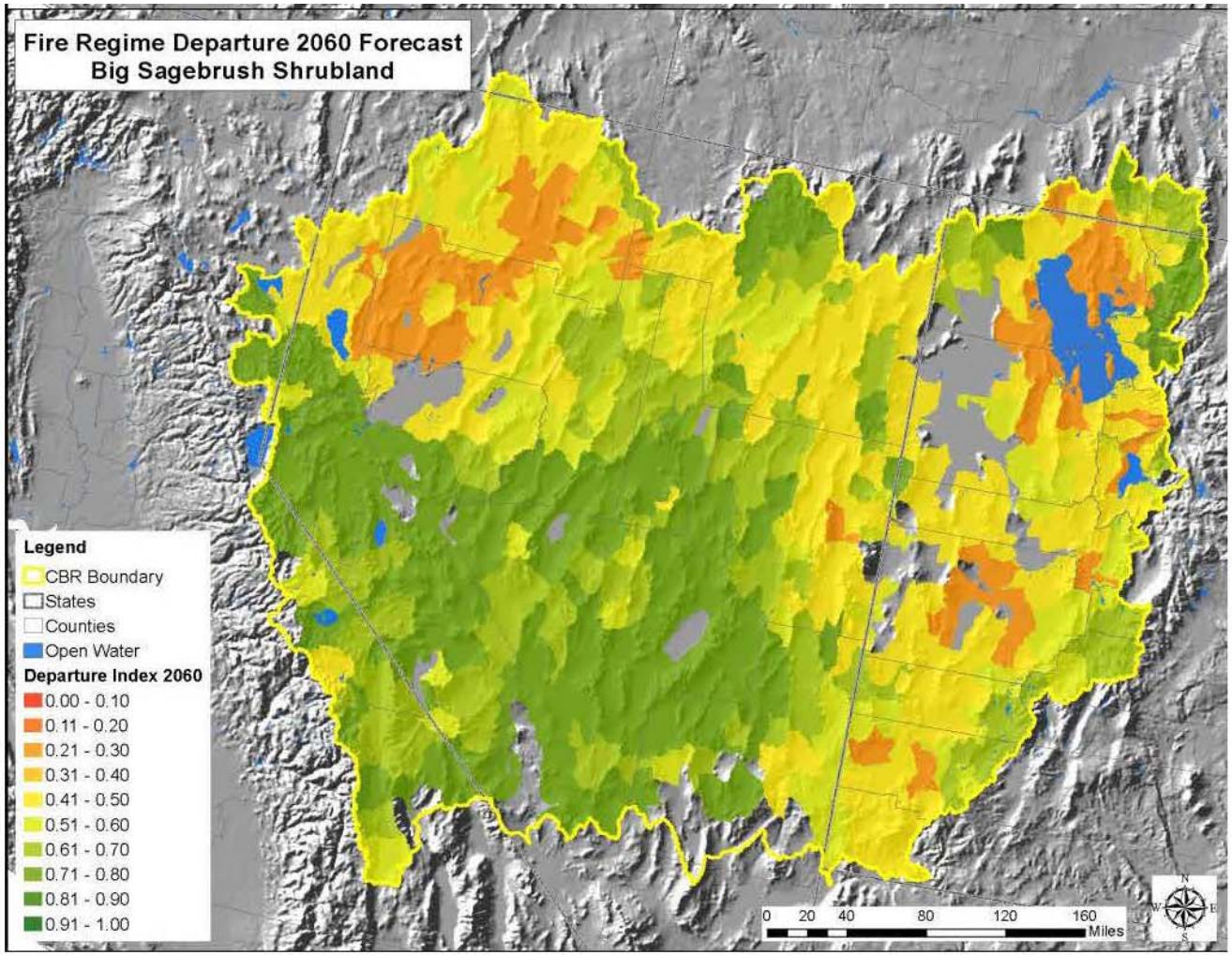


Figure 5-7. 2025 and 2060 Forecasts of fire regime departure for Inter-Mountain Basins Big Sagebrush Shrubland. Red and orange indicate high departure; dark green low.

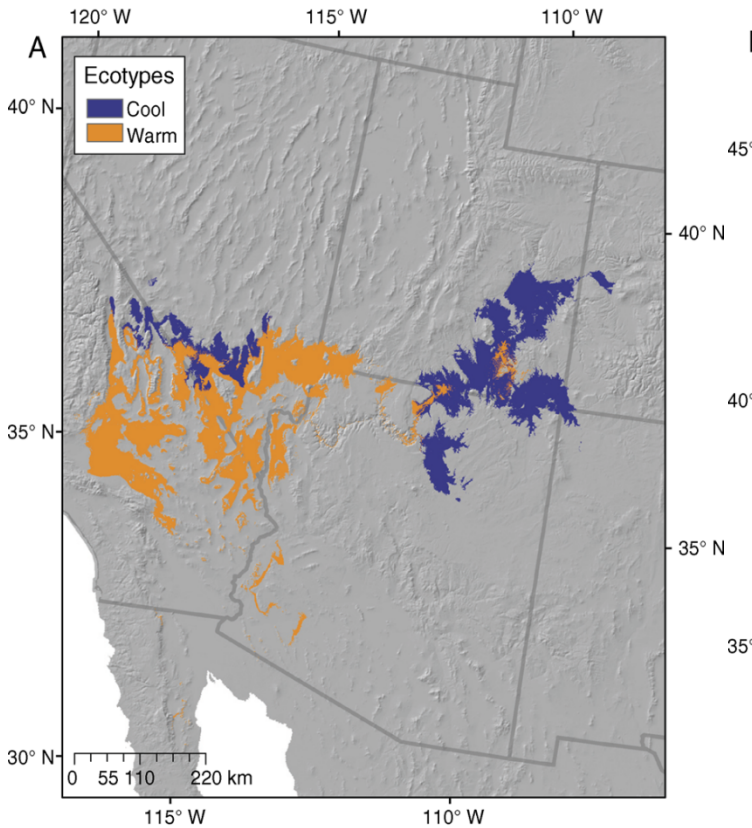
Cheatgrass dieoff

Photo credits to Bryce Wylie/Don Major and Tamzen Strigham.

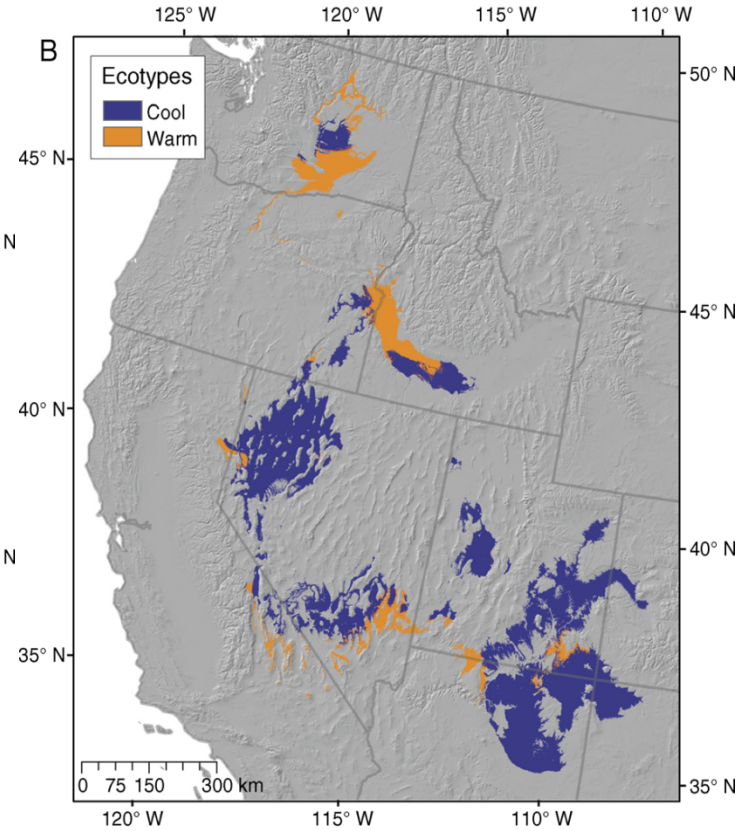
Native shrubs to replace sagebrush?

Distribution models for blackbrush, Richardson et al. 2014

Current



Forecasted, 2060

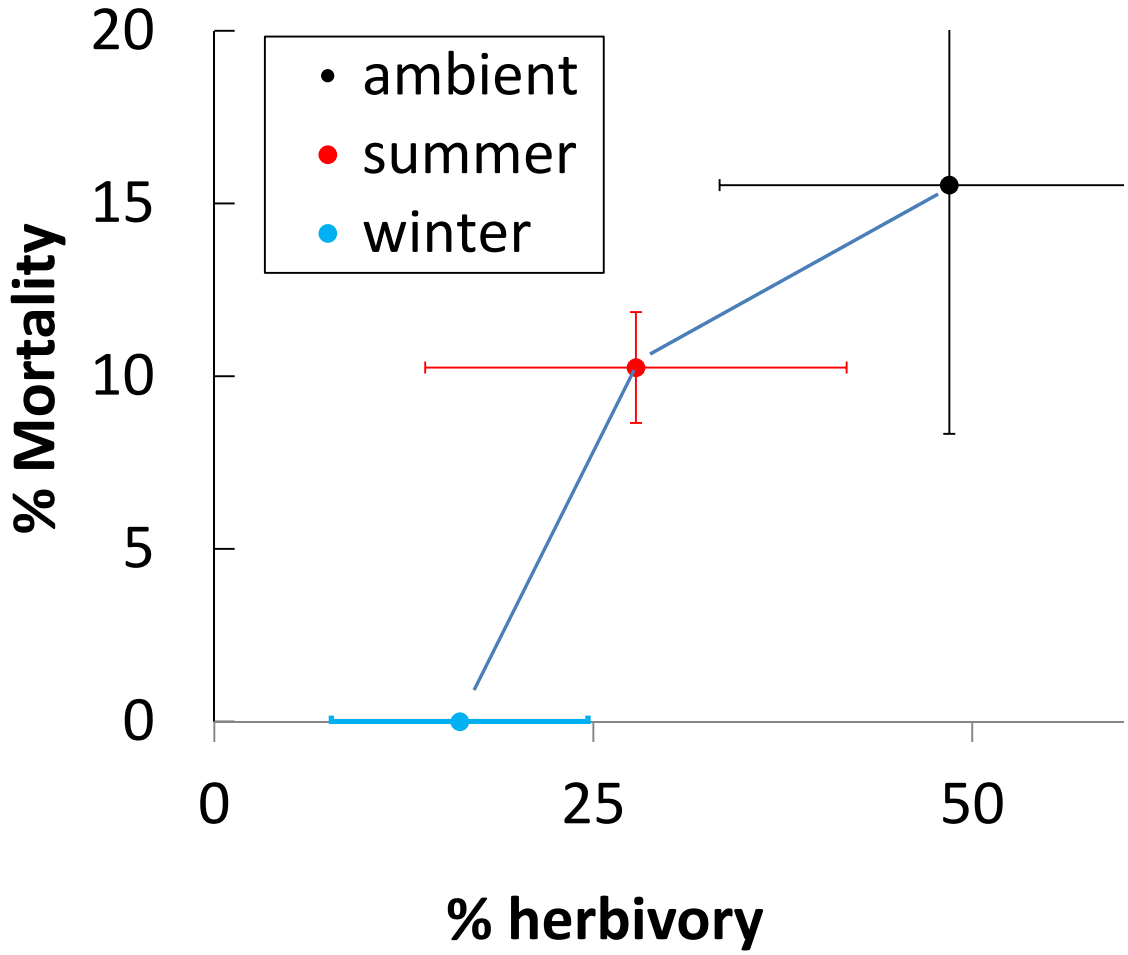


III. *Plant responses: experimental insight*

Seasonality of precipitation effects: INL Ecohydrology Experiment

Germino et al. 2014, J Ecology

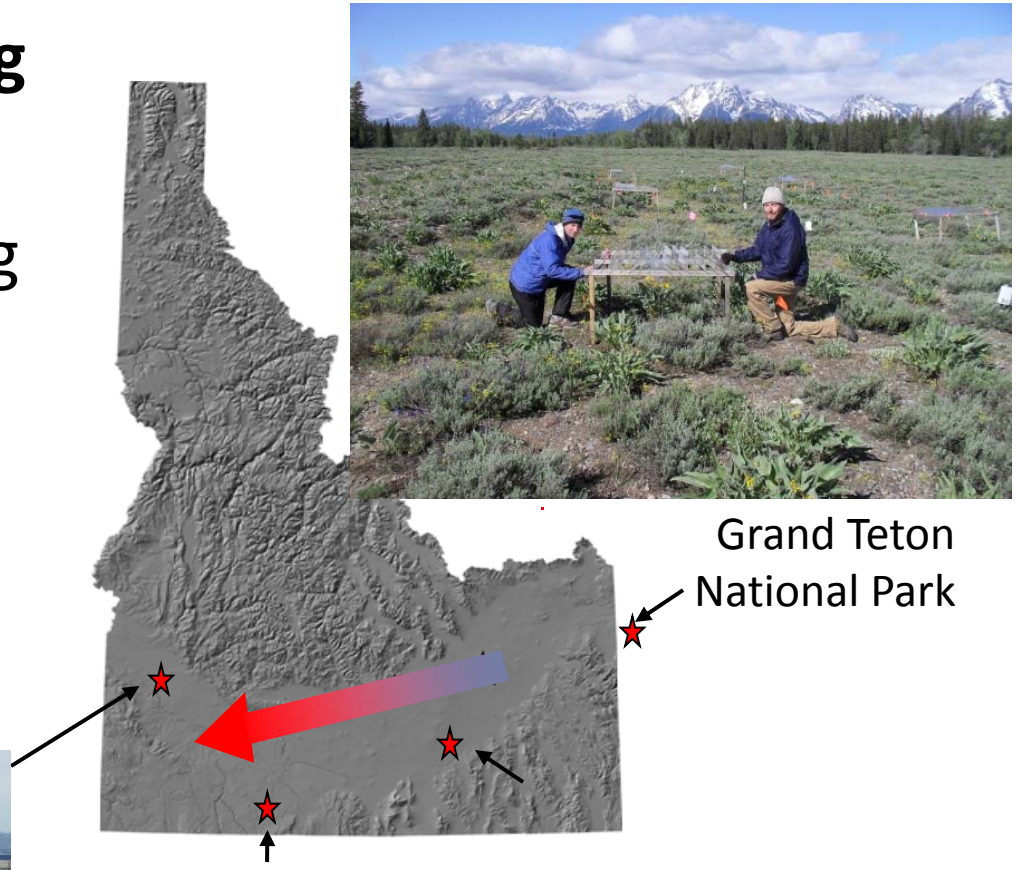
Precipitation added in winter (but not summer) leads to large increases in sagebrush, also cheatgrass.
Large changes in herbivory yet to be investigated.

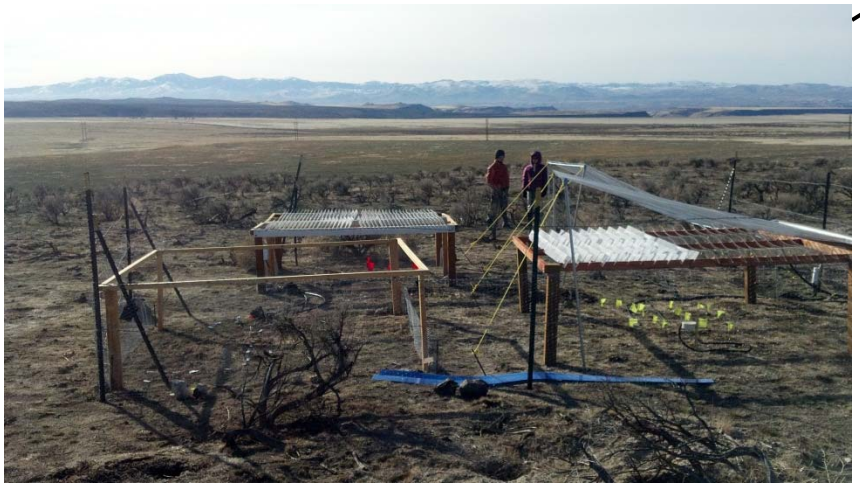


Snake River Plain Warming Experiment:

Warming effects vary along this gradient.

Germino et al. 2014





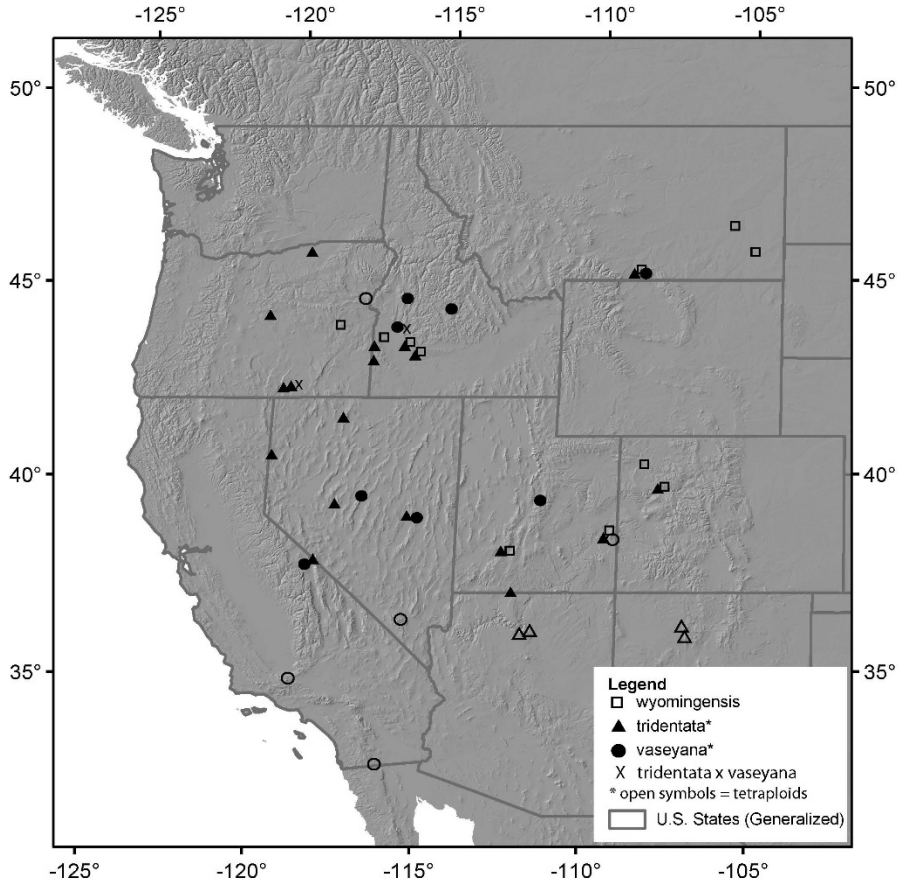
Birds of Prey NCA, burned & unburned

Sagebrush common gardens reveal climate effects:

High population-level climate adaptation,

Richardson, Germino USFS reports 2011-2013

Winter temperature and drought are important.



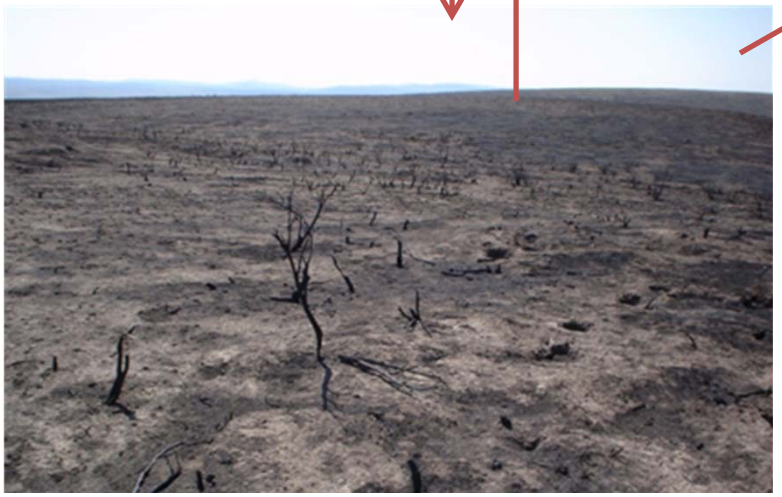
Common gardens of sagebrush seedlings after fire:

Suggest changes in relative abundance of subspecies.,

Minimum temperatures are key.

Climate effects pronounced in post-fire recovery

IV. Vegetation changes feedback on climate



Cheatgrass affects climate-fire relationship:

For 650 km2 of sagebrush steppe during 1980-2007 (USGS records):

	Sagebrush habitat	Cheatgrass
Annual probability of burning	<1%	1-2%
Fire return interval	97-313 years	50-82 years
Variation in fire explained by previous year's precipitation	**12-13%**	**22-27%**

Sequences of weather are important!

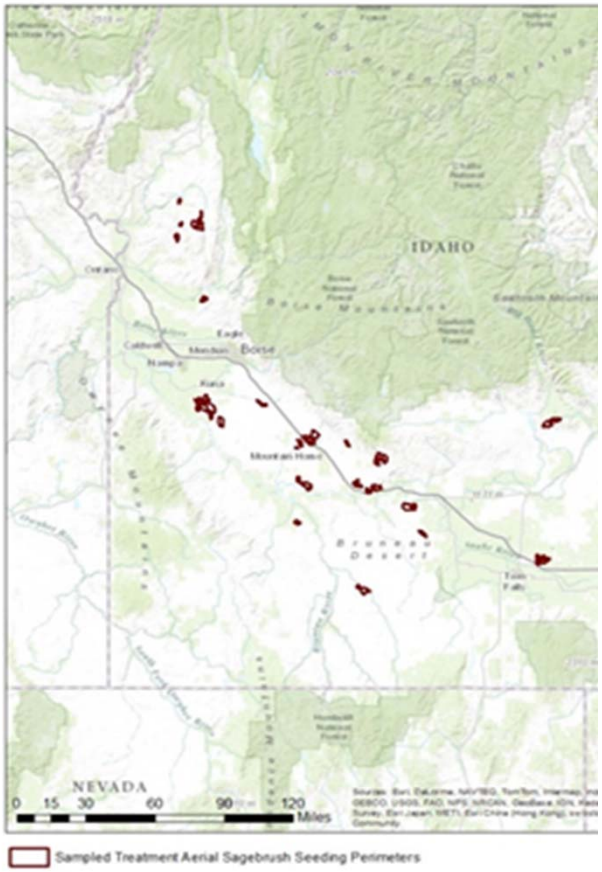
65% of fire starts on cheatgrass sites, many spread beyond

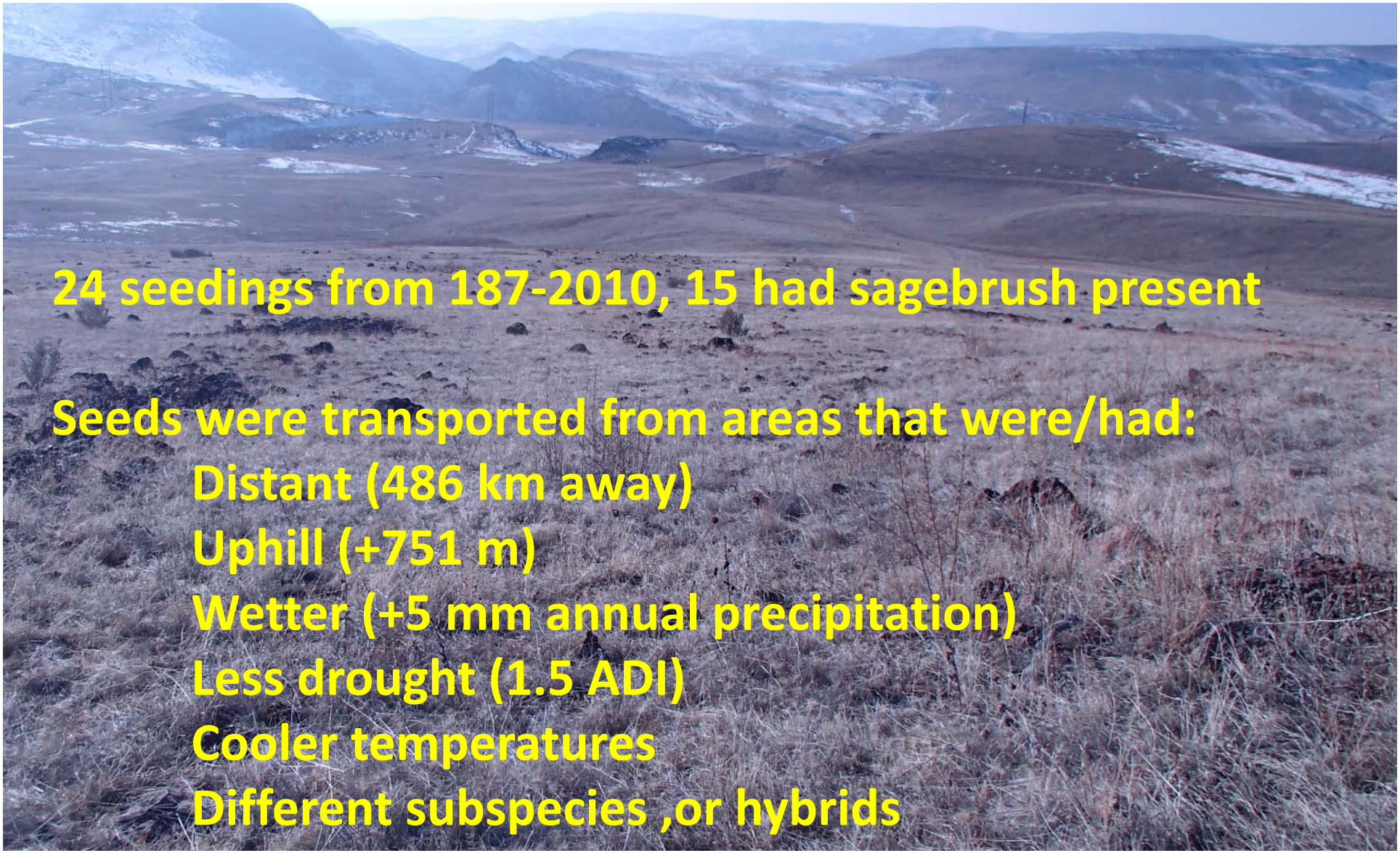
From Balch et al. 2013.

Climate adaptation via seed selection:

An example with post-fire seeding of sagebrush

Germino et al. 2014




24 seedings from 187-2010, 15 had sagebrush present
Seeds were transported from areas that were/had:
Distant (486 km away)
Uphill (+751 m)
Wetter (+5 mm annual precipitation)
Less drought (1.5 ADI)
Cooler temperatures
Different subspecies ,or hybrids

Climate of seed source relative to post-fire seeding site:

	+ sagebrush	Had no sagebrush
mean annual temperature	<0.75^{o}C lower	2°C lower
mean temperature of coldest month	NO DIFFERENCE	3°C lower
freezing degree days/yr	8 more	30 more
mean distance transferred	430 km	460 km

Post-seeding weather:

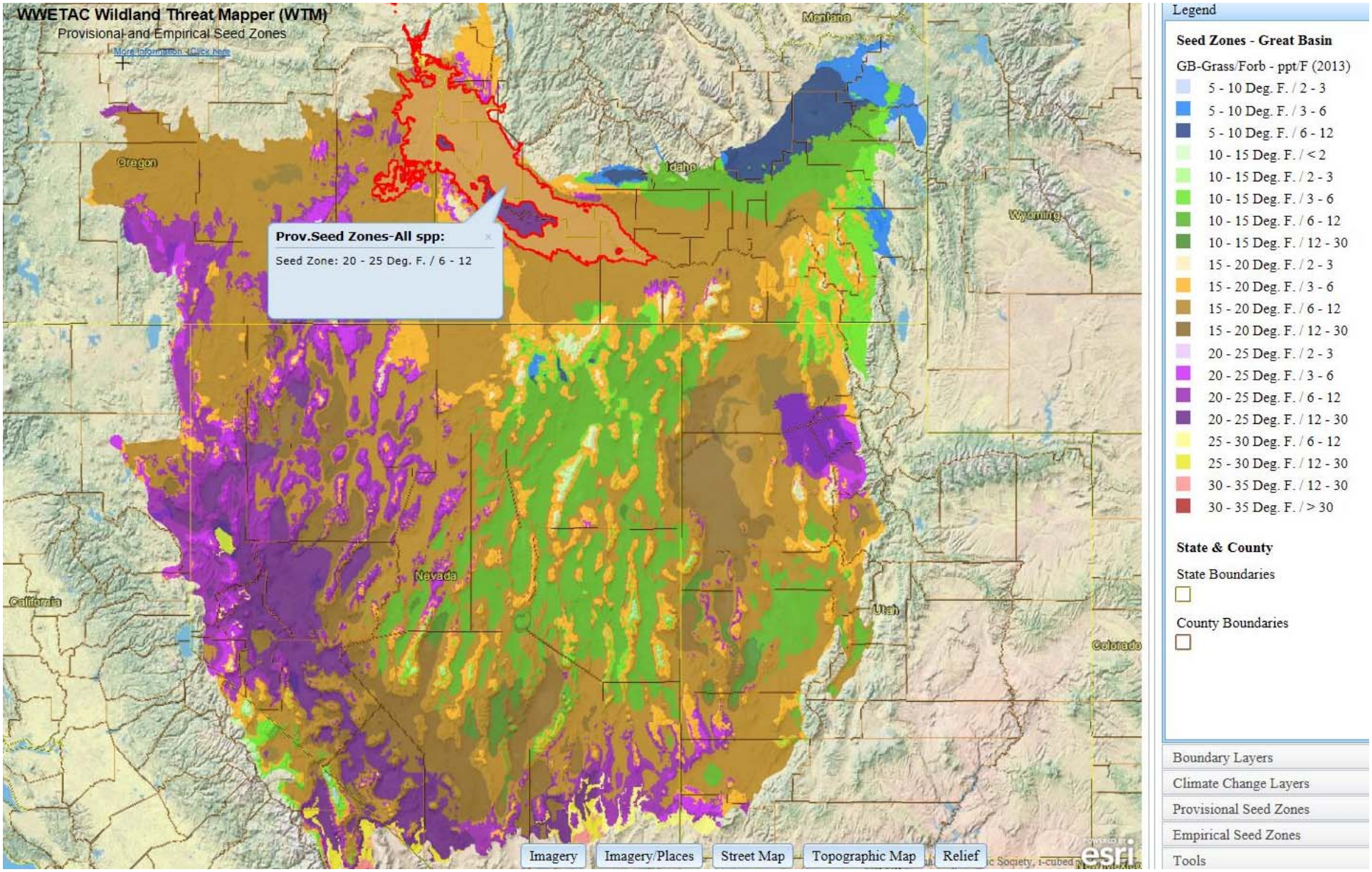
Successful seedings had colder and wetter post-fire weather:

1) Lower daily max temp
   (3rd post-seeding year; 1.3ºC; June-Sept)
2) Lower min temp of coldest month
   (3rd post-seeding year; 2ºC)
3) More freezing degree days
   (3 years post-seeding; +80 d, Oct-Mar)
4) Greater precipitation
   (4 year average, except Yr 1; 13 cm, Jan-Apr)

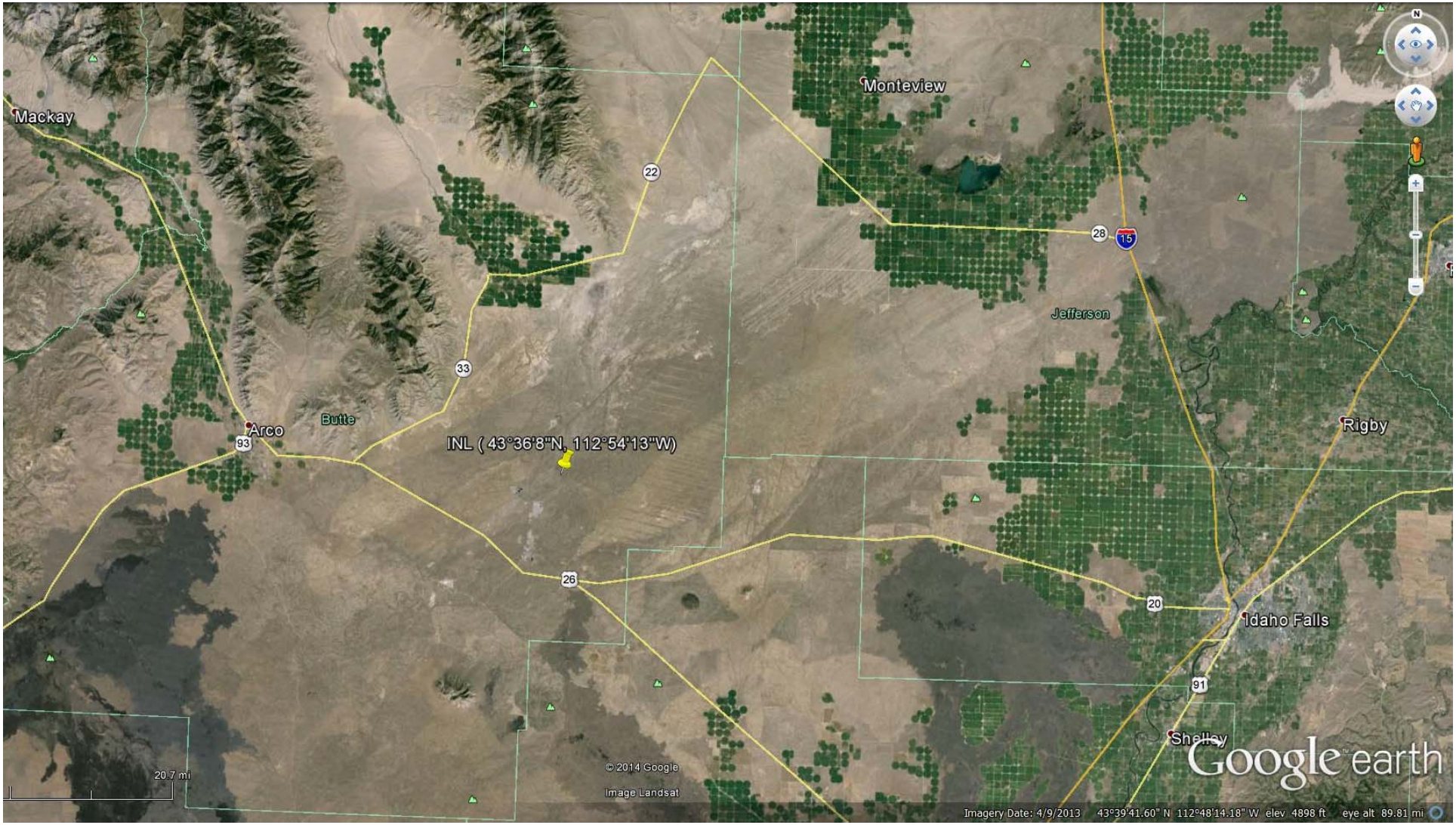
By planting cold-adapted sagebrush, have we sensitized post-fire landscapes to warm/dry weather?

Issue of "assisted migration"

Seed zone use - provisional



Wind and fire



Wind erosion

Wind erosion: scale-appropriate information on climate thresholds needed to predict soil stability,

eg. Crist/Comer et al. 2013 CBR REA:

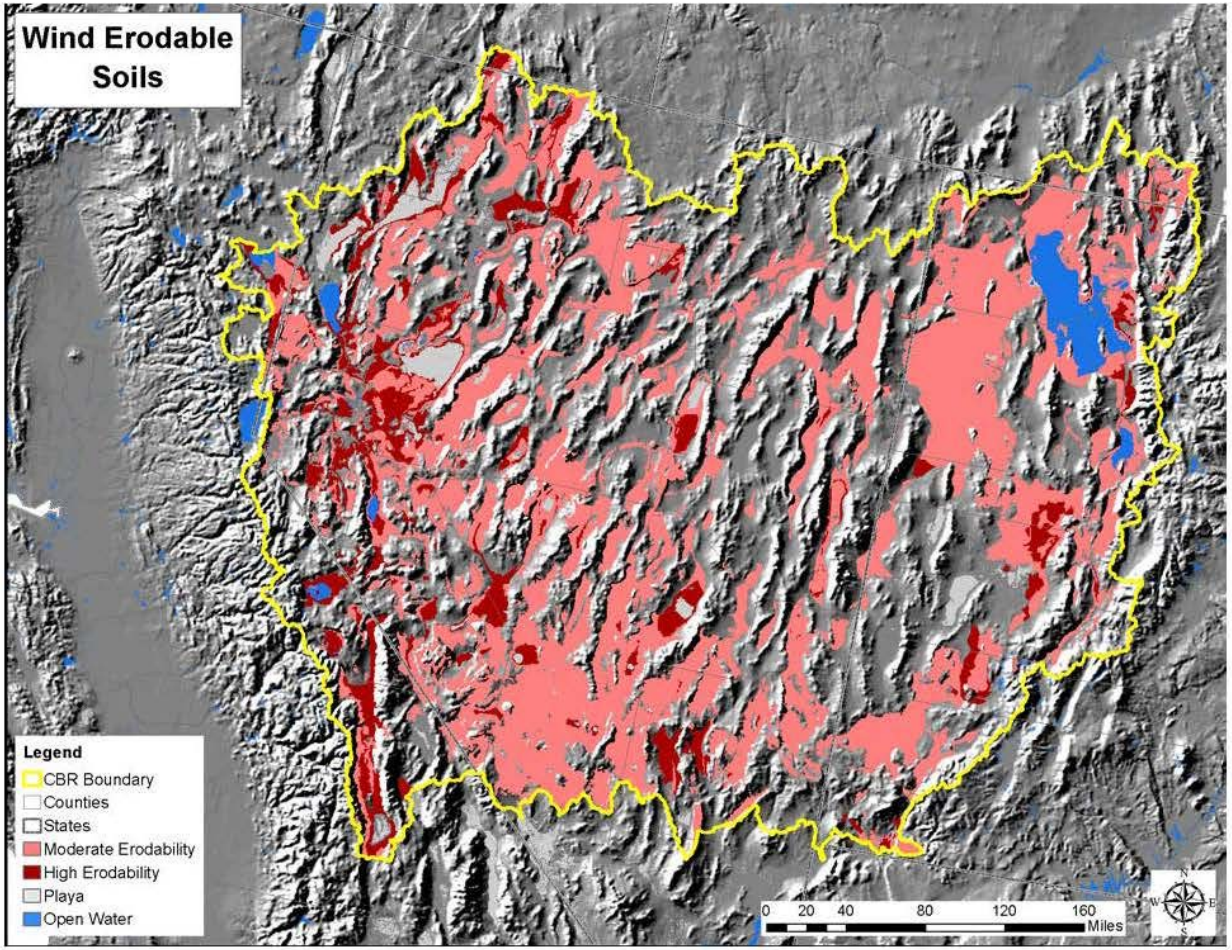


Figure 4-3. Modeled distribution of wind erodible soils in the Central Basin & Range ecoregion.

Where are the key challenges to maintaining the diversity and productivity of the Great Basin's sagebrush-steppe ecosystem?

- Less soil moisture with warming, more variable climate extremes (eg. drought)
- Problems for native species migration
- Potentially worse fire conditions, especially in NW
- Soil stability and sagebrush not favored by larger fires

Increased distribution of exotic annual grasses, contraction of sagerbush

What are some critical, near-term science needs to help us better understand rangeland fire in this ecosystem?

- Identification of thresholds related to fire and post-fire recovery
- Monitoring /assessment of climate, soil stability, and vegetation recovery
- Record keeping of treatments, assessment of treatments
- Addressing key weak-links in obtaining appropriate seed sources

Developing fire restoration/rehabilitation programs rather than short projects would be key, along with enhancing plant materials and technology.

The end

mgermino@usgs.gov

USGS
science for a changing world

Great Basin
LANDSCAPE CONSERVATION COOPERATIVE