Pinyon-Juniper Adaptive Silviculture Project

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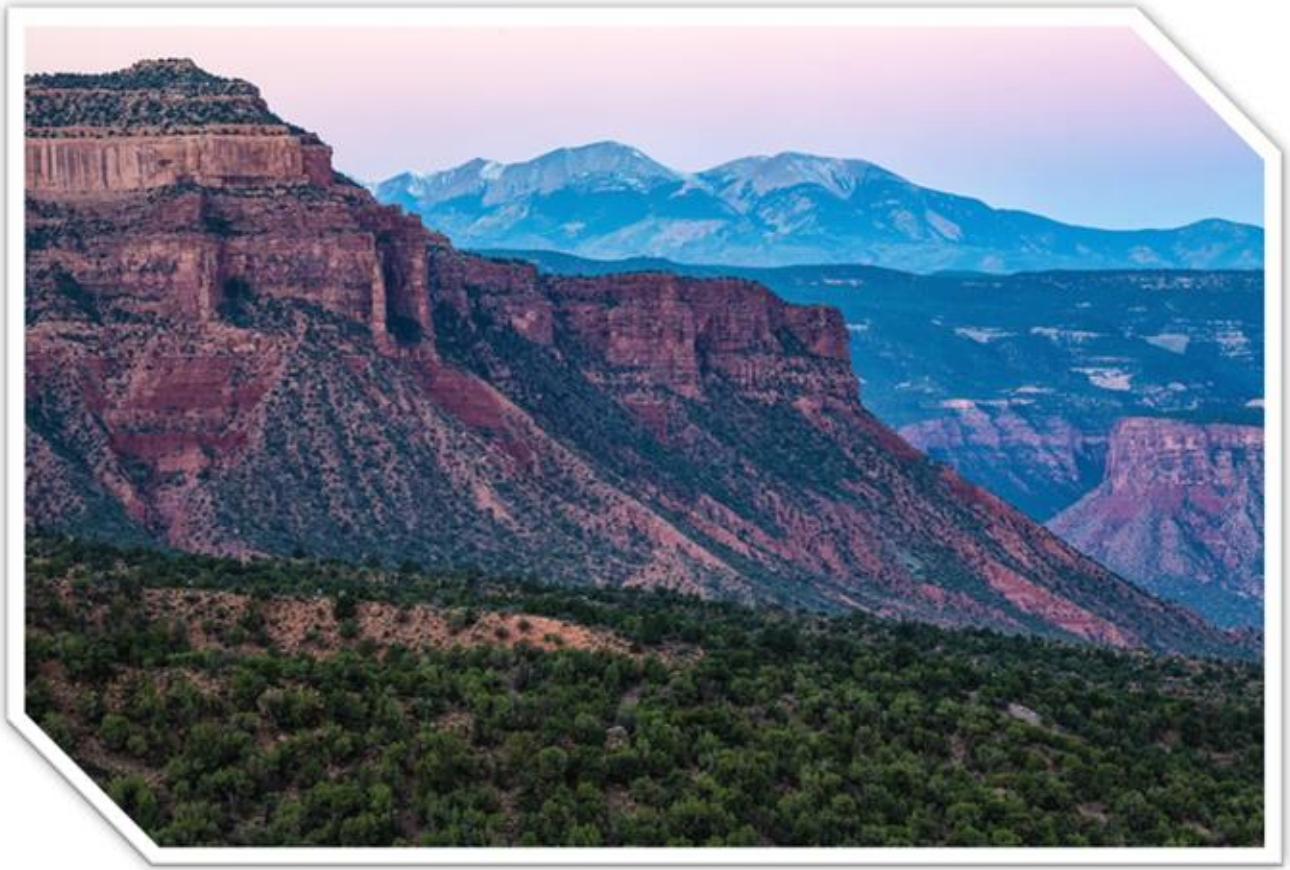
Pinyon-Juniper Management

Why are we discussing pinyon-juniper management? What has changed?

- A decade of sagebrush focused management
- Pinyon Jay paradox
- Changing drought and temperature regimes
- Increasing extreme fire weather behavior
- Increasing wildland urban interface

There is a need to improve our understanding of these ecosystems and ecotones and reevaluate our management as we gain new information.



Kinds of Pinyon-Juniper Vegetation

As generalized by Romme et al. 2009, there are three broad PJ types

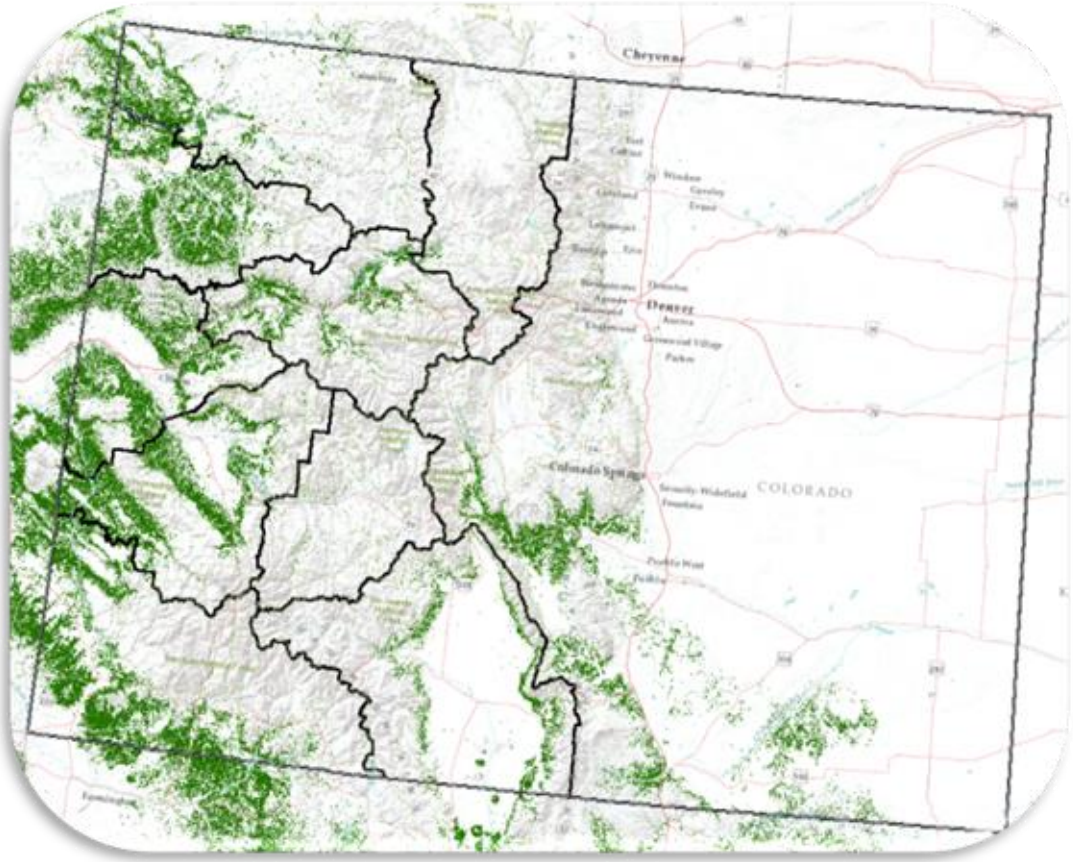
- Persistent woodland
- Savanna
- Wooded shrubland

In Colorado, most of BLM's management has been focused on wooded shrublands

- A lot of emphasis on sagebrush/PJ ecotone
- Other ecotones we manage are PJ into Ponderosa pine or other mixed conifer

Questions for consideration

To which types of PJ have we applied passive, active, and intensive management?



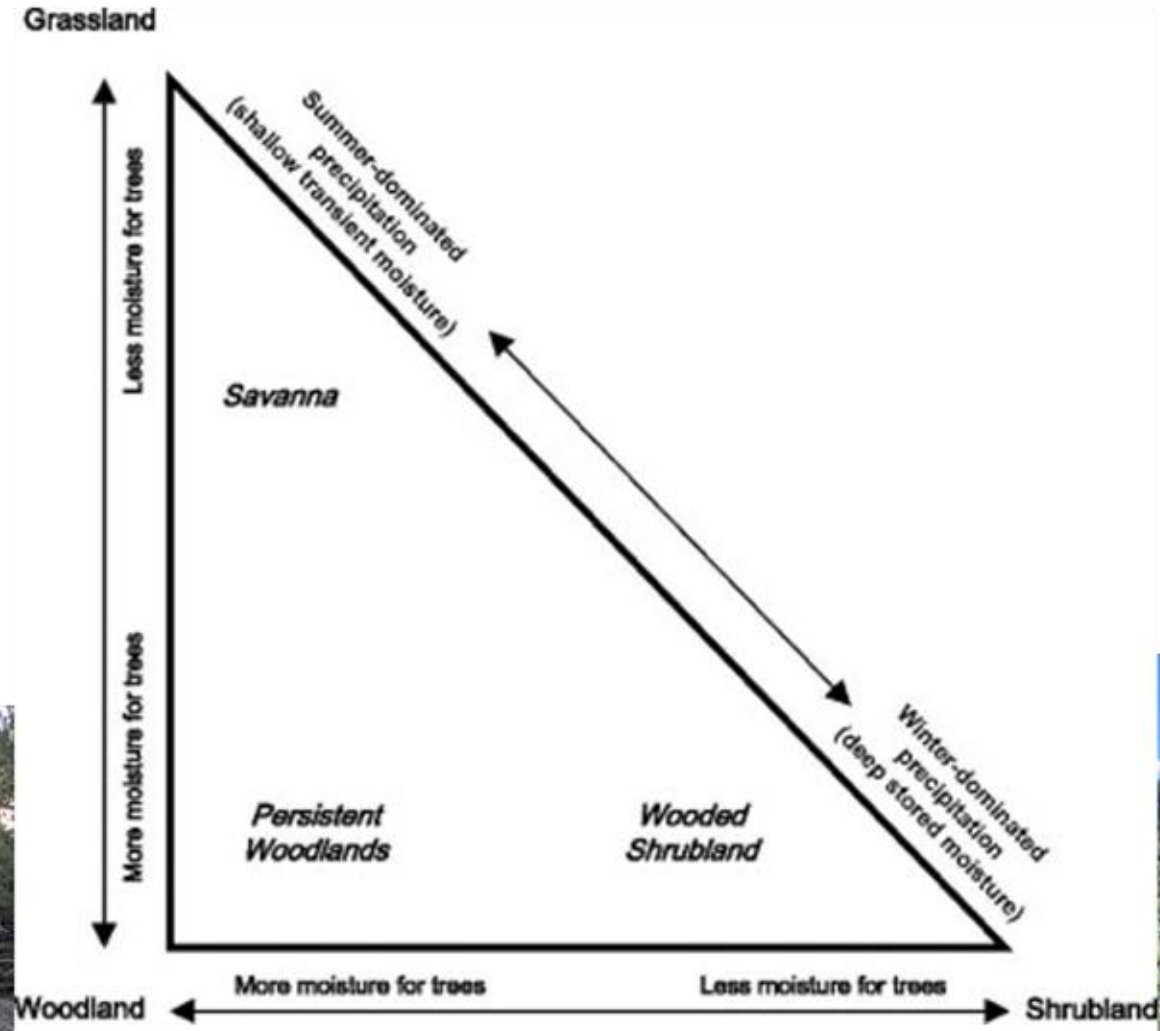
BLM manages 8.3 million acres of public lands and 27 million acres of federal mineral estate in Colorado

–~5.5 million acres of pinyon-juniper cover types in Colorado

–~2.9 million on BLM managed surface

Largest amount of mature and old-growth forests

Savanna



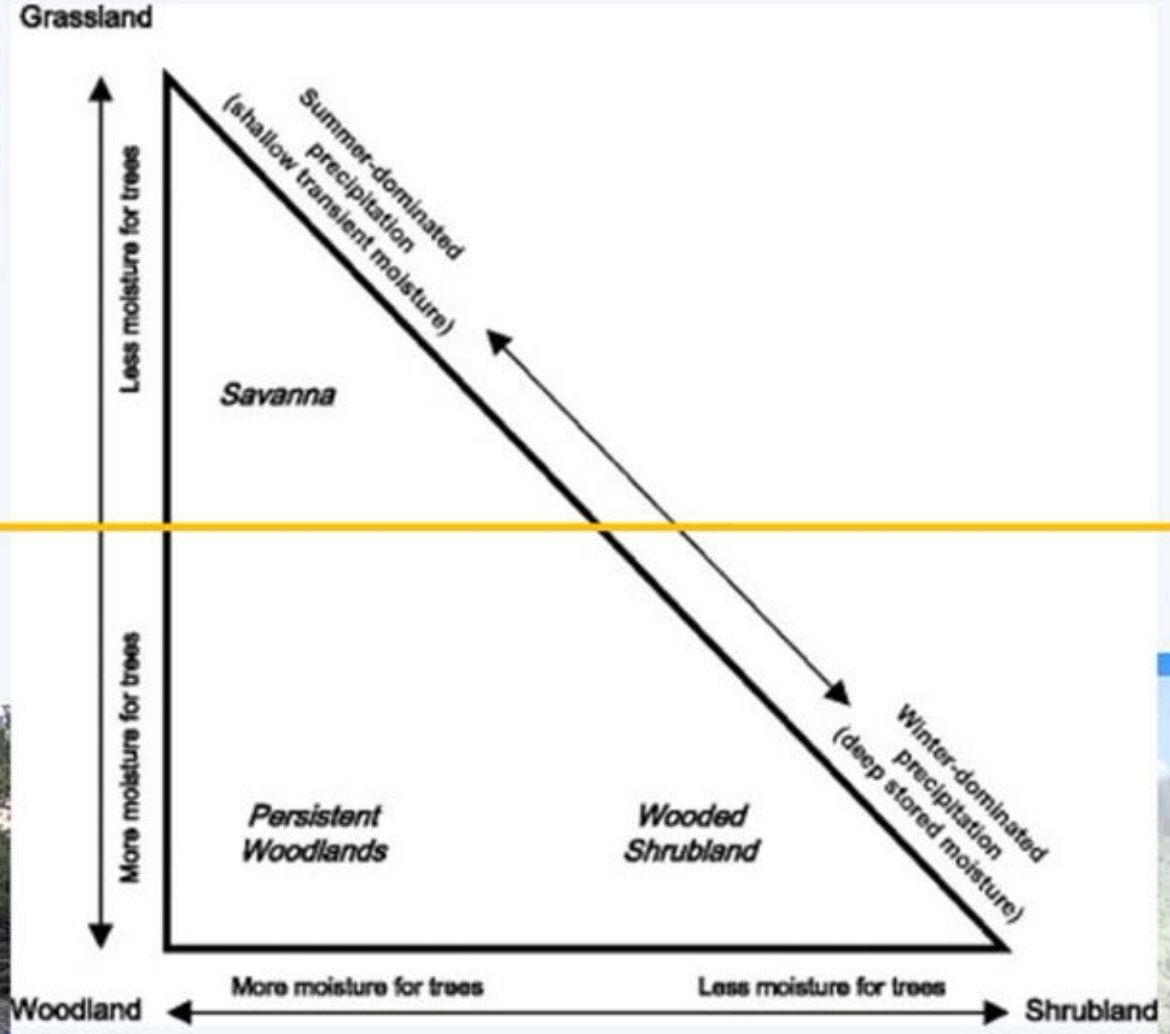
Romme et al., 2009

Persistent woodlands

Wooded shrublands

Savanna

- High grass cover and low tree density (water limitations)
- Common in eastern New Mexico where there is lots of monsoonal precipitation.
- *Surface fire is common here*



Romme et al., 2009

Persistent woodlands

- Consistently tree-dominated (greater water availability)
- Especially common in the Colorado Plateau.
- *Long fire return intervals due to surface fuel limitations*

Wooded shrublands

- Dynamic: tree vs. shrub component waxes and wanes overtime due to climate and small (patch-scale) disturbance.
- Especially common in the Great Basin.

Fires Along the WUI

Threat - Hazardous Fuels

-Proximity to values

-Site Conditions

Recent large stand replacing wildfires

Photo Courtesy Peter Weisberg;
Pine Nut Mts., NV. April 2022

Widespread Drought-related Tree Die-Off in the early 2000s

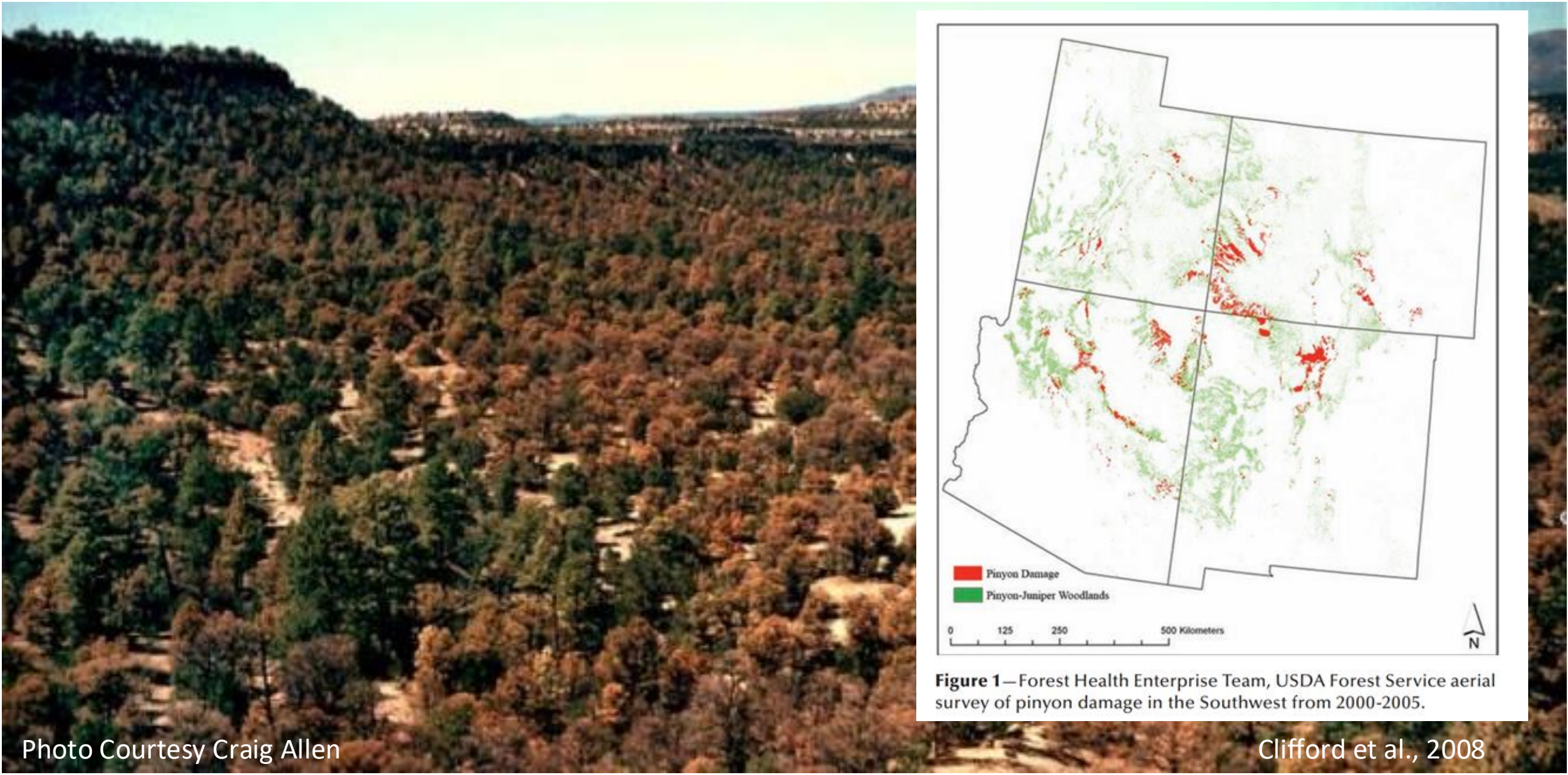


Figure 1—Forest Health Enterprise Team, USDA Forest Service aerial survey of pinyon damage in the Southwest from 2000-2005.

Photo Courtesy Craig Allen

Clifford et al., 2008

More recent tree die-off following the 2018 drought

Southwest, CO, Photo taken 2019

High uncertainty in how to manage for woodland resilience to drought and wildfire

Table 1 from Redmond et al., 2023 Ecosphere

TABLE 1 Priority areas and treatment options for different management objectives common in pinyon–juniper ecosystems.

Management priority	Treatment type(s)	Desired effect(s)	Target areas	Confidence from evidence
Maintain healthy woodlands	- No treatment	- Maintain tree populations - Avoid risk of harming biological soil crusts and understory vegetation - Maintain adequate tree regeneration	- Woodlands with high-value habitat or old trees - Woodlands with intact understories or high biological soils crusts	*Moderate*: Some observational studies find no association between stand density and tree mortality[1]; avoids risks of soil disturbance and loss of tree populations associated with treatments.[2]
Increase woodland resilience to drought, insects, and pathogens	- Uneven-aged silviculture to reduce tree densities to desired level in each age/size class and to manage tree spacing for a diversity of structures (clumps and openings)	- Reduce tree competition - Maintain adequate tree regeneration and stimulate understory vegetation - Enhance mosaic nature of the woodland	- Uneven-aged woodlands - Dense homogenous woodlands with high-value habitat - Dense stands in trailing edge, or declining core woodlands	*Low*: Greater tree densities associated with greater mortality in some studies,[1] but this may be associated with fine-scale proximity.[3] More long-term research needed for uneven-aged silvicultural treatments.[4,5]
Fire risk reduction	- Mechanical treatments to reduce surface fuels, ladder fuels, and canopy bulk density, including low thinning and pruning lower limbs - Prescribed burning in areas with low susceptibility to invasive annuals	- Reduce the probability of a large fire - Reduce fire intensity for fire suppression actions and firefighter/public safety - Reduce likelihood of fire-induced conversion to alternate stable state (annual grassland)	- Areas near the wildland–urban interface - Prescribed burning better suited in woodlands in cool/wet climates due to greater resistance to annual grass invasion. Burning may be difficult to implement where understory cover is sparse.	*Low to moderate*: limited studies on the efficacy of fuel treatments for reducing fire risk in pinyon–juniper. Potential adverse effects of thinning on fire behavior due to increases in abundance and continuity of fine fuels.[6,7]
Invasive species management	- Manage or remove livestock to maintain native herbaceous	- Reduce the risk of invasive plant species establishment and	- Recently disturbed woodlands with limited native	*High*: Seeding of native perennials can reduce invasive plant

Pinyon-Juniper Adaptive Silviculture Project

Goal: Experimentally assess the efficacy of different silvicultural treatments for increasing vegetation resilience and reducing fire risk across environmental gradients

NATIONAL SYSTEM OF PUBLIC LANDS
U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

THE UNIVERSITY OF CALIFORNIA BERKELEY
1868

FOREST SERVICE
US
DEPARTMENT OF AGRICULTURE

UNIVERSITY OF NEVADA RENO
1874

USGS
science for a changing world

COLORADO STATE UNIVERSITY
EDUCATION · SERVICE · RESEARCH · EXTENSION
1870

Silvicultural treatments designed to vary in thinning intensity and spatial complexity

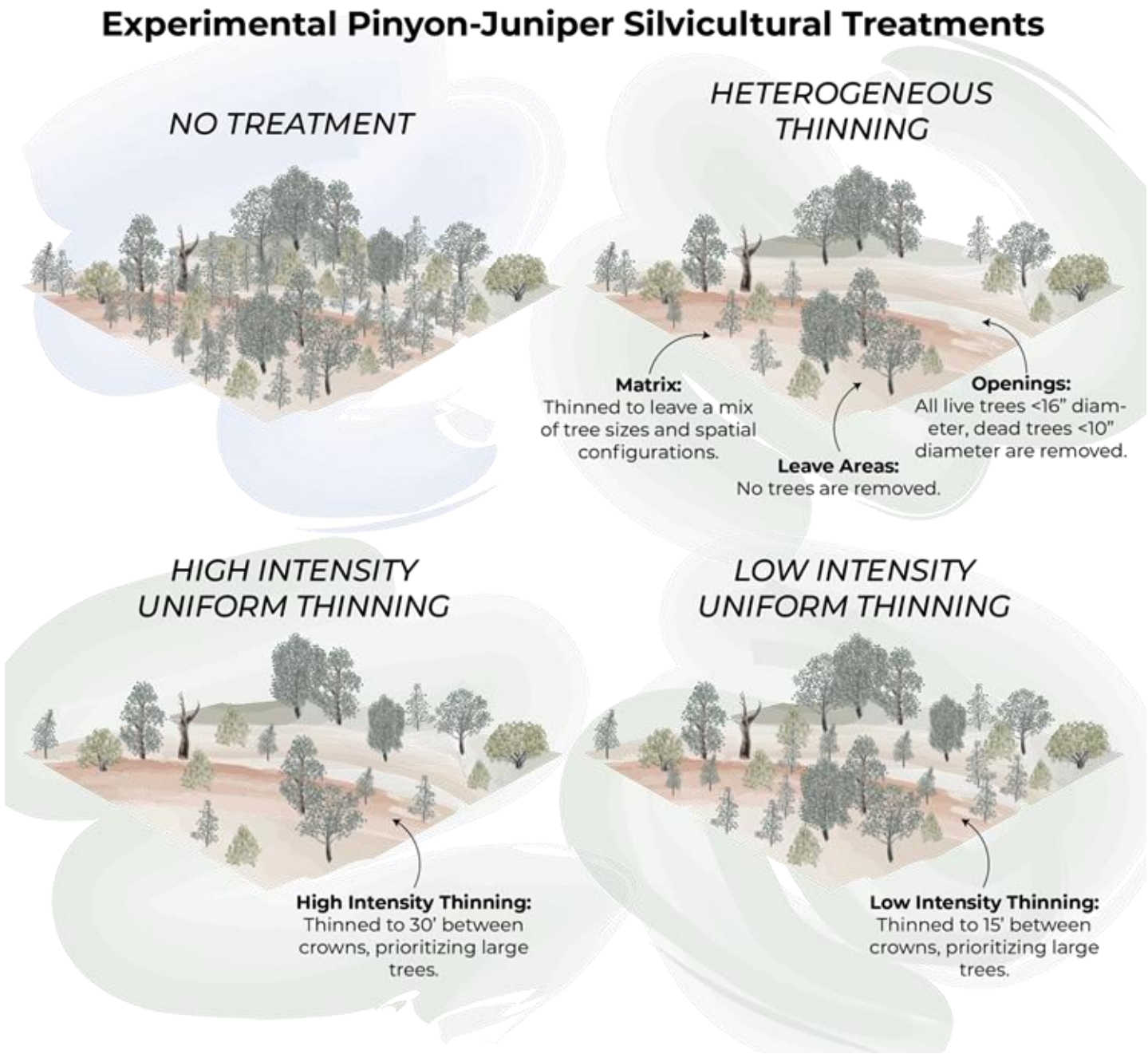
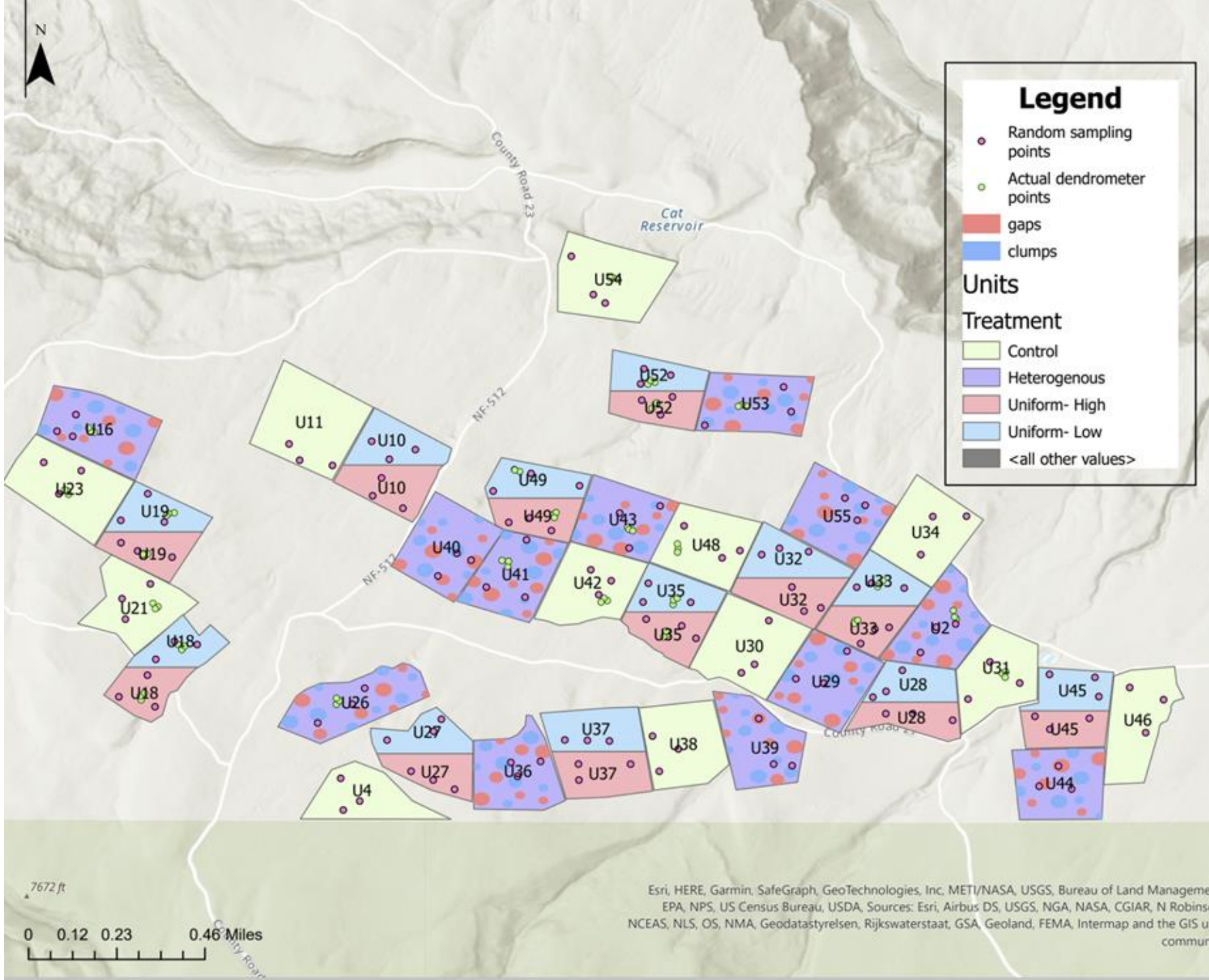


Figure courtesy of Mariah McIntosh

Replicated treatments span a 6500-7500 ft elevational gradient in southwest Colorado



Sampling design characterizes woodland structure, understory vegetation, and fuels

- 192 plots sampled across the study area to characterize woodland structure, understory vegetation, and fuels
- Point dendrometers installed on 72 trees to continuously monitor tree growth and air temperature
- Soil moisture and temperature sensors installed post-treatment
- Terrestrial lidar scans at sensored sampling point for further fuel characterization

Developing prescriptions was challenging

- A lot of discussion between researchers and practitioners
- Balance between prescription complexity and feasibility
- Iterative process -> developed the prescriptions, field tested and refined, tested again to check for clarity

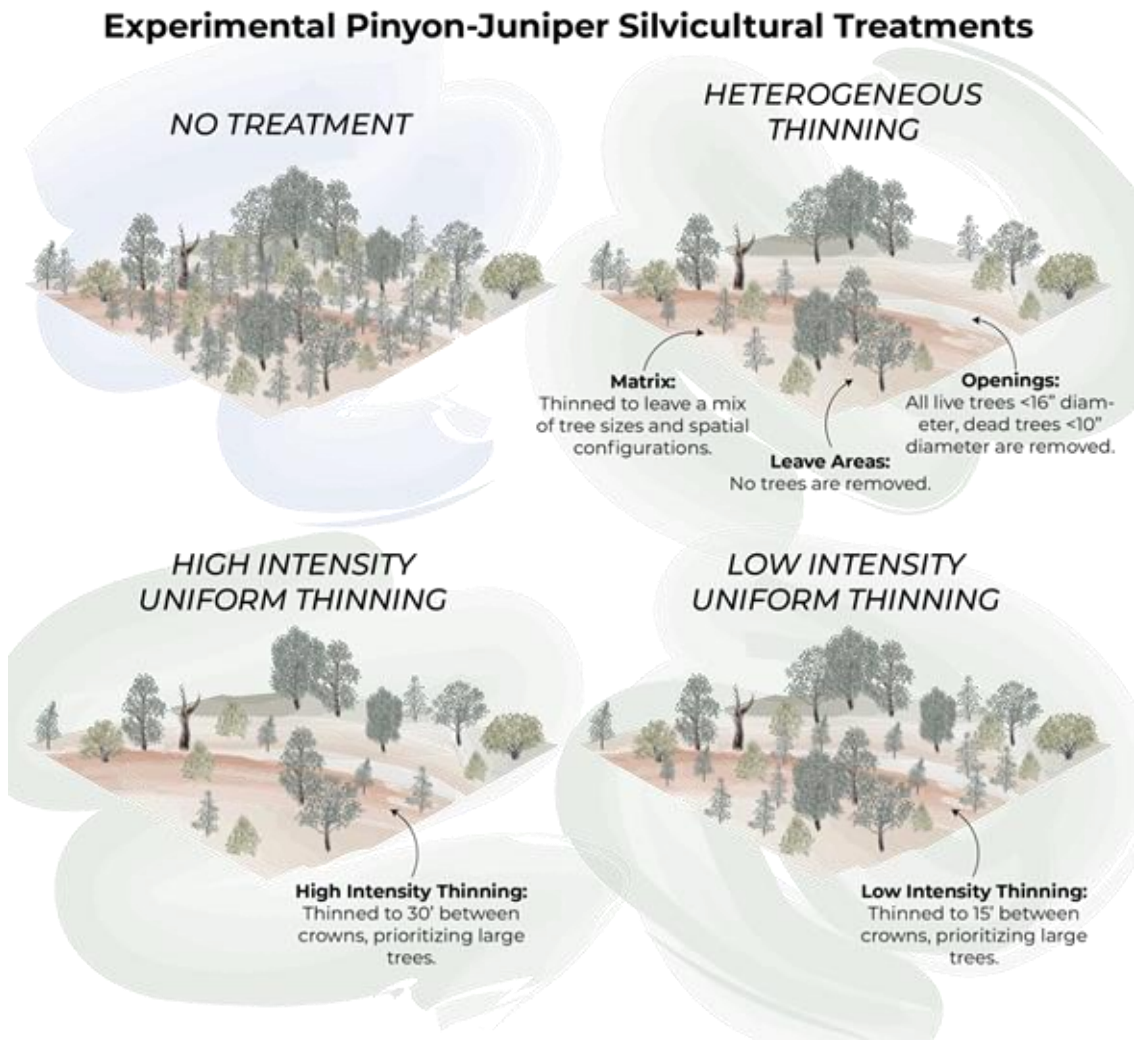


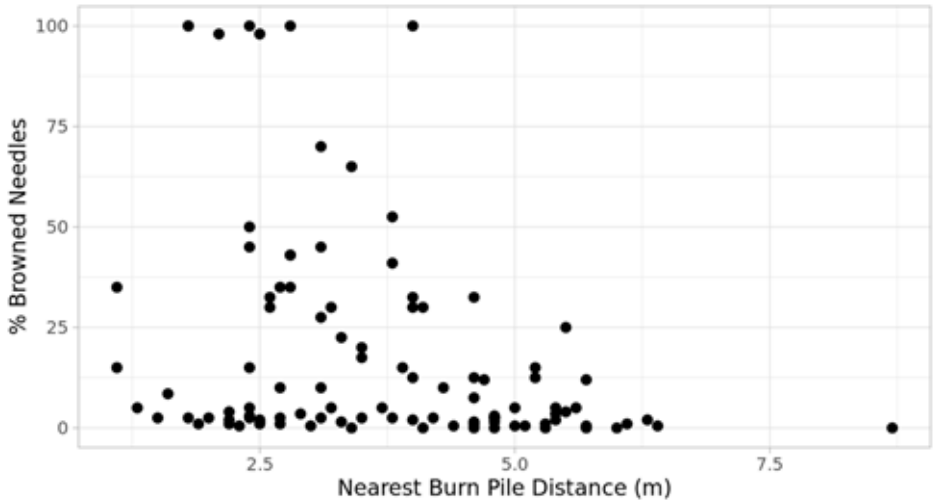
Figure courtesy of Mariah McIntosh

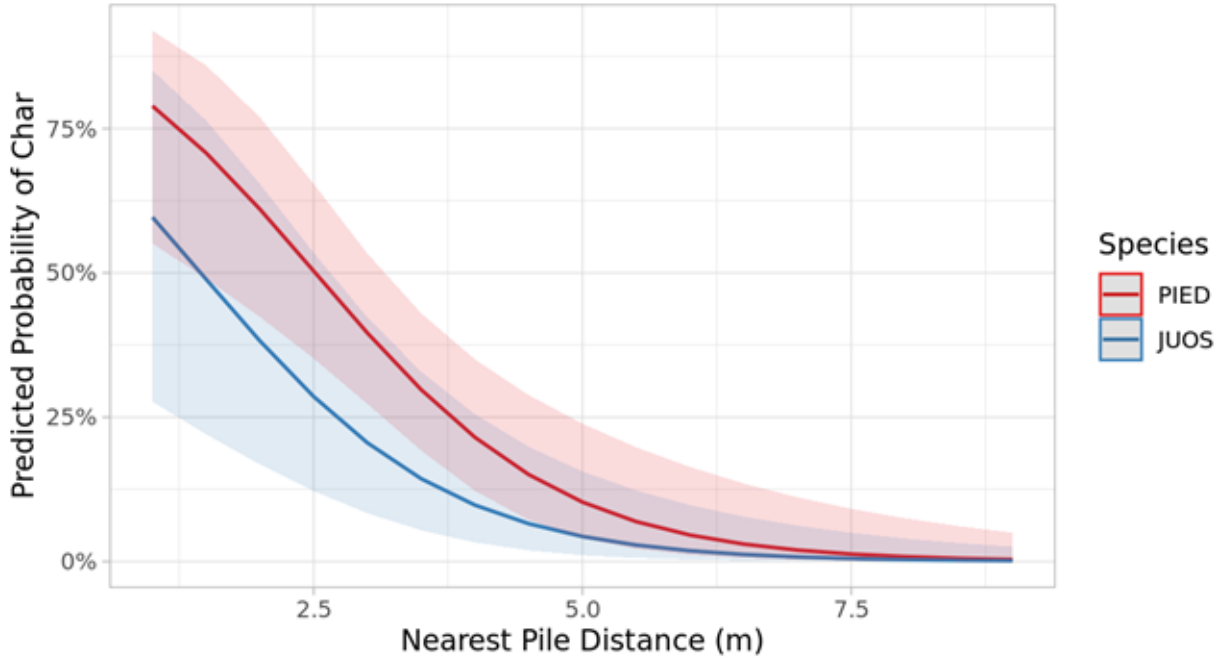
Implementation Challenges

- Required a lot of oversight to ensure contractors were following the prescription
- Government timeline (need to submit the SOW very early) meant that we couldn't guarantee refinements to prescription would be implemented
- Challenges with pile burning
  - Weather variability and limited burn windows
  - particularly in our light thinning treatment

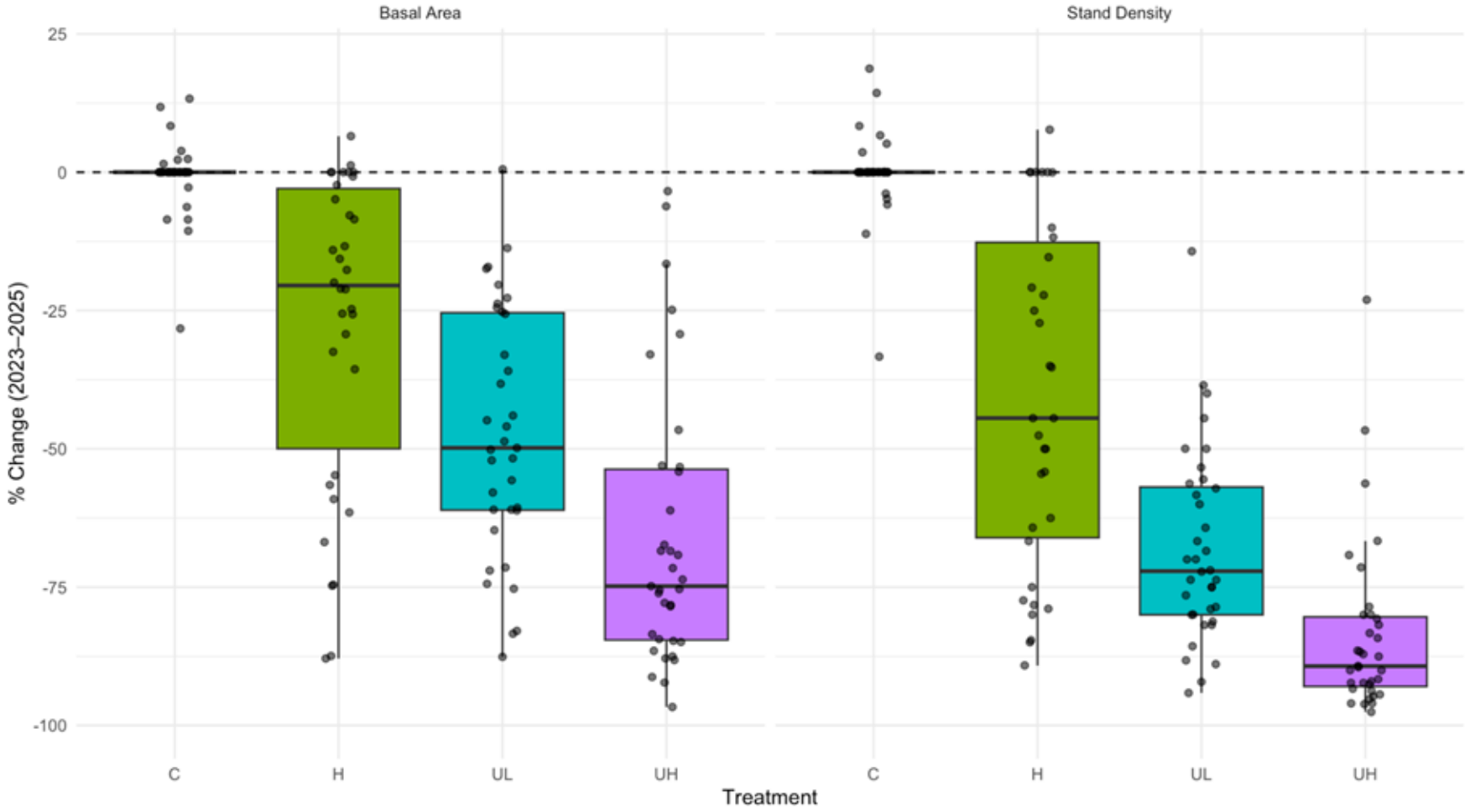
Unexpected setbacks with pile burning

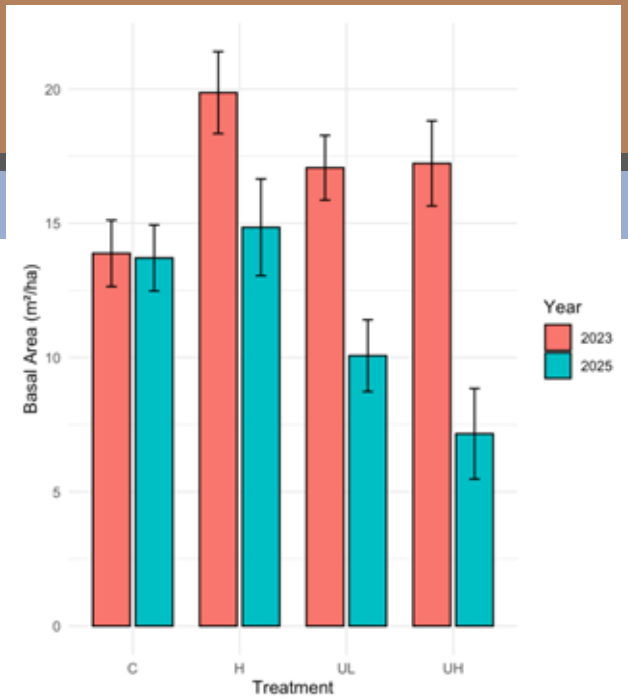
Little to no damage from piles 5 m away

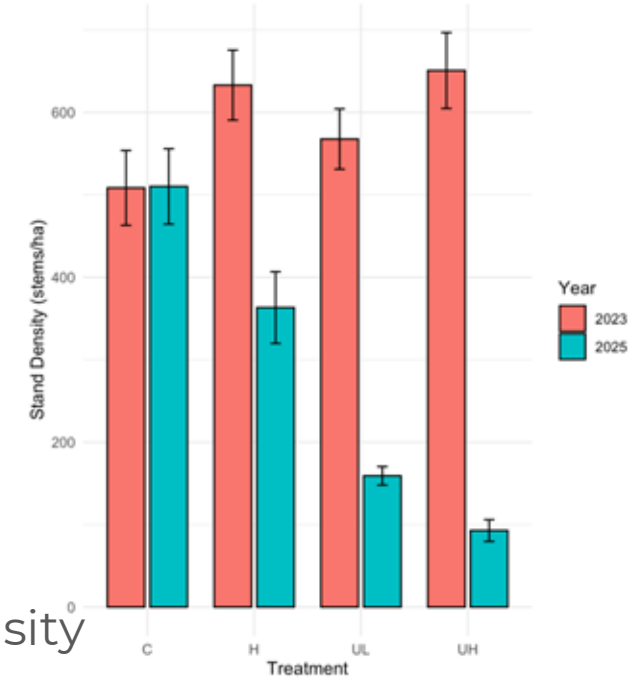




Changes in stand structure

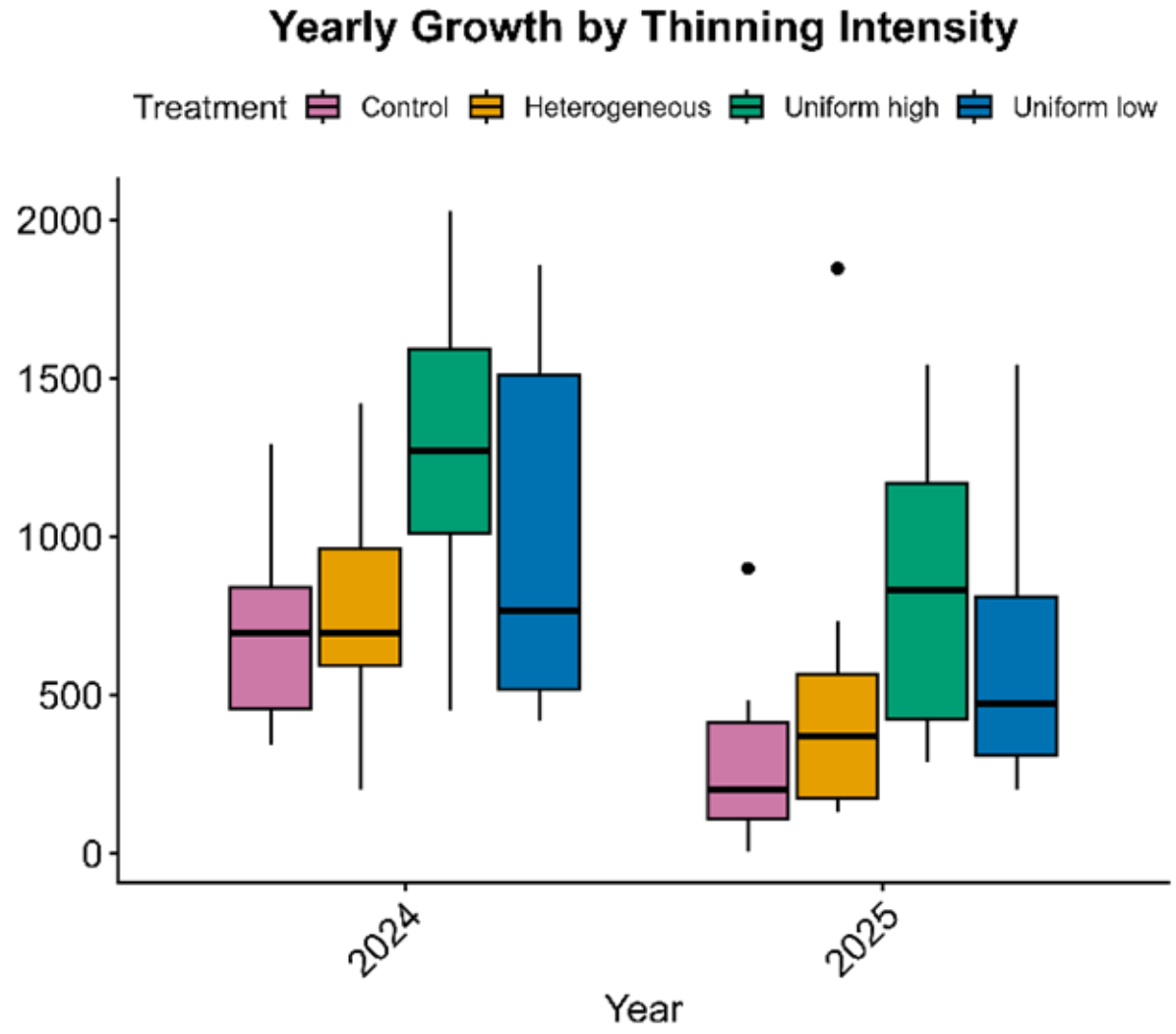






C = Control; H = Heterogeneous; UL = Low-intensity Uniform; UH = High-intensity uniform thinning

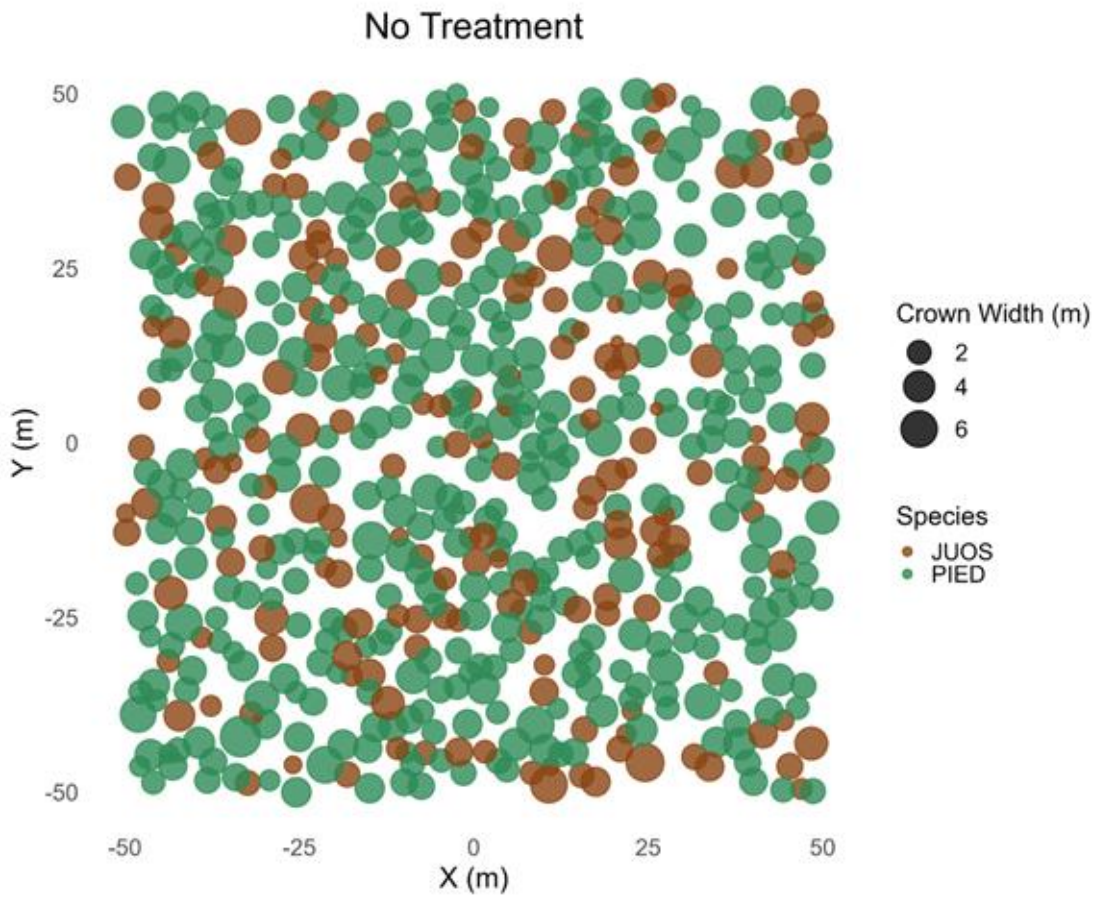
General increases in tree growth rates in the high intensity thinning treatment, particularly during the wet year



Revenis et al., In Prep

Wildfire Behavior Modeling

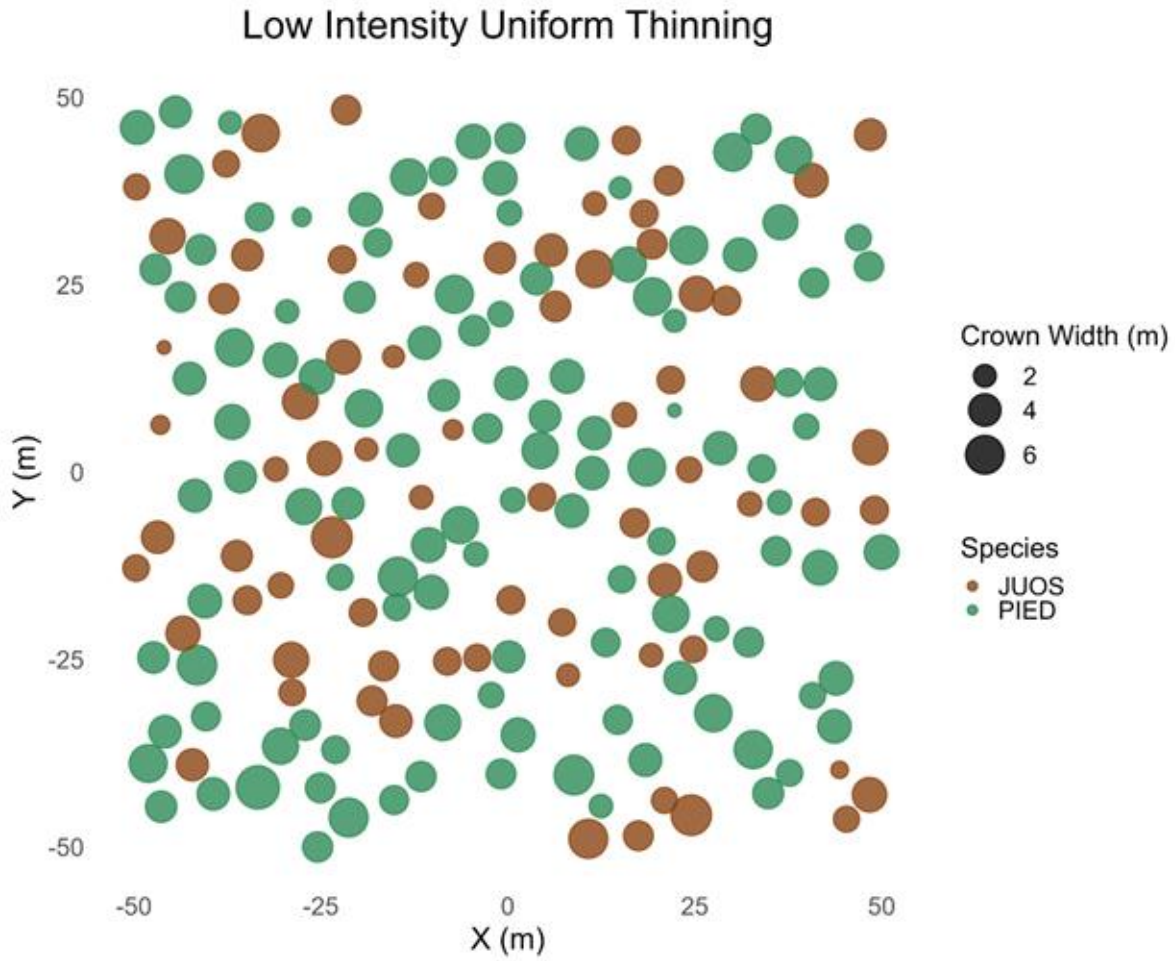
- Computational fluid-dynamics model: FIRETEC
  - Spatially explicit
  - Interactions between fuel, fire, and atmosphere
- Simulations:
  - 4 canopy fuels
  - 3 surface fuel trajectories
  - 2 wind conditions
- Surface fuels:
  - Discontinuous fuels, continuous herbaceous, heterogeneous mixture of herbaceous and shrub
- Winds
  - Moderate and High wind scenarios

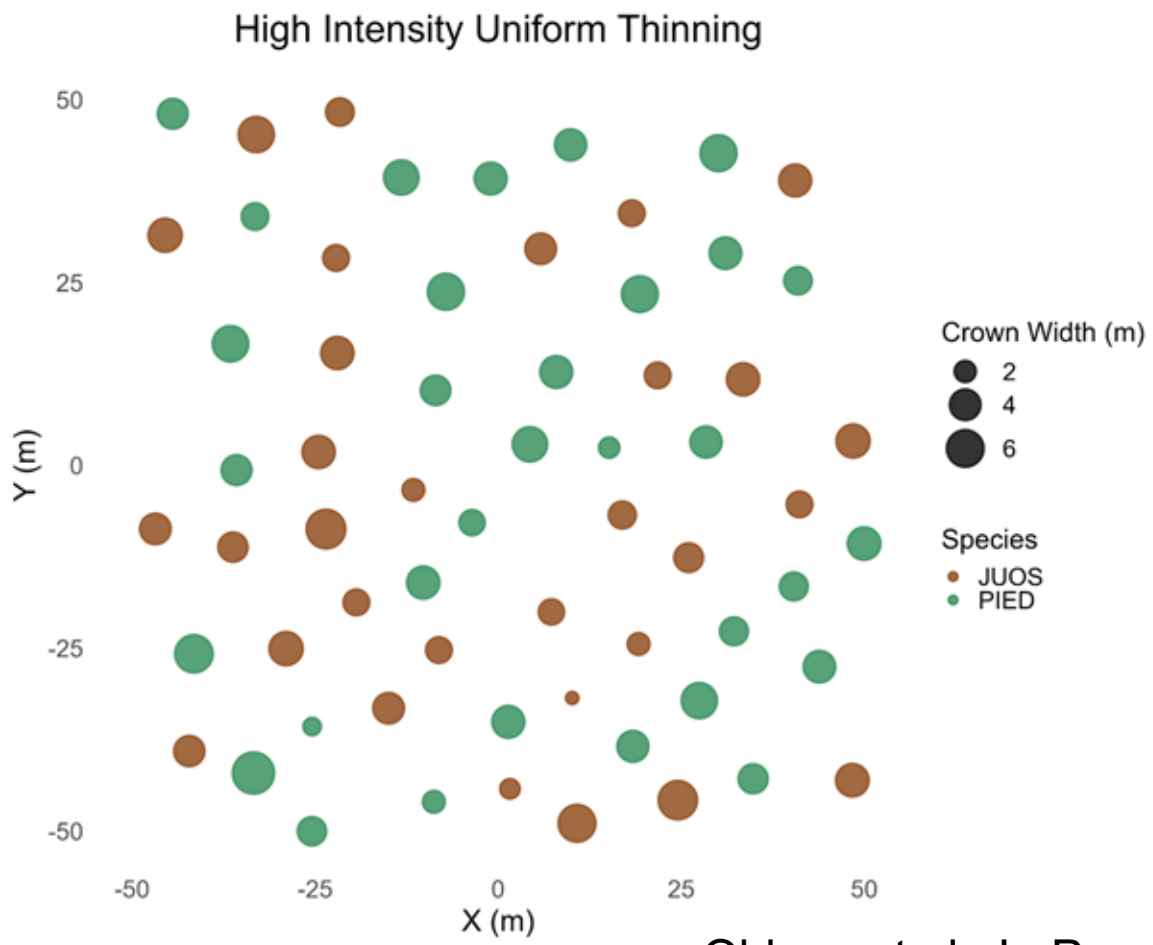


Ohlson et al., In Prep

Wildfire Behavior Modeling - Uniform Treatments

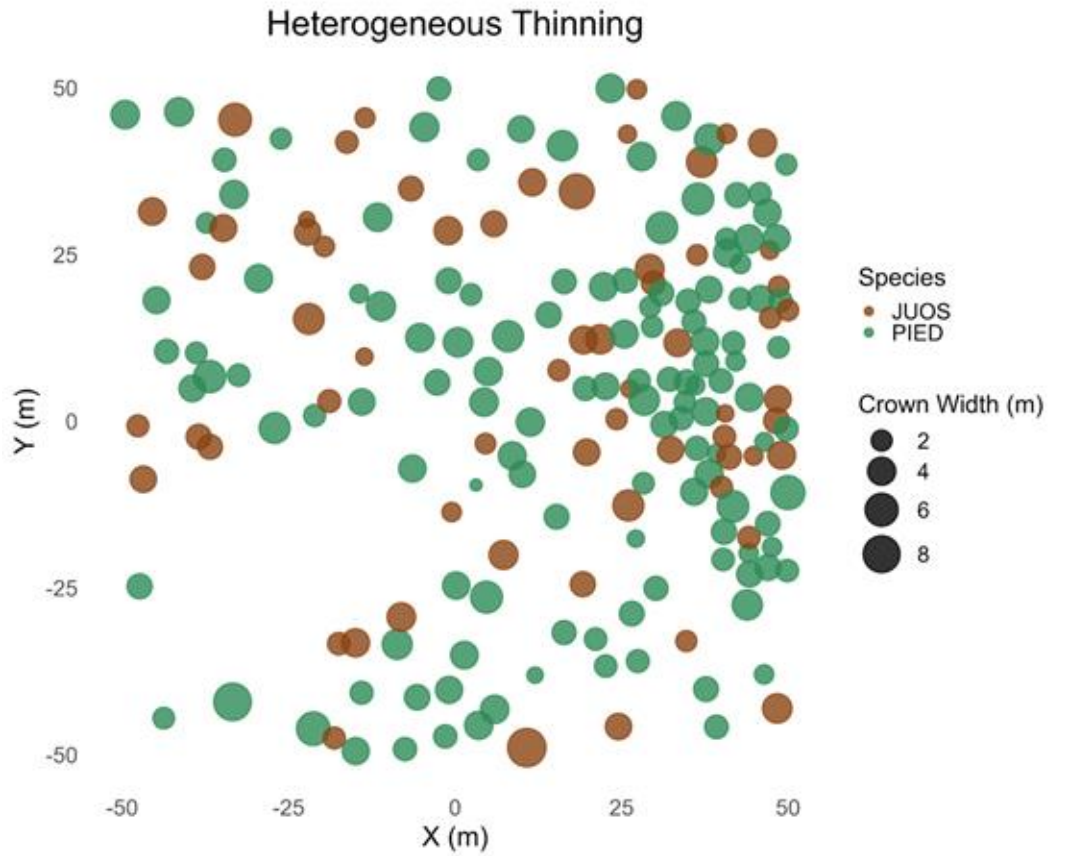
- Simulated thinnings to match treatment prescriptions and post-treatment forest structure





Ohlson et al., In Prep

Wildfire Behavior Modeling - Heterogeneous Treatment



Ohlson et al., In Prep

Lessons Learned and Conclusions

- Collaboration has been key to implementing and learning from silvicultural treatments
- Unique challenge in pinyon-juniper woodlands at burning piles in thinning units
- Thinning may be effective at enhancing tree growth, although unclear whether that translates to greater survival during drought, insects and disease, and wildfire

Thank you!

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