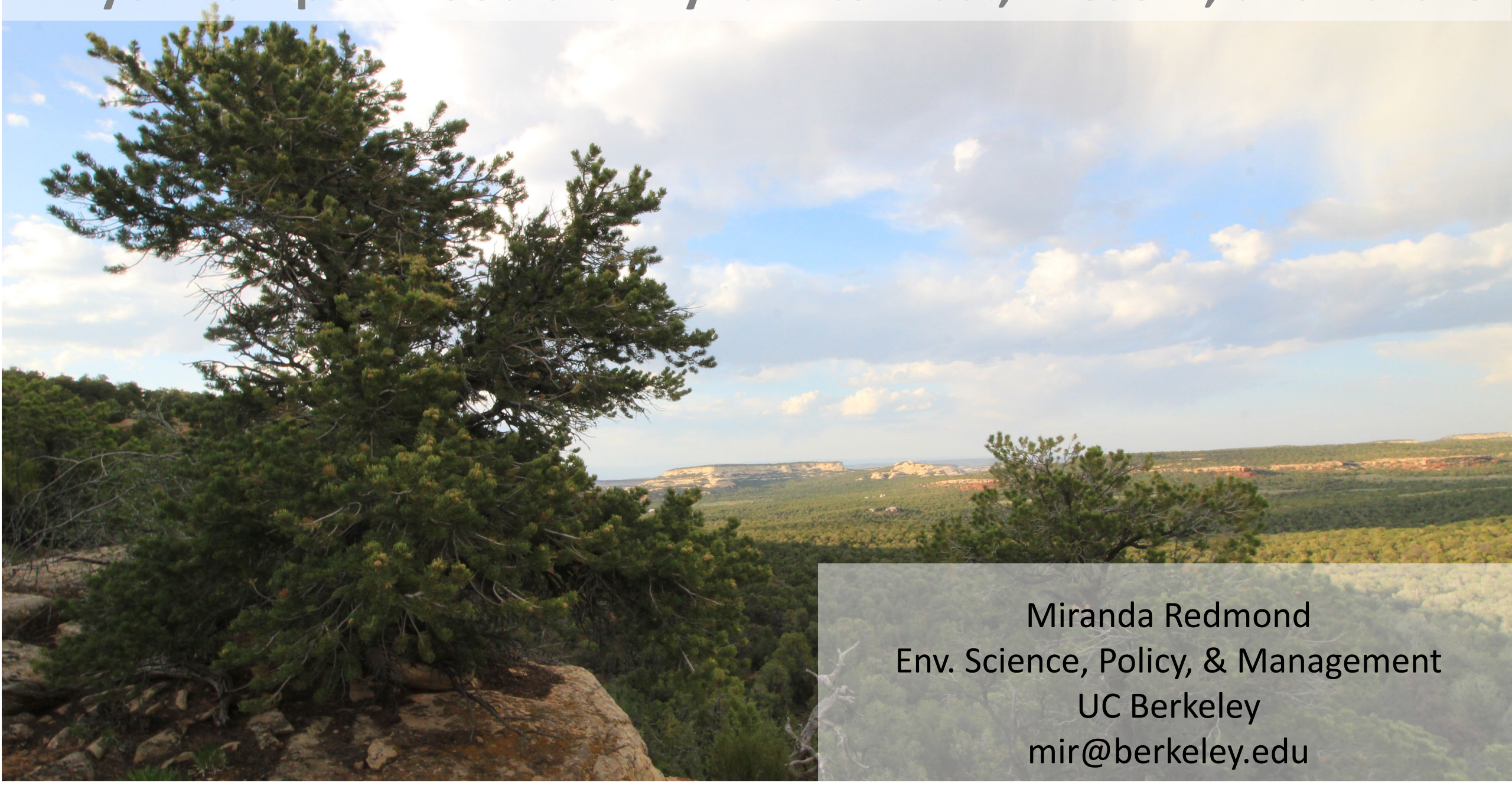
Pinyon-Juniper Woodland Dynamics: Past, Present, and Future



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Outline

1. Introduction to pinyon-juniper woodlands

2. Pinyon-juniper dynamics overtime
   - Past
   - Present
   - Future

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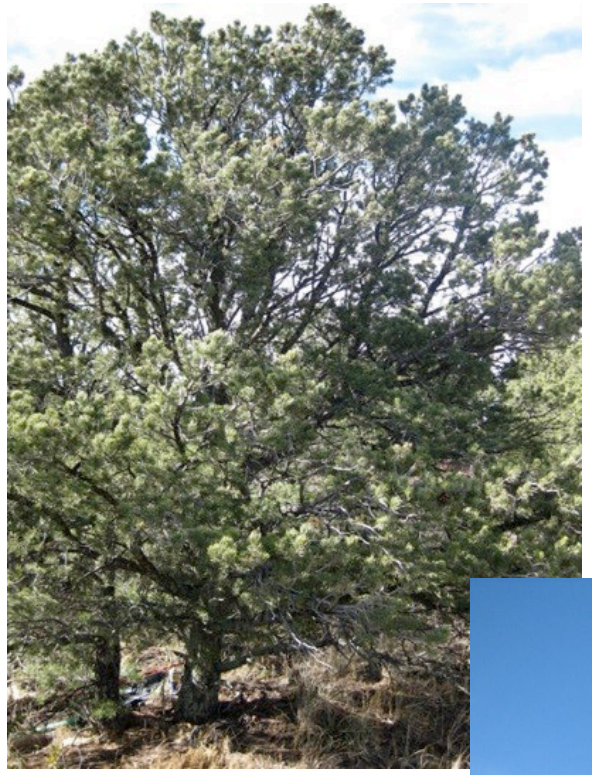
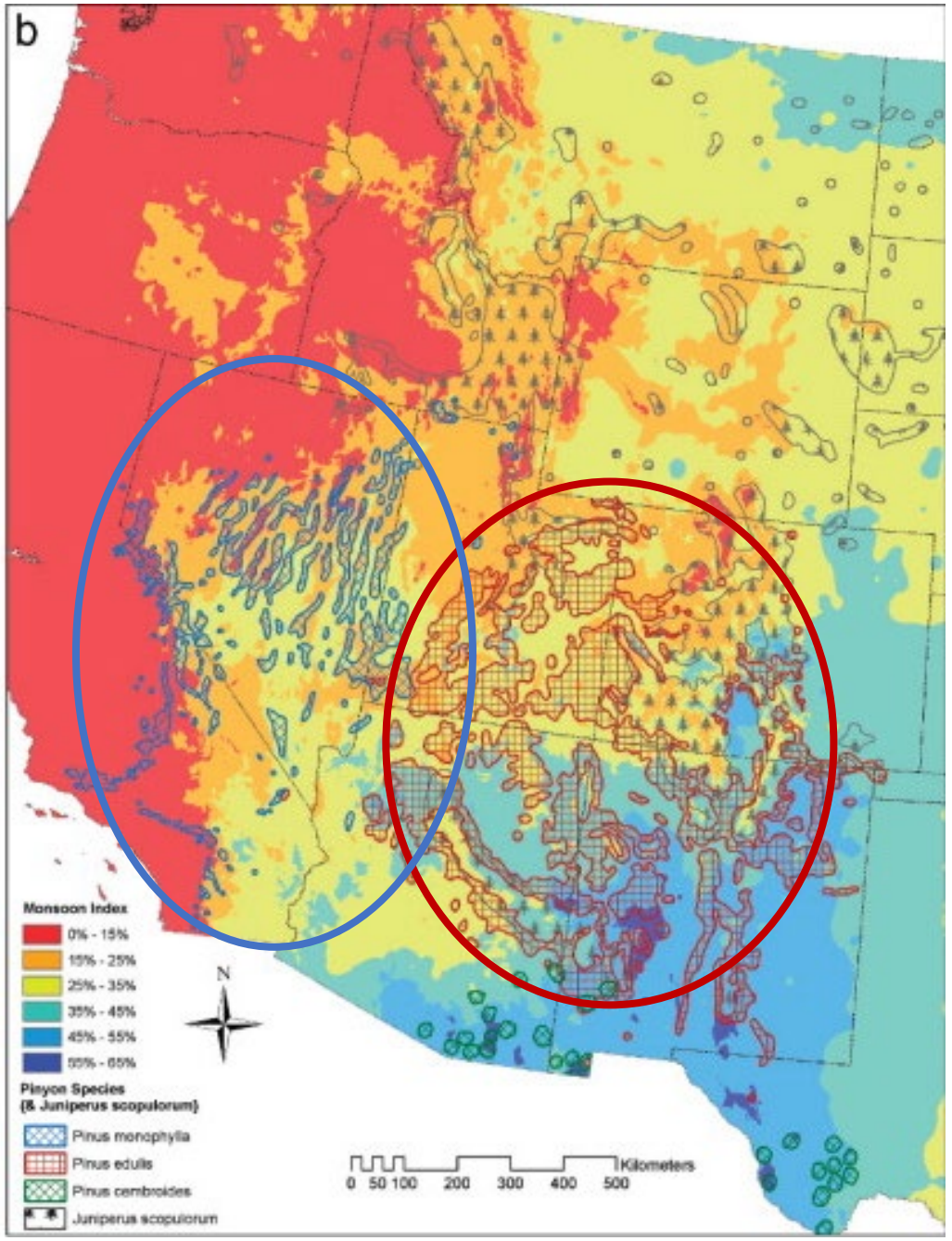
Pinyon-juniper woodlands

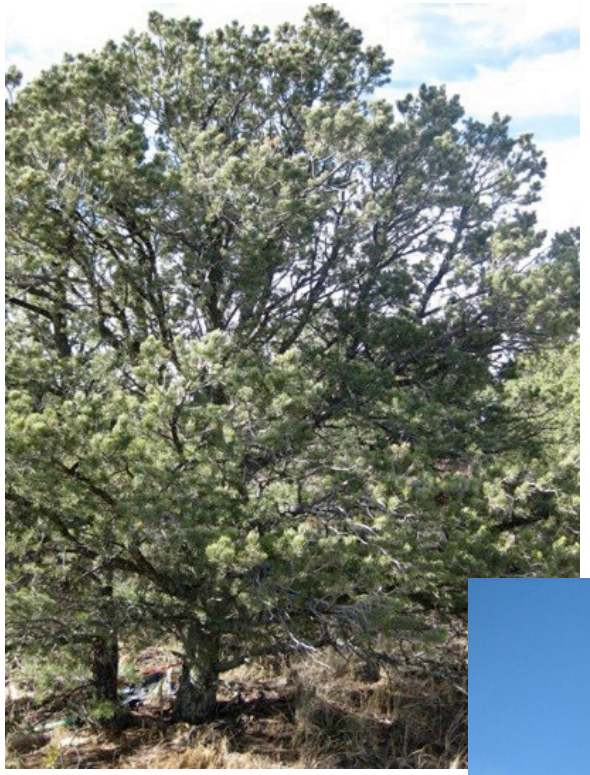


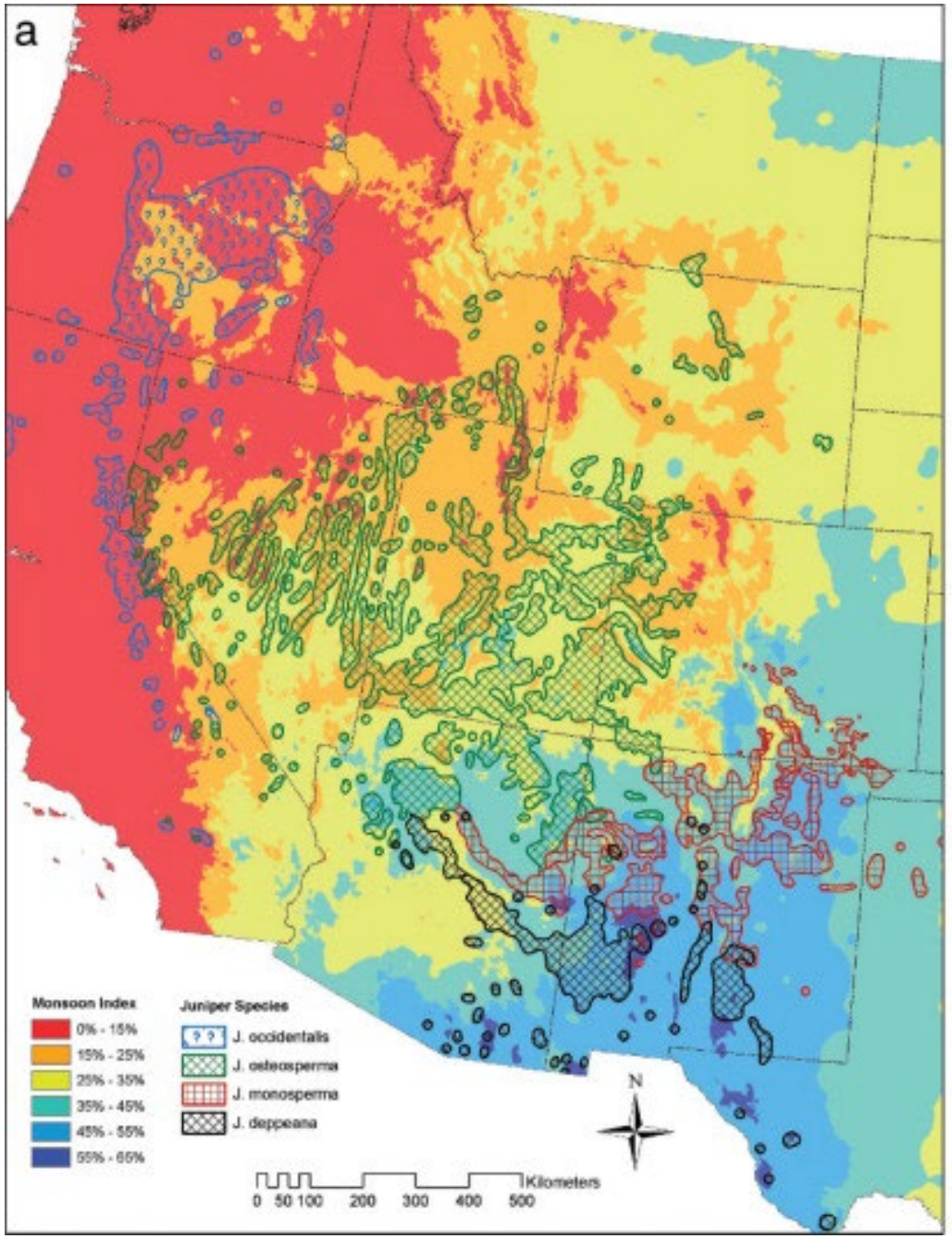


Romme et al. 2009

Photo: National Park Service

Pinyon-juniper woodlands





Romme et al. 2009

Photo: National Park Service

Pinyon-juniper woodlands

Photo: A Local Wander

Pinyon-juniper woodlands

Pinyon-juniper woodlands

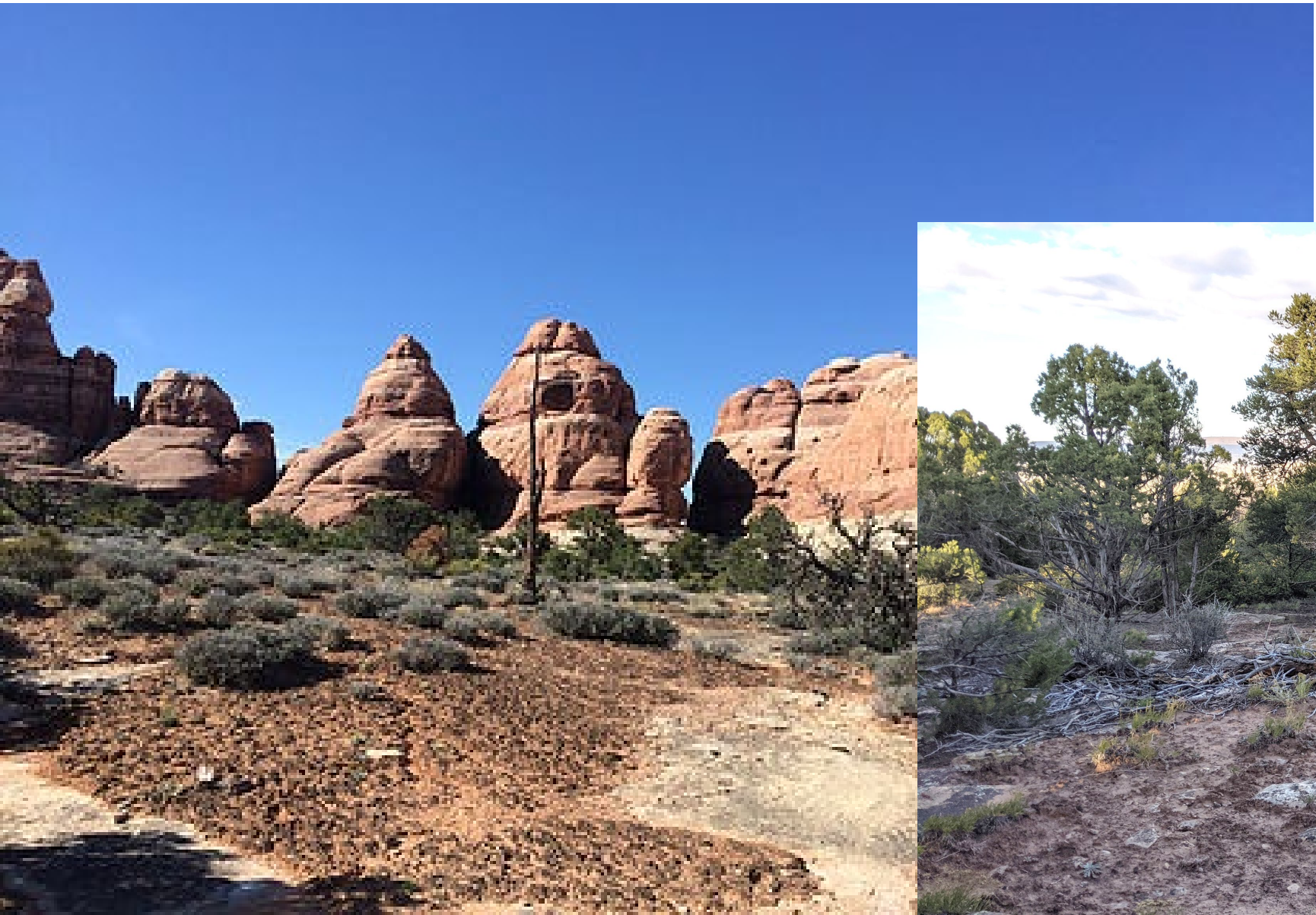


Photo: Will Grandbois, Post Independent

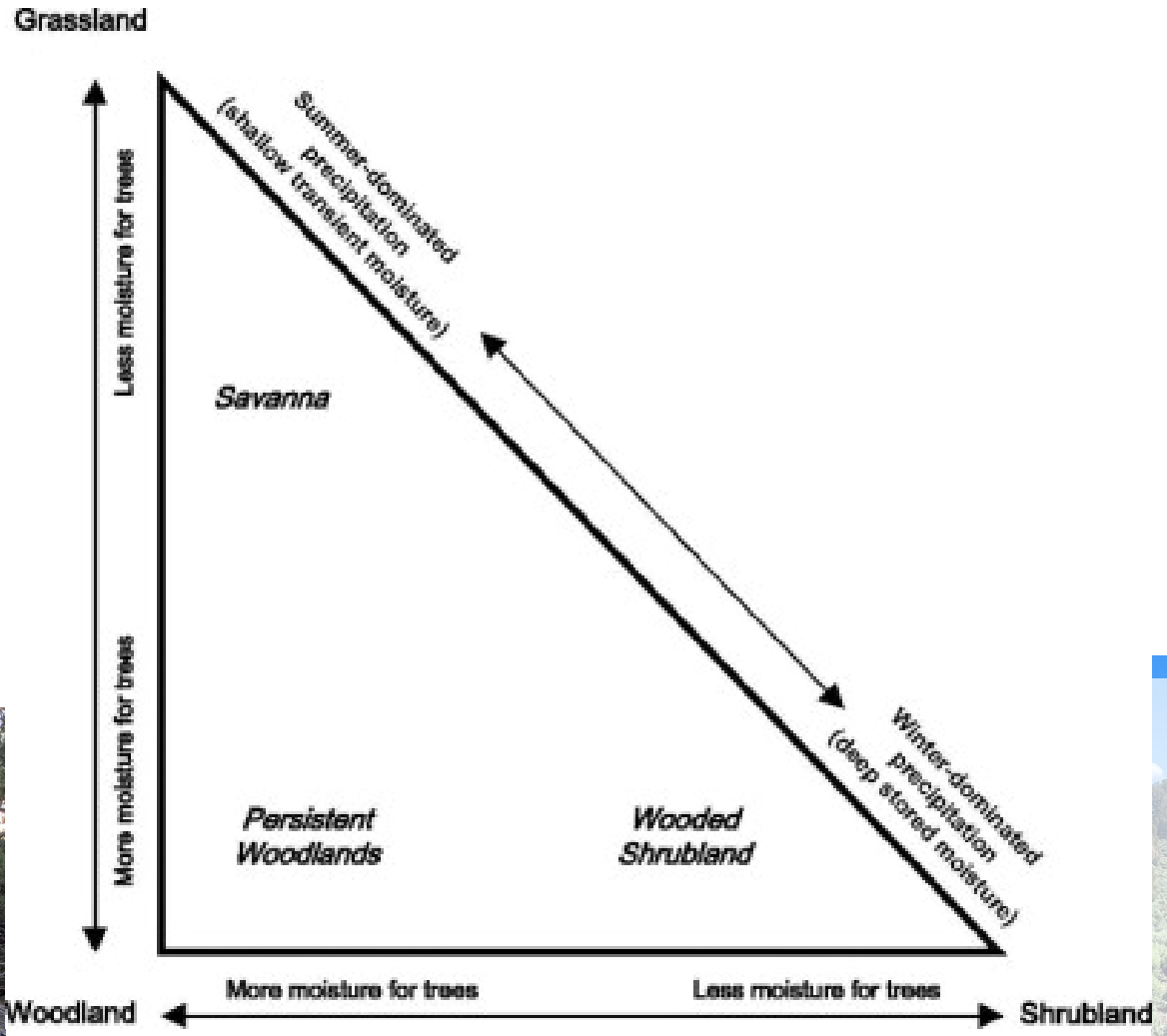
Pinyon-juniper woodlands

Pinyon-juniper woodlands

Photo Courtesy Ali Urza

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.

Support a diversity of species

Photos courtesy : Jeff Mitton, Taylar Bankston, Rosie Frederick, Sally King, NPS

Used for a variety of purposes

The Bancroft Library

Joseph Zummo

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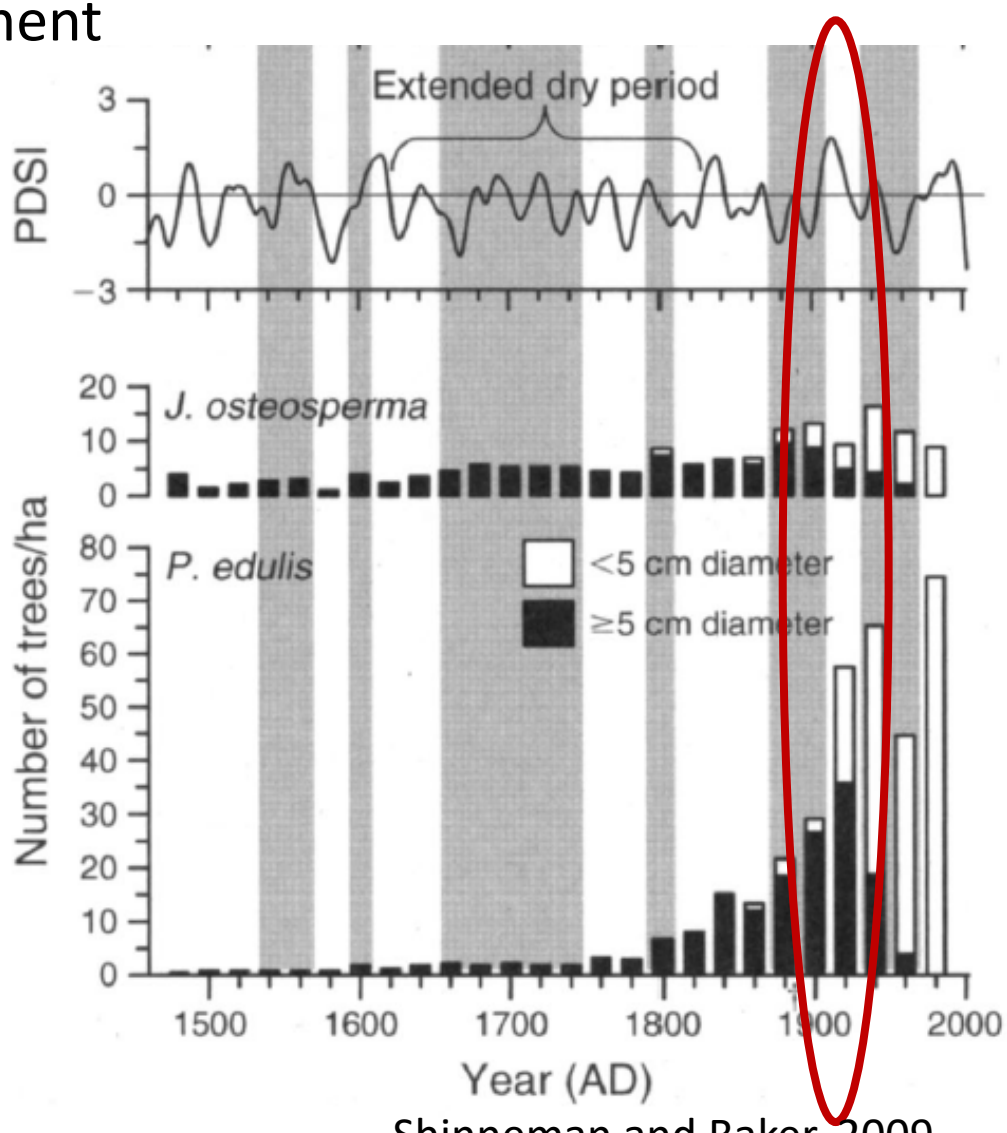
Temporal dynamism partially driven by climate

Cool and wet conditions that promoted tree establishment

Tree die-off events during dry periods in the past (and present)

Post-glacial migration north



Shinneman and Baker, 2009

Temporal dynamism also driven by humans

Stewarded by Indigenous peoples since time immemorial

Harvesting in the 19th century

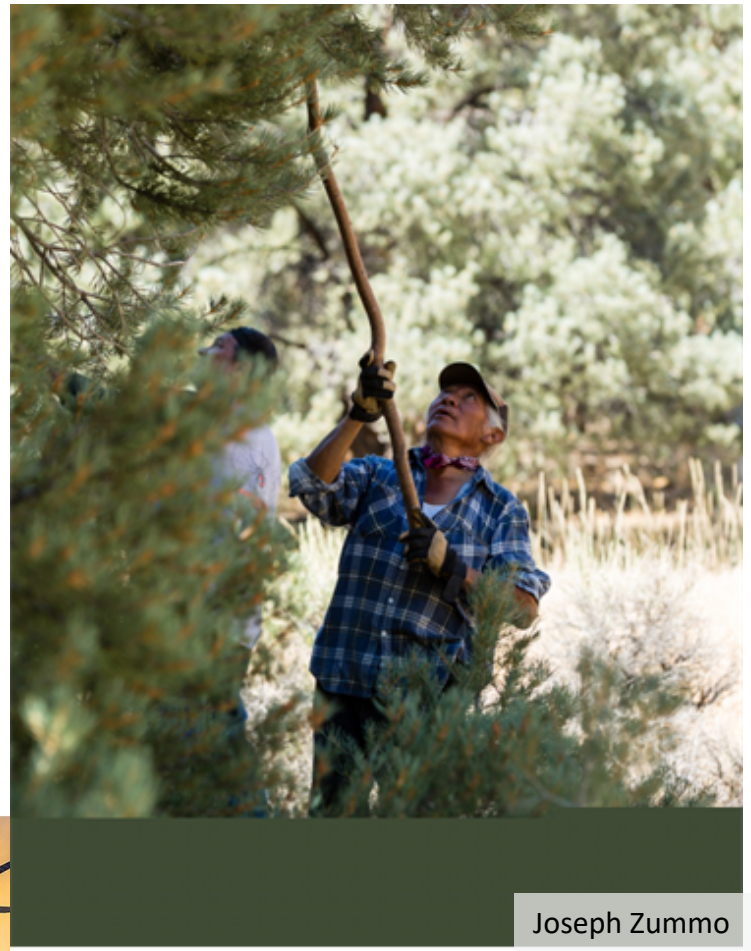
Fire suppression

Grazing

Tree removal treatments

Page et al., 2023; Photo Credit: Peter Weisberg

Amme et al., 2009



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19th Century Harvesting

Page et al., 2023; Photo Credit: Peter Weisberg

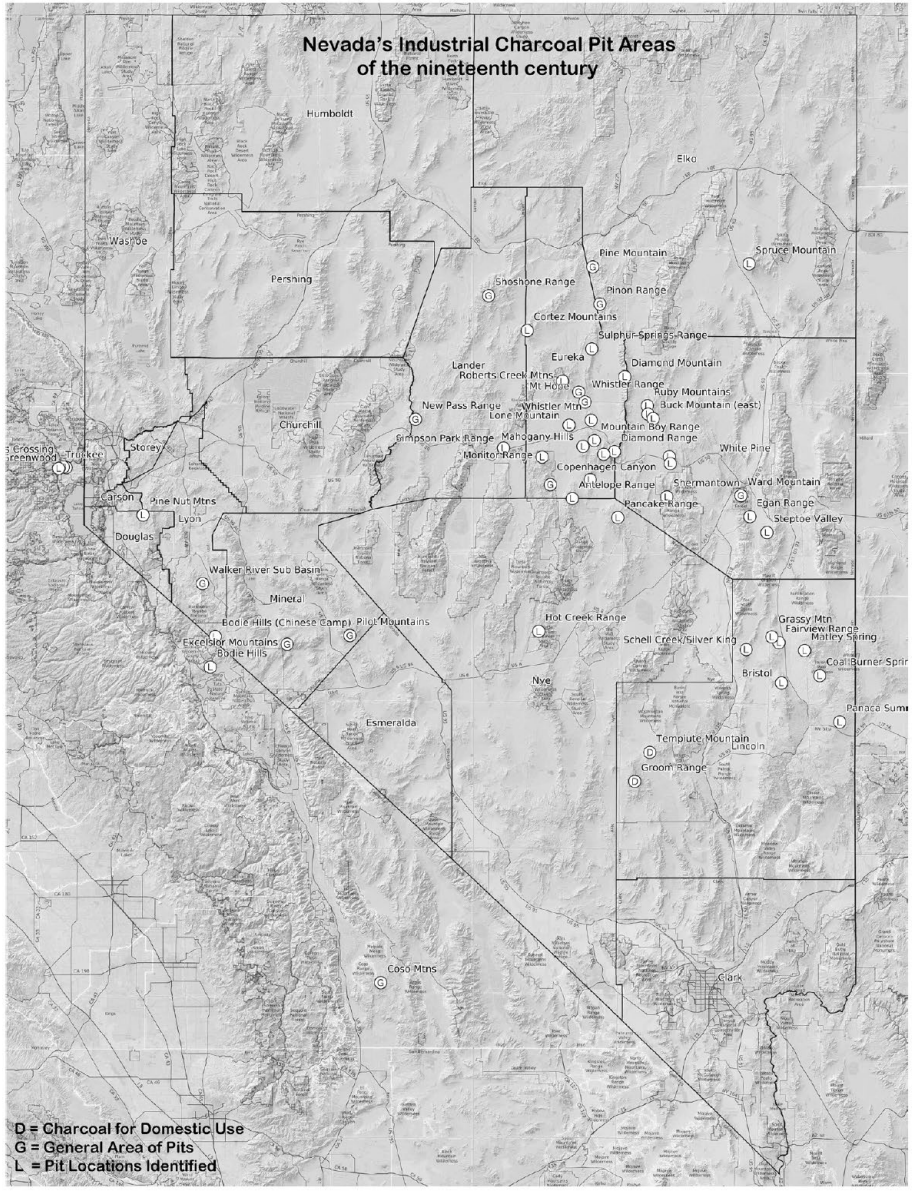


FIGURE 1. Charcoal pit areas of nineteenth-century Nevada. (*Map by Doug Page*)

19th Century Harvesting

Amme, Pague, Redmond, 2020,
Rangeland Ecology & Management

Page et al., 2023; Photo Credit: Peter Weisberg

Temporal dynamism also driven by humans

Stewarded by Indigenous peoples since time immemorial

Harvesting in the 19th century

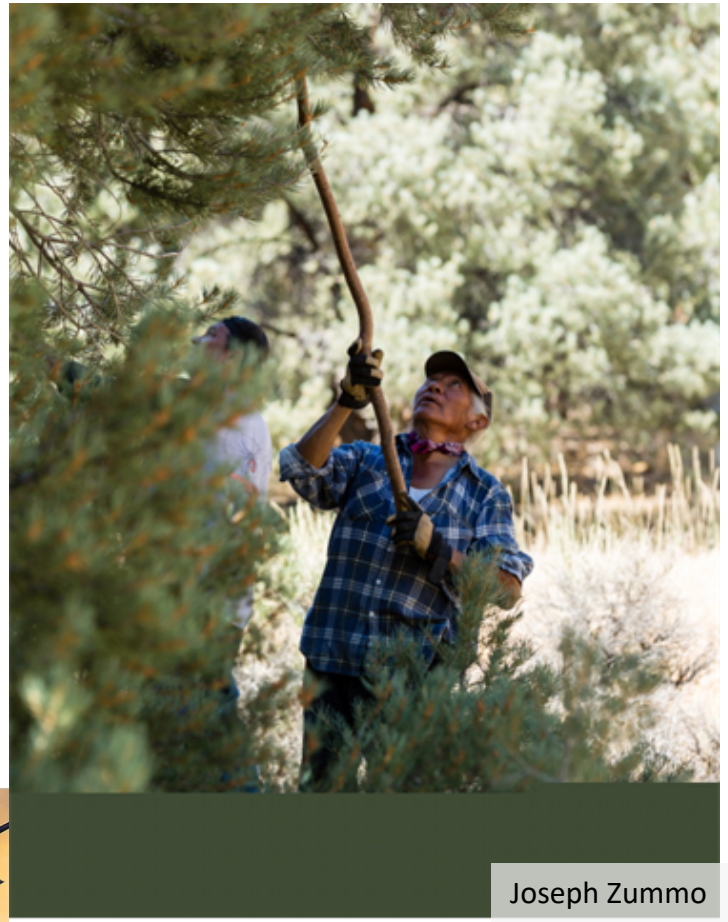
Fire suppression (esp. P-J savannah)

Grazing

Tree removal treatments

Amme et al., 2009

Page et al., 2023; Photo Credit: Peter Weisberg



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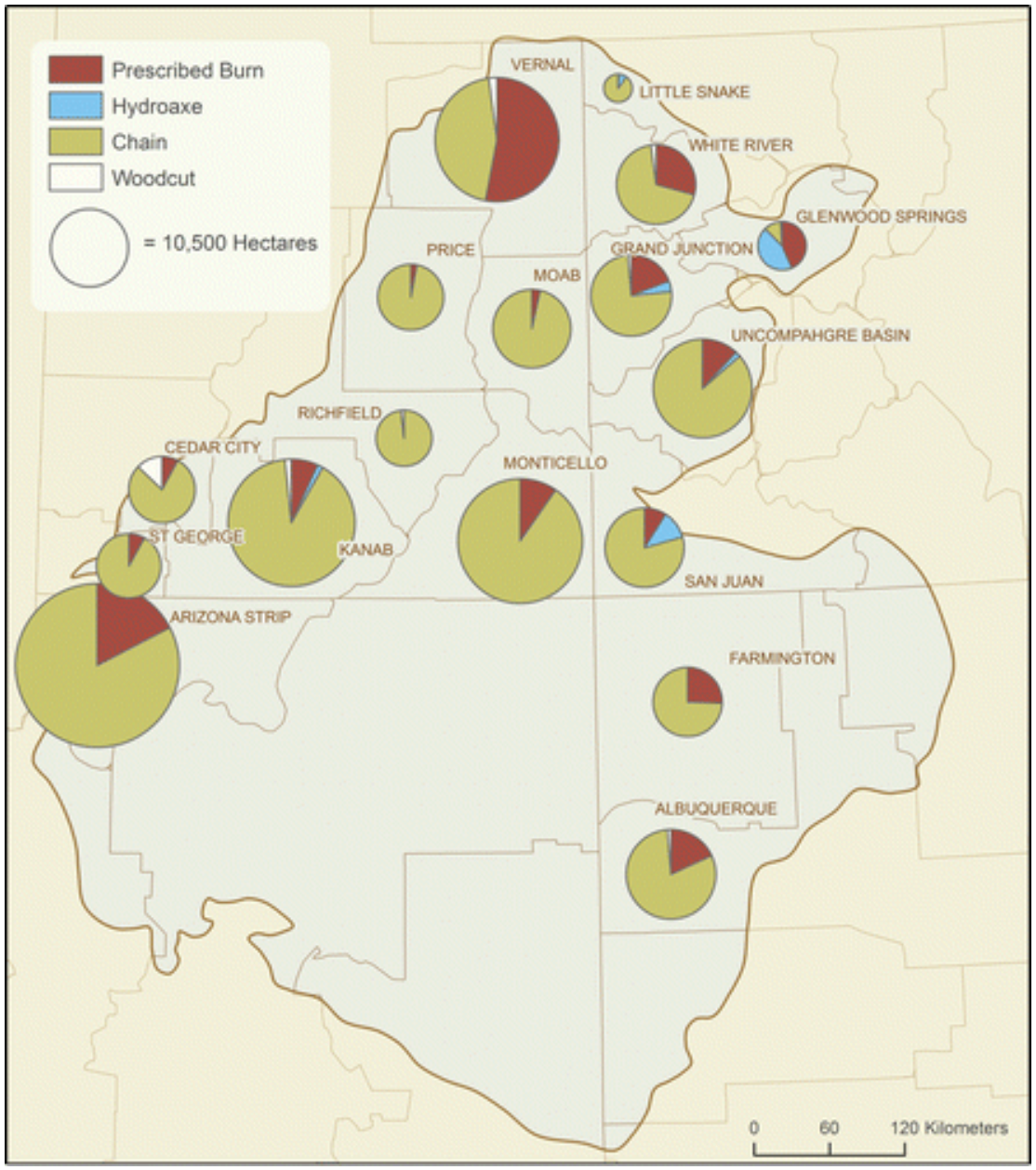
20th Century Changes: Repeat Photography

Increasing tree density and expansion of pinyon-juniper woodlands since the early 1900s

Pinyon-juniper woodlands in Capulin Volcano National Monument, NM

Federal agency management focused on tree removal in the 20th century



- 247,000 hectares of pinyon-juniper removal treatments on BLM lands between 1950 and 2003, corresponding to 6.6% of P-J within BLM lands

Photo: Nicole Nielson

Redmond et al., 2014 *Rangeland Ecology & Management*

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Diversity in woodland structure and composition across the landscape

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

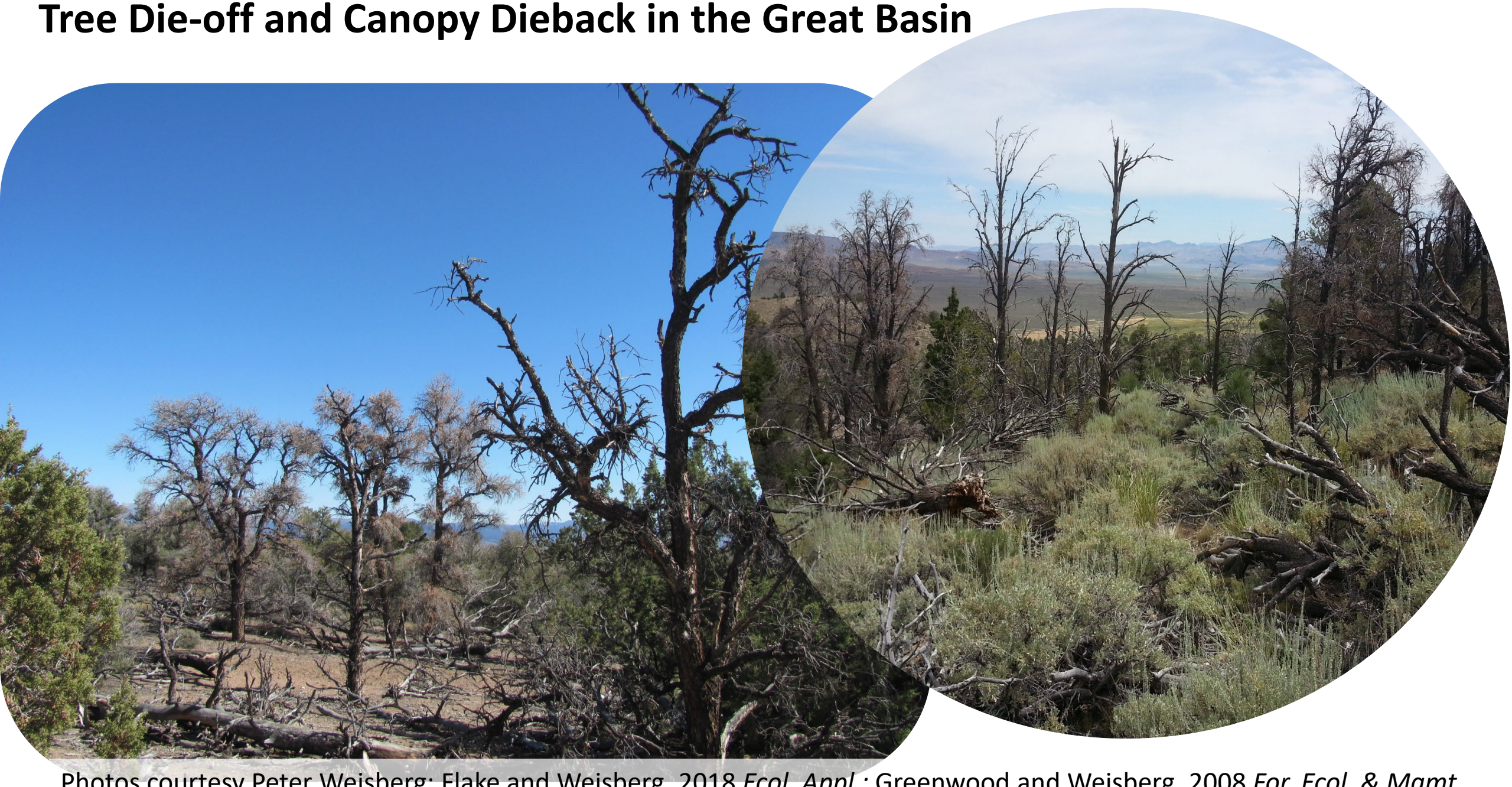
Photo Courtesy Craig Allen

Pinon-juniper Woodlands, Jemez Mountains, New Mexico, USA

More recent tree die-off following the 2018 drought

Breshears et al. 2018, *FFGC,* Redmond et al. 2019, *F. Env. Science;* Wion et al., 2022, *Env. Res. Letters, Kannenberg et al., 2020 For. Ecol. & Mgmt*

Tree Die-off and Canopy Dieback in the Great Basin

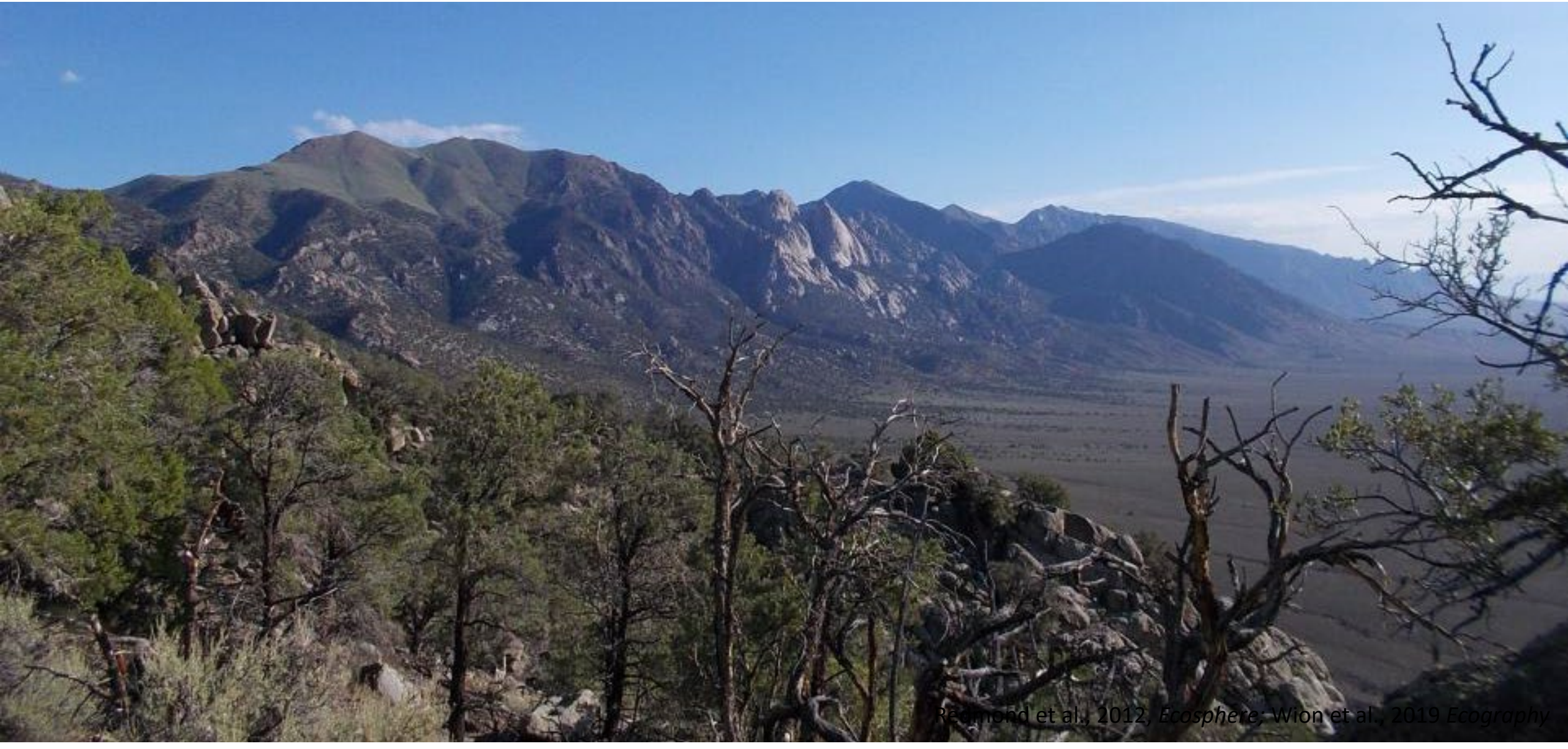


Photos courtesy Peter Weisberg; Flake and Weisberg, 2018 *Ecol. Appl.;* Greenwood and Weisberg, 2008 *For. Ecol. & Mgmt.*

Declines in Seed Cone Production and Growth

Redmond et al., 2012, *Ecosphere;* Wion et al., 2019 *Ecography;* Redmond et al., 2017, *Ecosphere*

Variable Responses



Redmond et al., 2012, *Ecosphere*; Wion et al., 2019 *Ecography*

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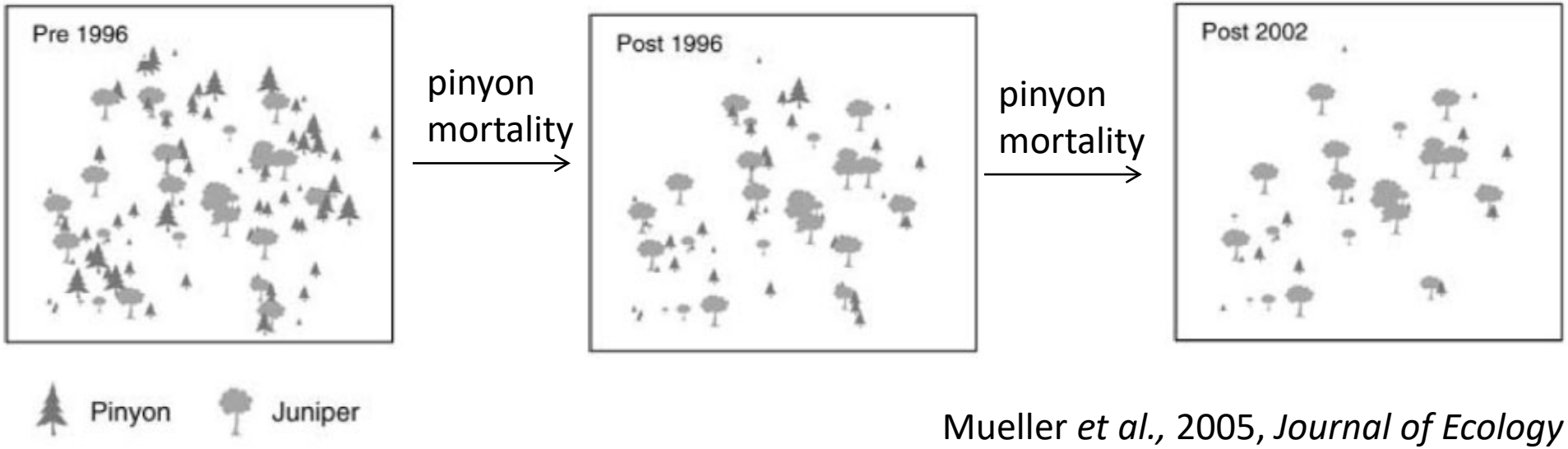
Shift towards more juniper dominance?

- Juniper is the more drought tolerant species, more common in drier, low elevation sites



Mueller *et al.,* 2005, *Journal of Ecology*

Shift towards more juniper dominance?

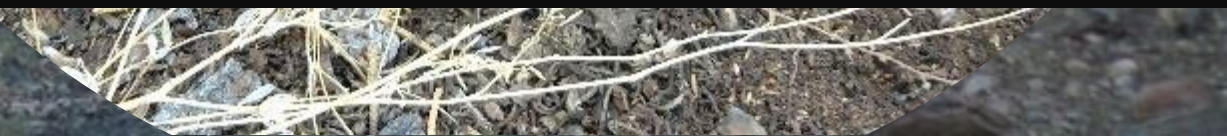
- Juniper has higher rates of establishment immediately after a disturbance than pinyon

Redmond *et al.,* 2013, *Forest Ecol. & Mgmt;* Bristow *et al.,* 2014, *Rangeland Ecol & Mgmg;* Photo by Peter Weisberg

Redmond et al., 2018; Redmond & Barger, 2013

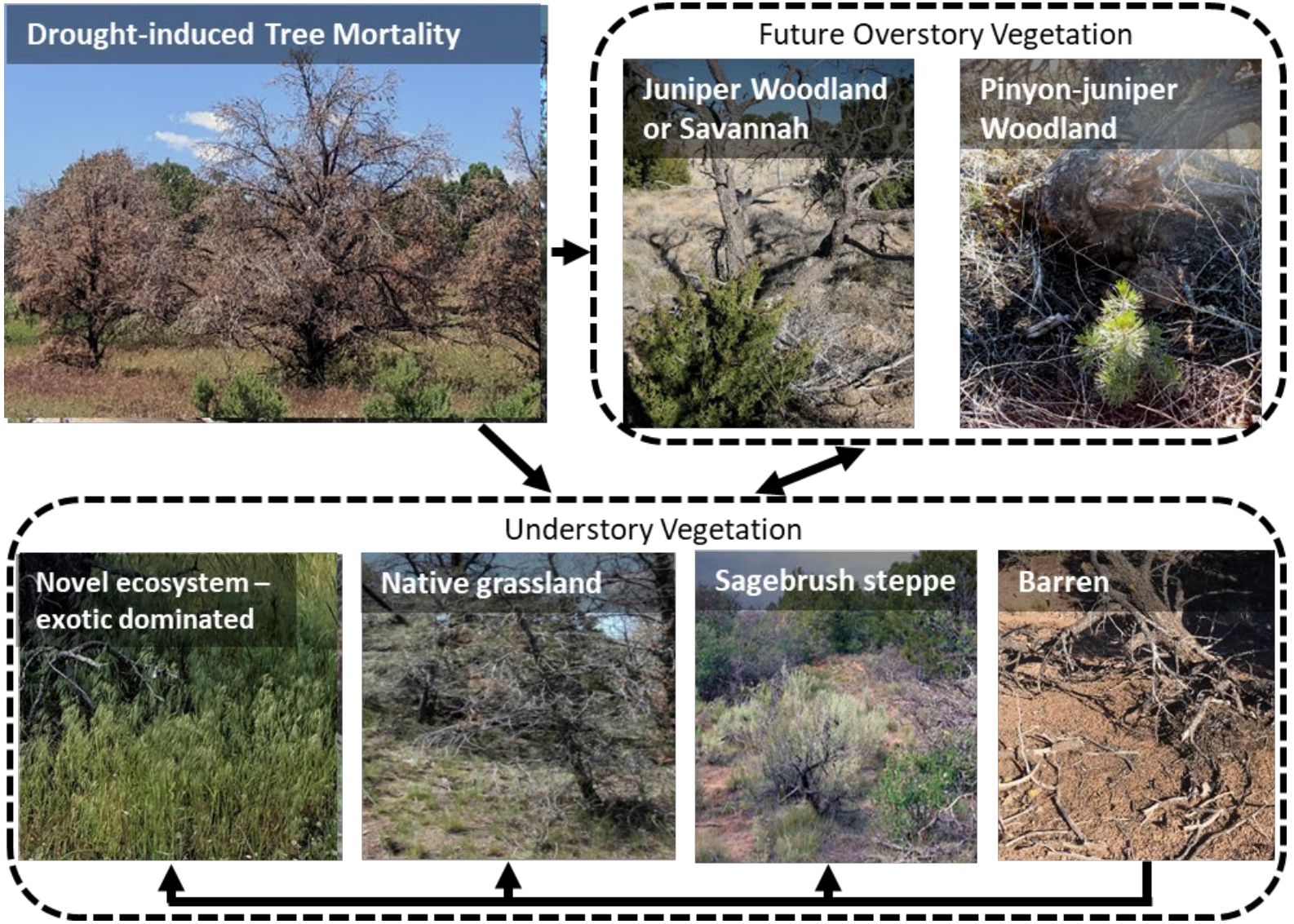
Substantial advanced regeneration following drought-related tree die-off in some areas

Limited new seedling establishment following severe die-off and regeneration failure in dry areas



Redmond et al., 2018; Redmond & Barger, 2013

Tree Mortality Response



Redmond & Barger, 2013, New Phytol.; Redmond et al. 2015, Glob. Change Biol.; Redmond et al. 2018, J. of Ecology

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ARTICLE

Macrosystems Ecology

Managing for ecological resilience of pinyon–juniper ecosystems during an era of woodland contraction

Miranda D. Redmond[1] | **Alexandra K. Urza**[2] | **Peter J. Weisberg**[3]

Collaboration and interdisciplinary efforts are needed

inno

ma

app

Key takeaways

1. Pinyon-juniper woodlands are:
    1. Diverse
    2. Dynamic
    3. Vulnerable

2. Urgent need to manage for pinyon-juniper resilience to drought

Thank you!

Questions / Comments, get in touch- email: mir@berkeley.edu

twitter: @miranda_redmond