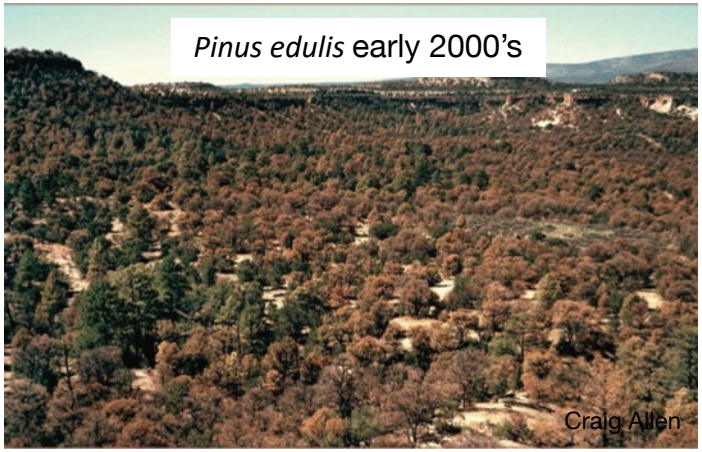
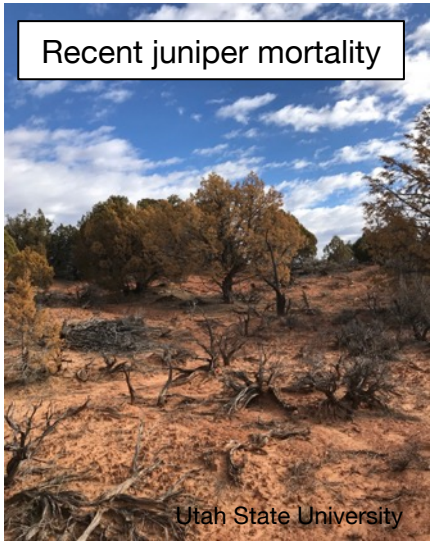
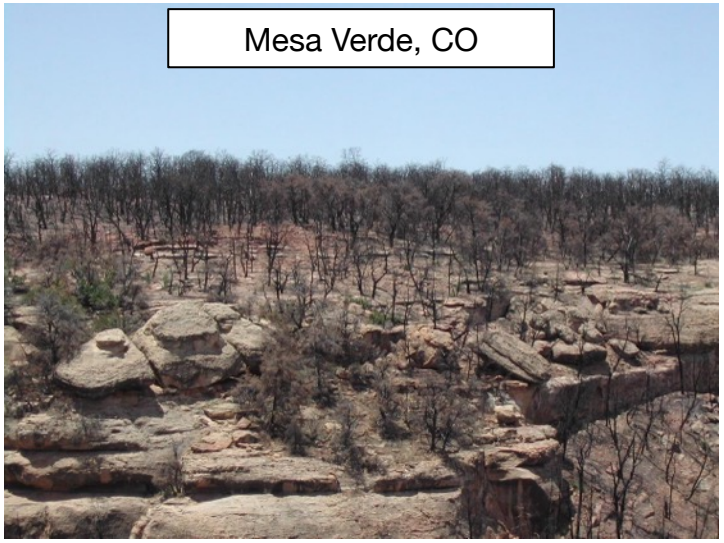

Trends and threats in
pinyon-juniper populations
in the intermountain west

Emerging threats to P-J woodlands

Rising temps, drought, and wildfire







Status and trends of Pinyon-Juniper populations in the intermountain west

Bob Shriver, University of Nevada, Reno (rshriver@unr.edu)

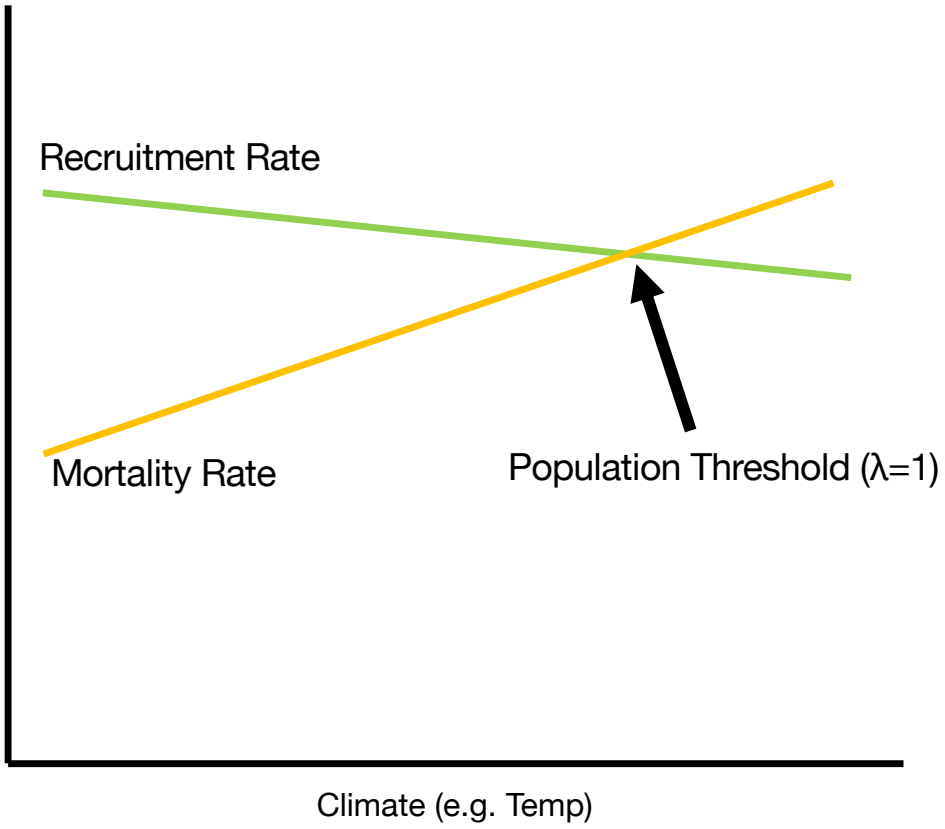
1) What is the current status of P-J populations across the intermountain west?

2) What are the longer-term trends in P-J populations?

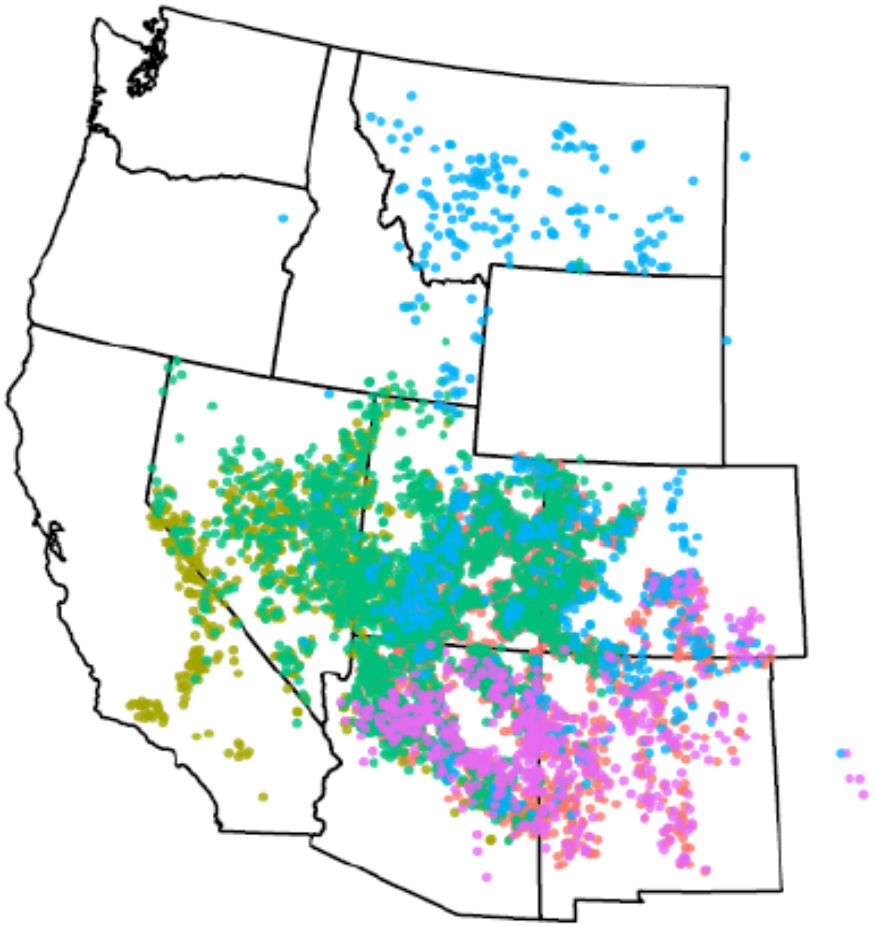
3) What does the future look like for P-J with climate change?

*Focus will be on climate induced impacts

Range Dynamics: Mortality and Recruitment



Forest Inventory and Analysis (FIA) Data



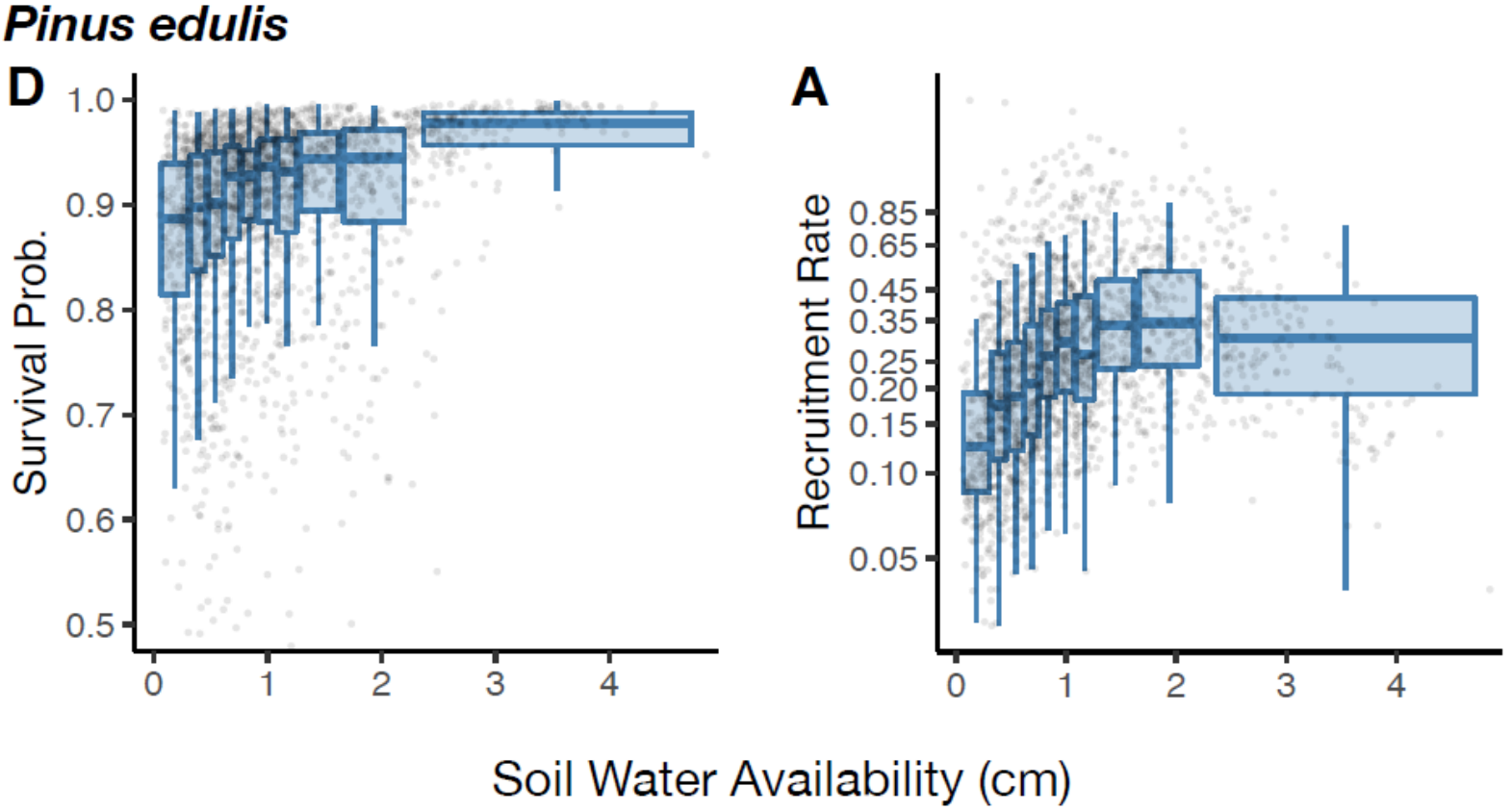
Species

- *Pinus edulis* (Two-needle piñon)
- *Pinus monophylla* (Single leaf piñon)
- *Juniperus osteosperma* (Utah juniper)
- *Juniperus scopulorum* (Rocky mtn. juniper)
- *Juniperus monosperma* (One-seed juniper)

Plots with fire or tree harvest were excluded

Citation: Shriver, R. K., Yackulic, C. B., Bell, D. M., & Bradford, J. B. (2021). Quantifying the demographic vulnerabilities of dry woodlands to climate and competition using rangewide monitoring data. *Ecology*, *102*(8), e03425.

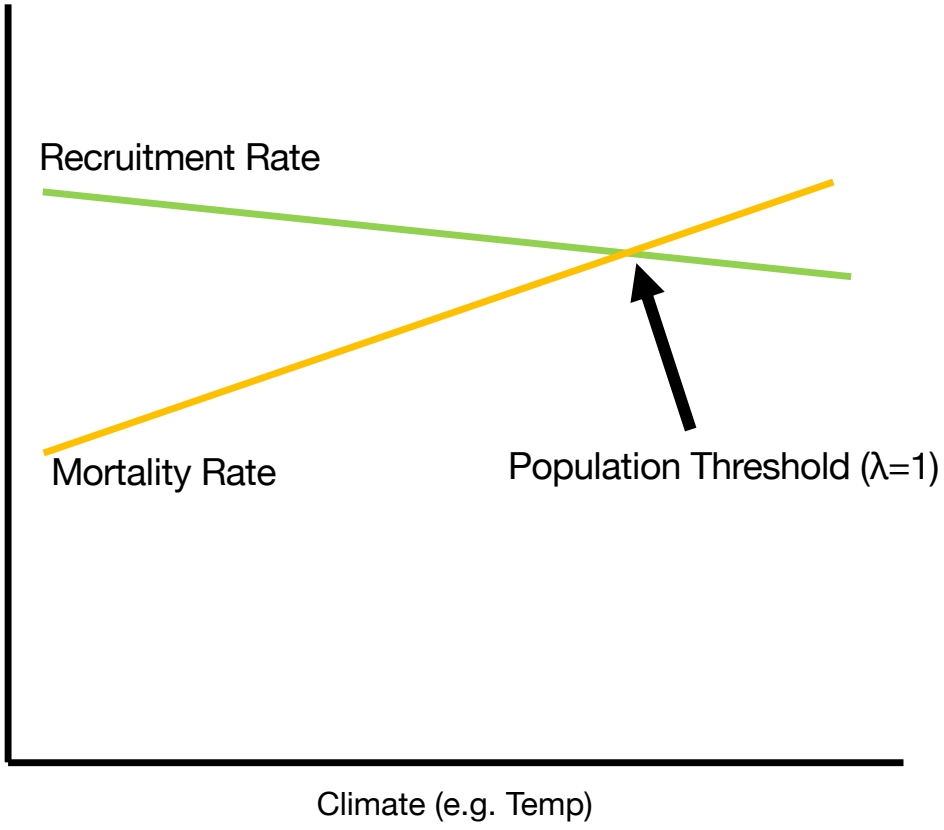
Survival declines in warm-dry conditions



Citation: Shriver, R. K., Yackulic, C. B., Bell, D. M., & Bradford, J. B. (2021). Quantifying the demographic vulnerabilities of dry woodlands to climate and competition using rangewide monitoring data. *Ecology*, *102*(8), e03425.

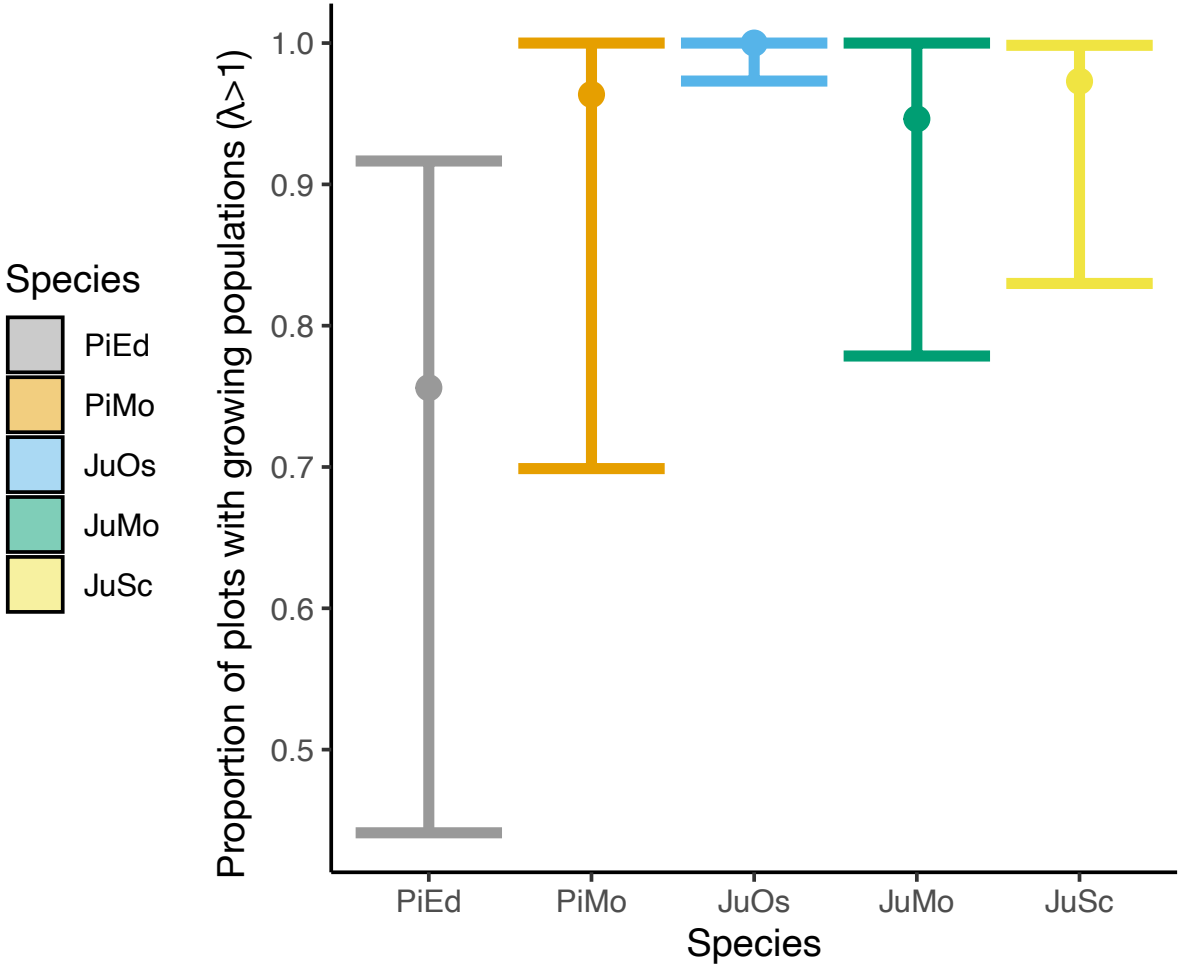
Range Dynamics: Mortality and Recruitment

When will we reach the threshold? Where are populations most vulnerable?



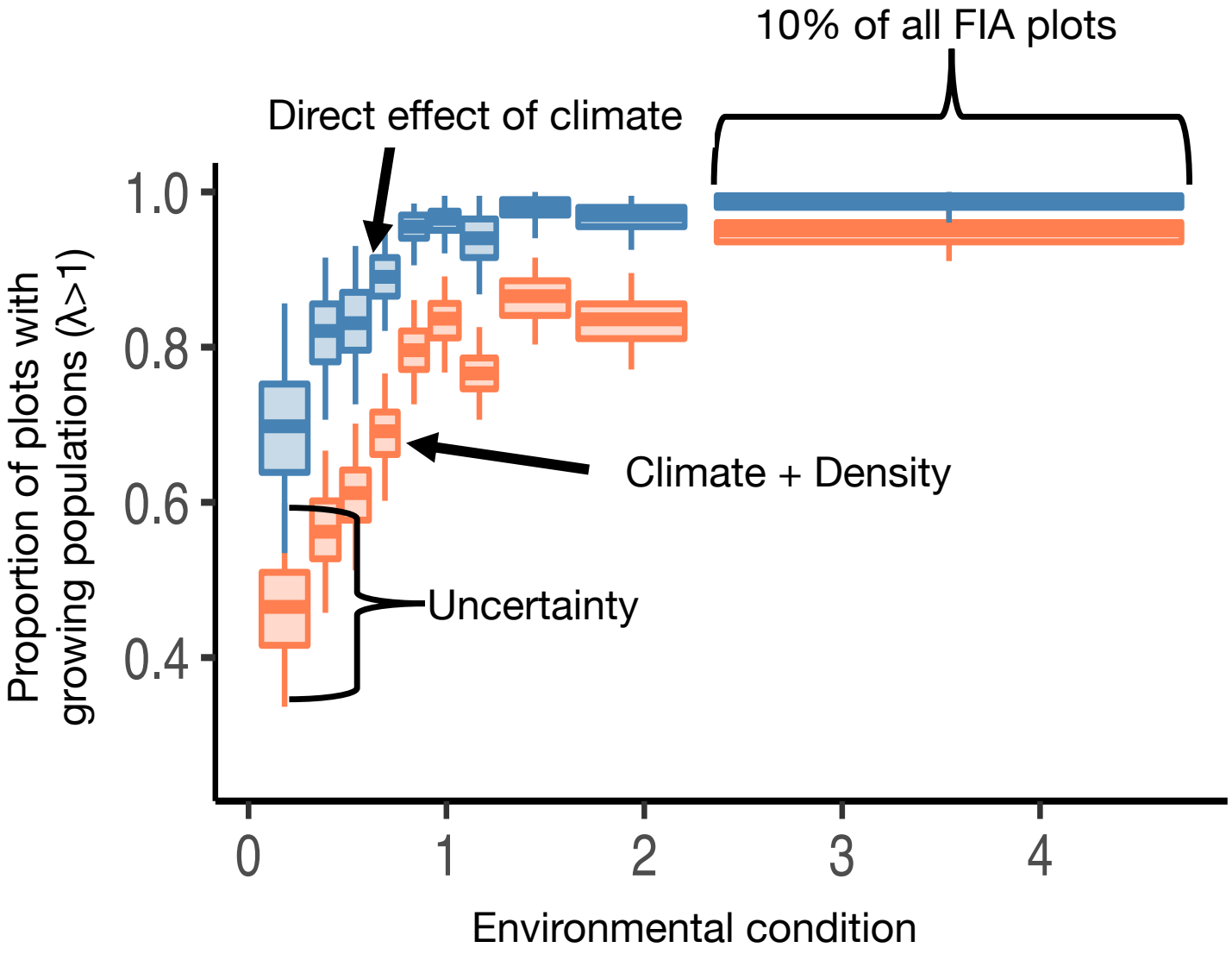
4 of 5 species are declining in some part of their range.

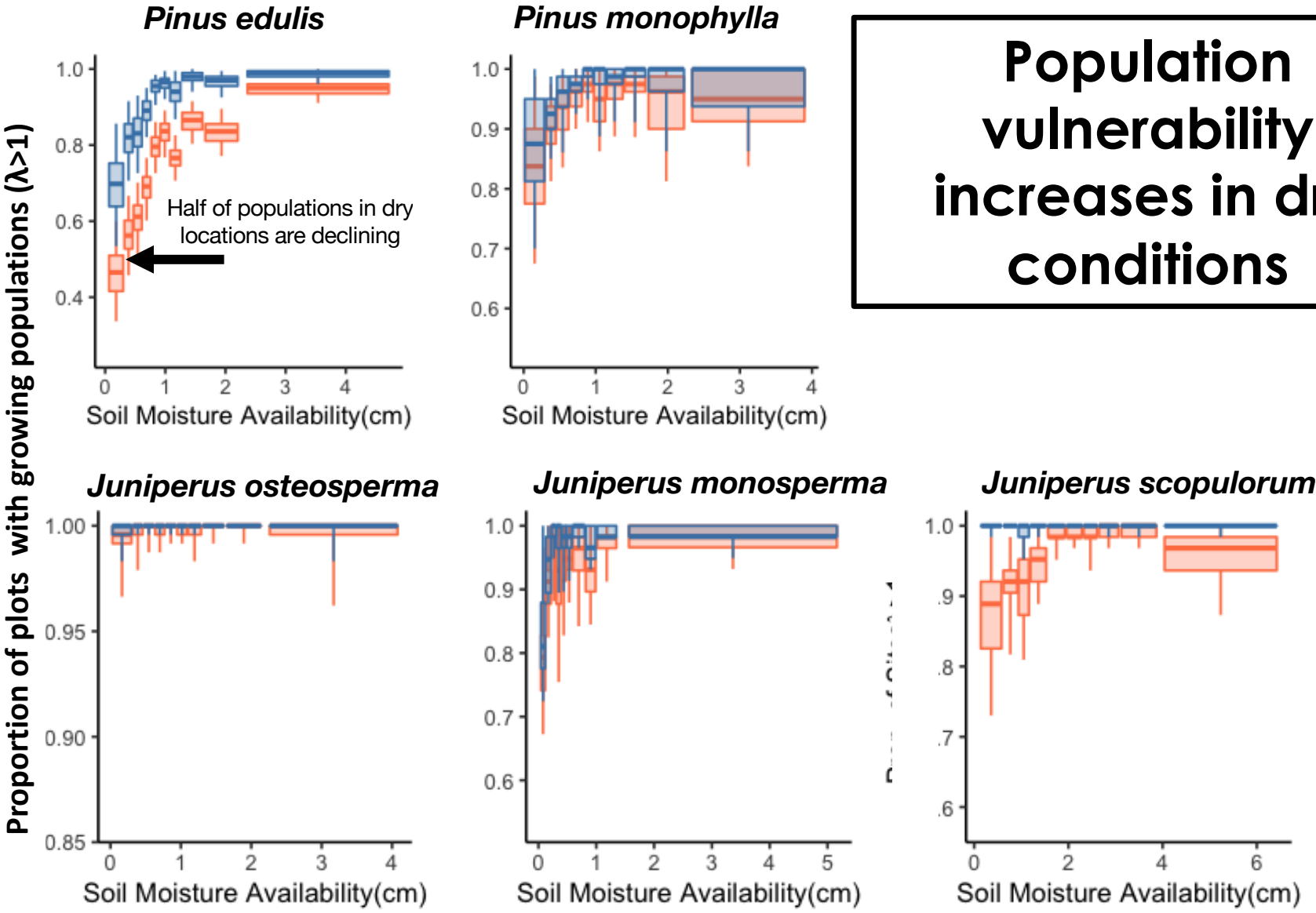
Pinus edulis is currently experiencing the most widespread declines.



Citation: Shriver, R. K., Yackulic, C. B., Bell, D. M., & Bradford, J. B. (2022). Dry forest decline is driven by both declining recruitment and increasing mortality in response to warm, dry conditions. *Global Ecology and Biogeography*, *31*(11), 2259-2269.

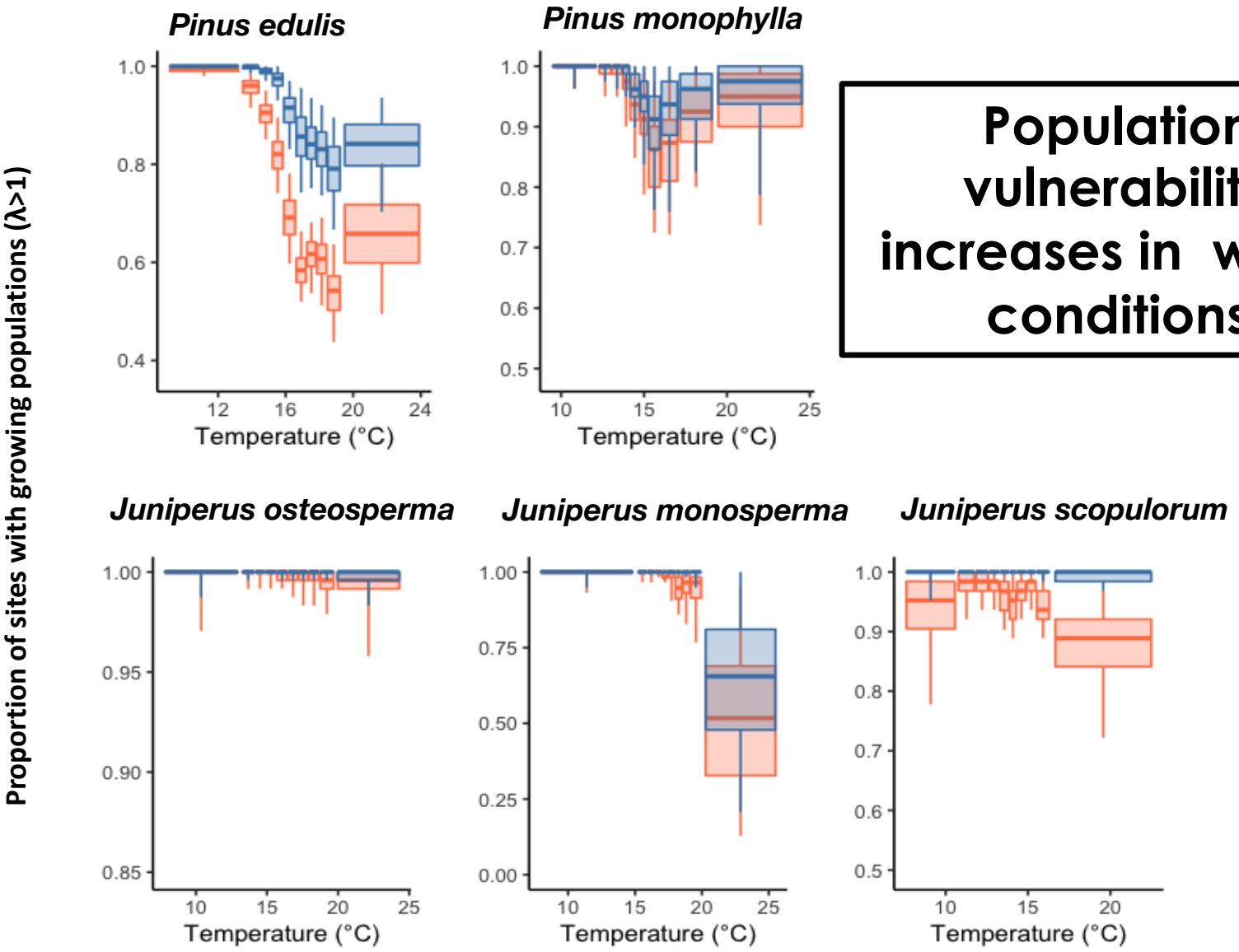
Climate vulnerabilities





Population vulnerability increases in dry conditions

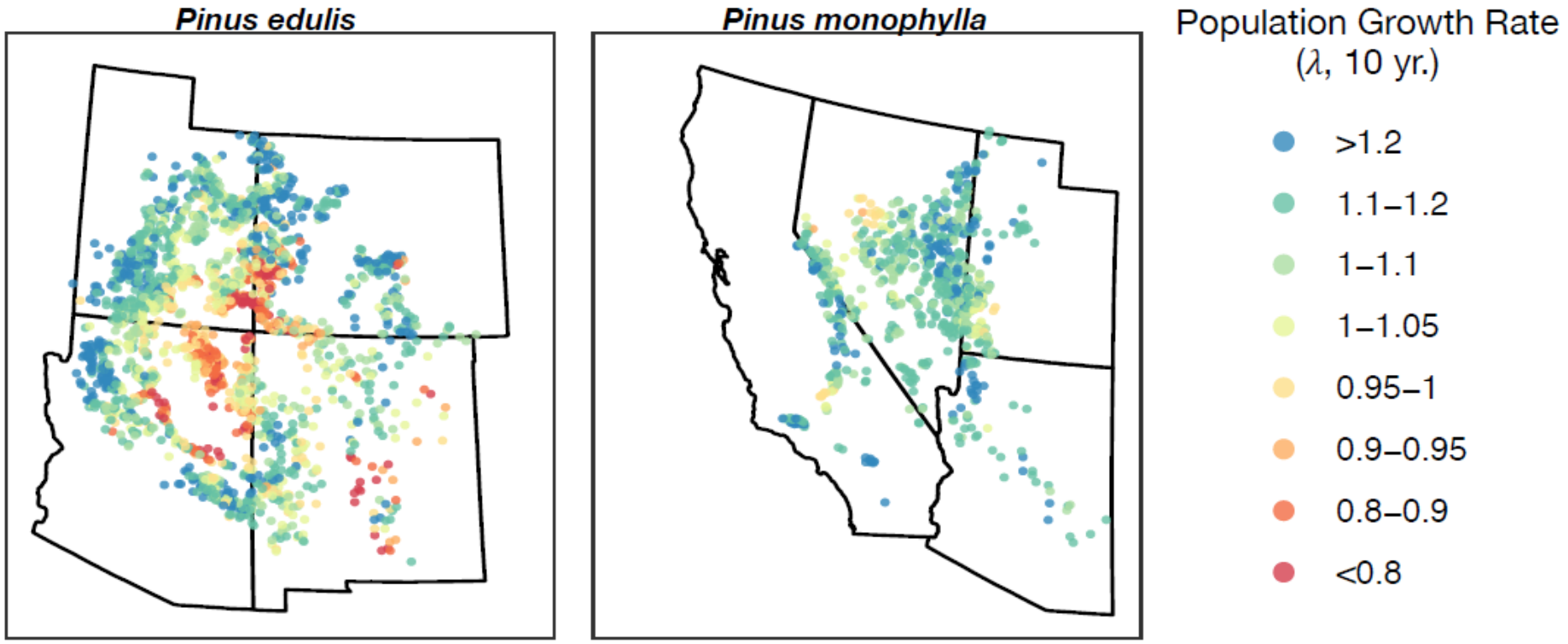
Citation: Shriver, R. K., Yackulic, C. B., Bell, D. M., & Bradford, J. B. (2022). Dry forest decline is driven by both declining recruitment and increasing mortality in response to warm, dry conditions. *Global Ecology and Biogeography*, *31*(11), 2259-2269.



Population vulnerability increases in warm conditions

Citation: Shriver, R. K., Yackulic, C. B., Bell, D. M., & Bradford, J. B. (2022). Dry forest decline is driven by both declining recruitment and increasing mortality in response to warm, dry conditions. *Global Ecology and Biogeography*, *31*(11), 2259-2269.

Geographic patterns of population vulnerability are complicated by heterogenous landscapes



Citation: Shriver, R. K., Yackulic, C. B., Bell, D. M., & Bradford, J. B. (2022). Dry forest decline is driven by both declining recruitment and increasing mortality in response to warm, dry conditions. *Global Ecology and Biogeography*, *31*(11), 2259-2269.

What is the current status of P-J populations across the intermountain west?

- Warm-dry conditions are associated with increasing population vulnerability.

- Increasing population density more concentrated in areas with cooler-wetter conditions.

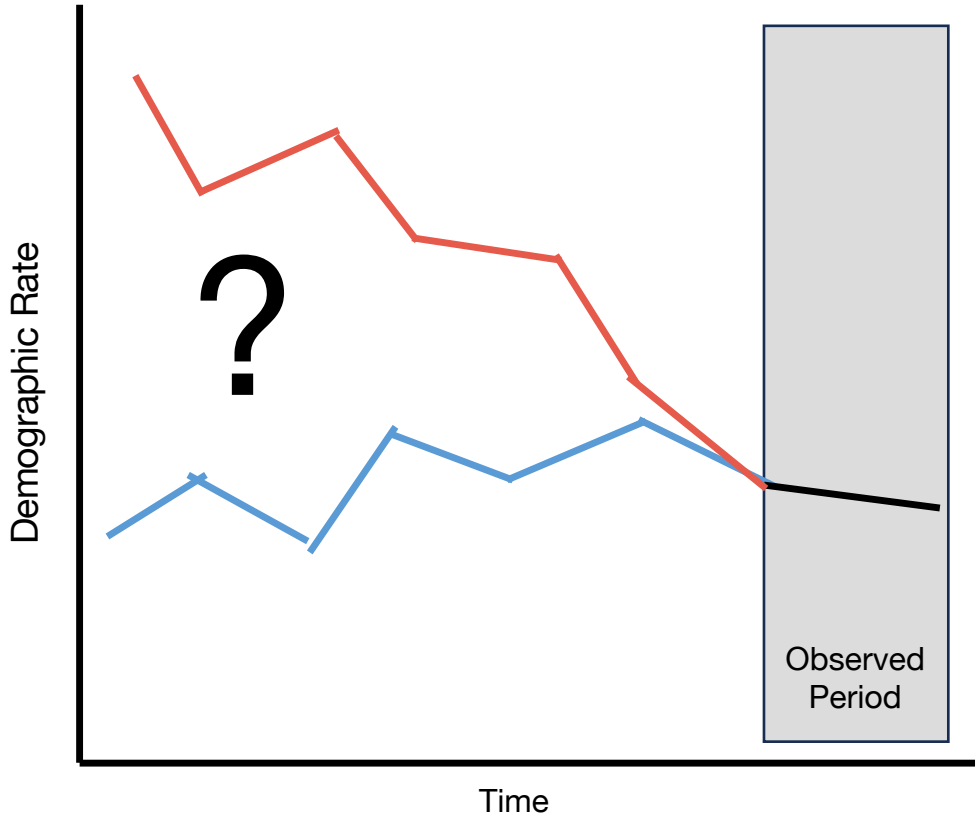
- *Pinus edulis* is currently experiencing the most widespread declines.

1) What is the current status of P-J populations across the intermountain west?

2) What are the longer-term trends in P-J populations?

3) What does the future look like for P-J with climate change?

Where does the current period fit in the long-term trajectory?



Remotely-sensed cover data have become increasingly popular to track woodland changes in woodlands

Remotely-sensed cover data have become increasingly popular to track woodland changes in woodlands

Cover data alone are not sufficient to infer P-J population health.

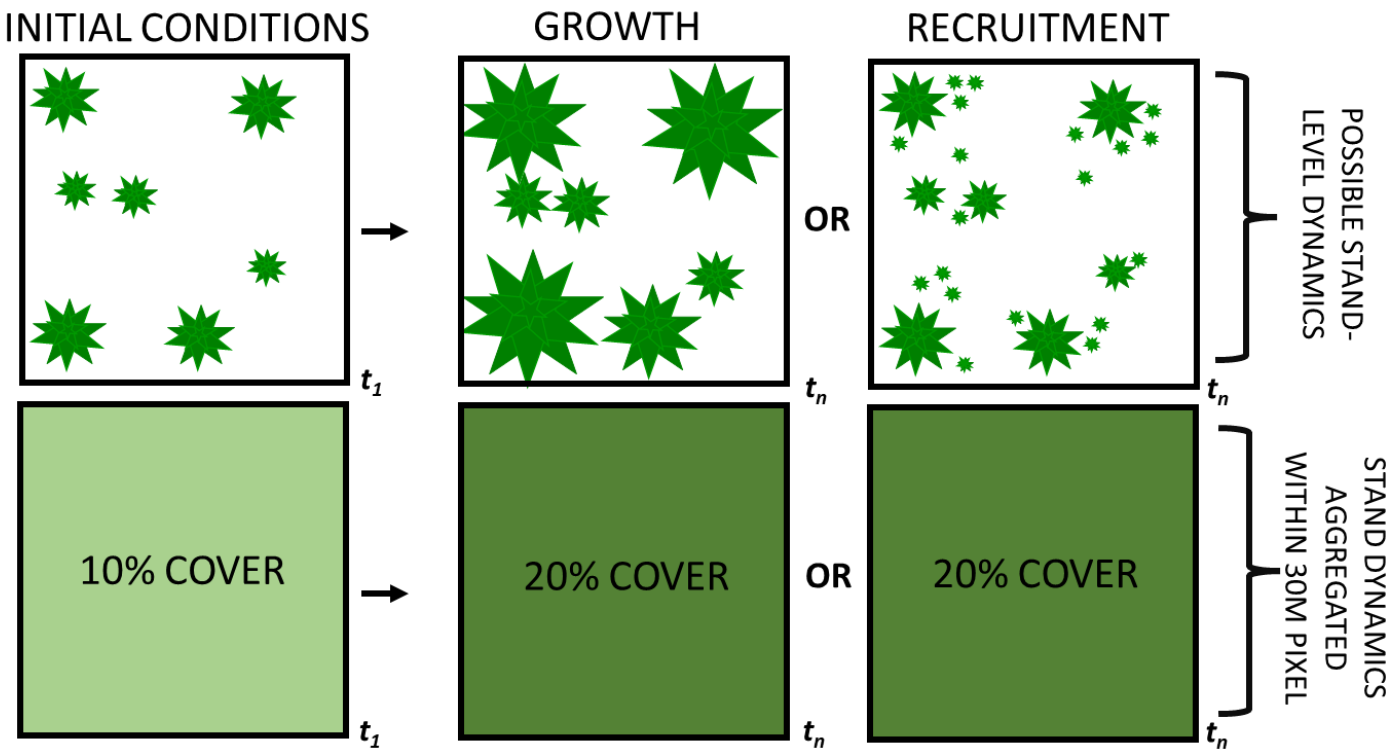
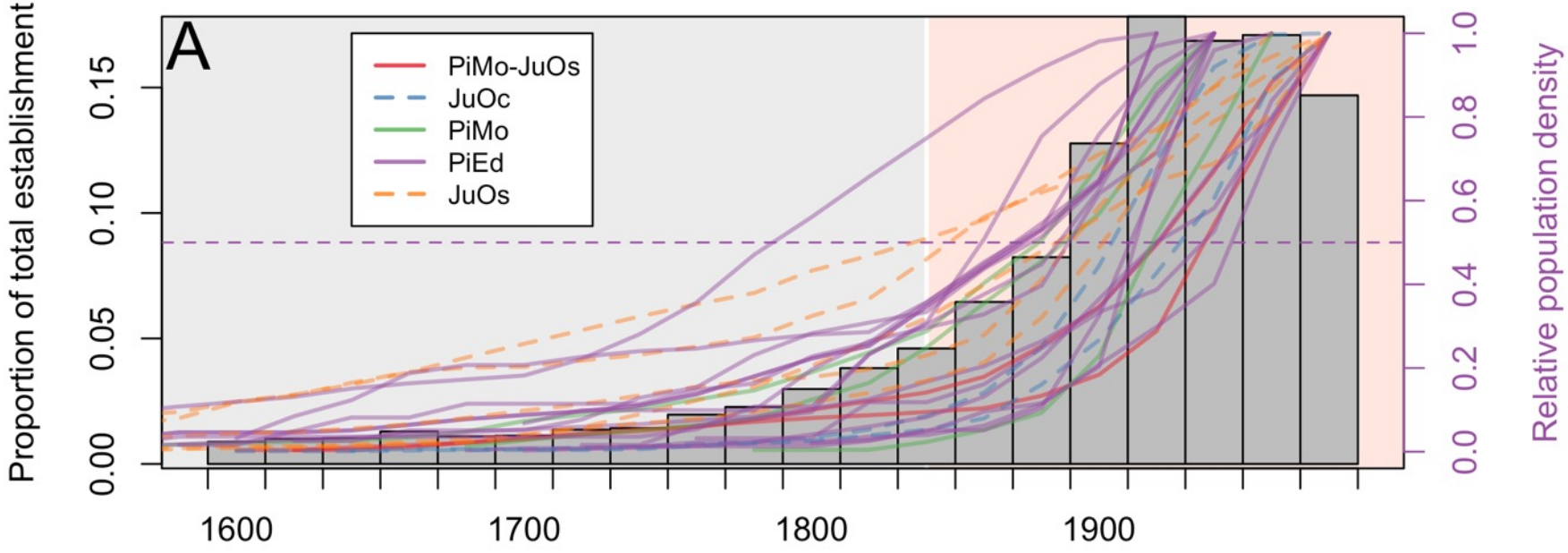


Illustration by Elise Pletcher

Remotely-sensed cover data have become increasingly popular to track woodland changes in woodlands

Remote sensing detection of tree often substantially lags tree establishment.

Tree-ring records can be used to track how establishment has changed over time



Citation: Shriver, R. K., Pletcher, E., Biondi, F., Urza, A. K., & Weisberg, P. J. (In Review). Increasing woodland density in the western US over the last 200 years was driven by long-term plant demography rather than Euro-American settlement. Preprint on bioRxiv.

Correcting establishment numbers for population size

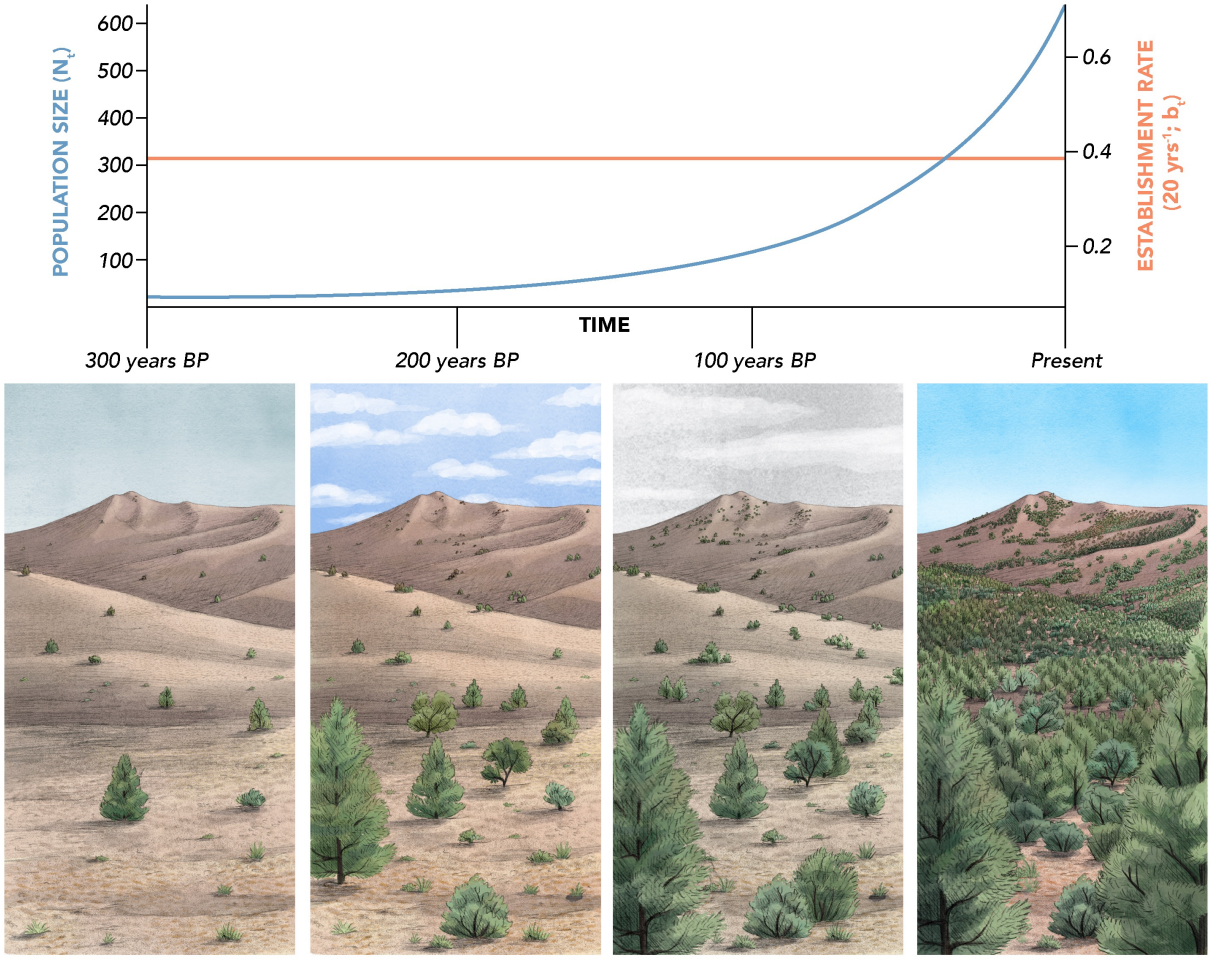
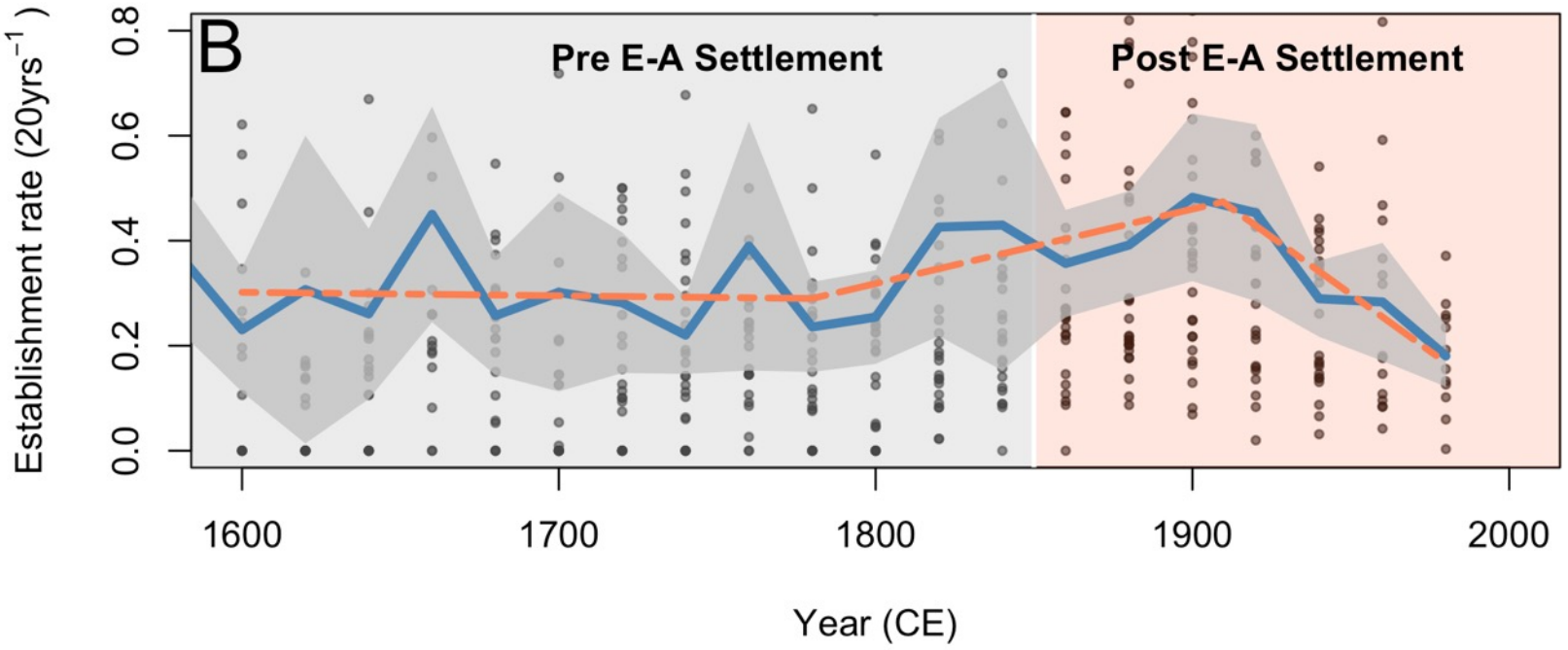


Illustration by Alex Boersma

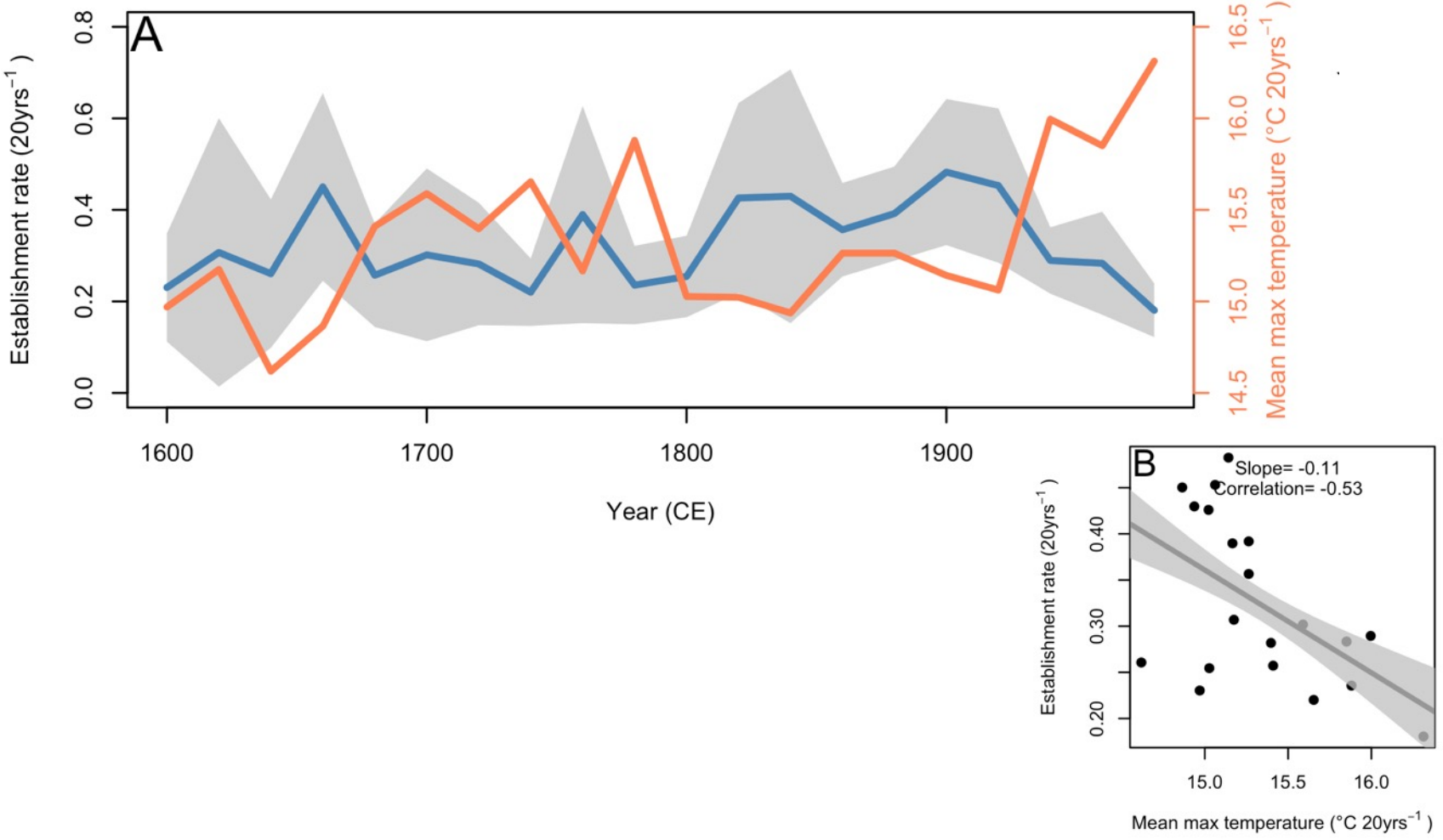
Citation: Shriver, R. K., Pletcher, E., Biondi, F., Urza, A. K., & Weisberg, P. J. (In Review). Increasing woodland density in the western US over the last 200 years was driven by long-term plant demography rather than Euro-American settlement. Preprint on bioRxiv.

Tree establishment rates are currently at their lowest-level in at least 400 years

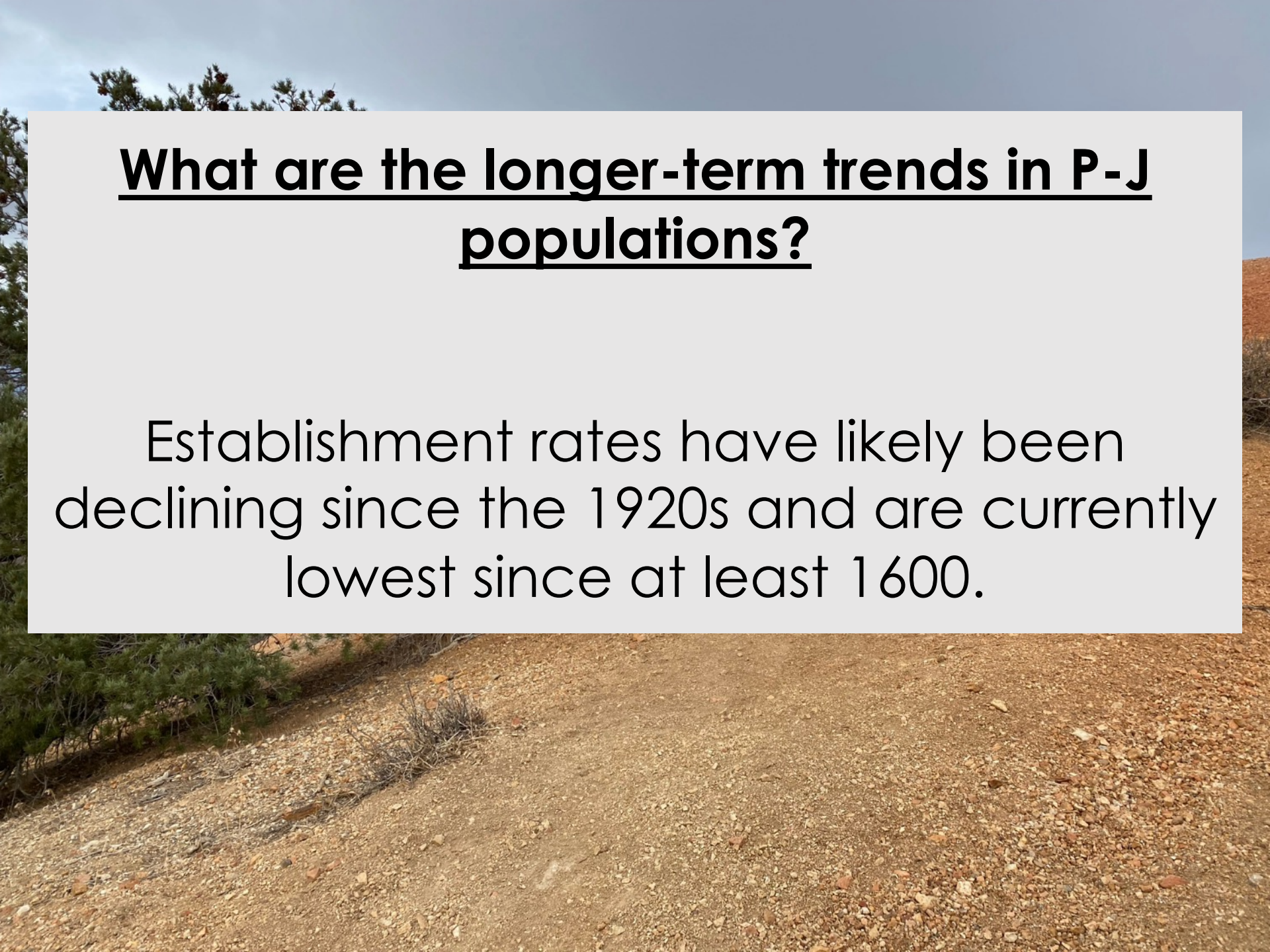


Citation: Shriver, R. K., Pletcher, E., Biondi, F., Urza, A. K., & Weisberg, P. J. (In Review). Increasing woodland density in the western US over the last 200 years was driven by long-term plant demography rather than Euro-American settlement. Preprint on bioRxiv.

Increases in temperature are associated with declining establishment rates



Citation: Shriver, R. K., Pletcher, E., Biondi, F., Urza, A. K., & Weisberg, P. J. (In Review). Increasing woodland density in the western US over the last 200 years was driven by long-term plant demography rather than Euro-American settlement. Preprint on bioRxiv.



What are the longer-term trends in P-J populations?

Establishment rates have likely been declining since the 1920s and are currently lowest since at least 1600.

1) What is the current status of P-J populations across the intermountain west?

2) What are the longer-term trends in P-J populations?

3) What does the future look like for P-J with climate change?

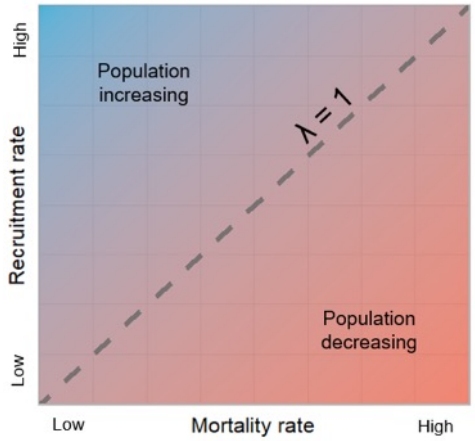
Predicting future trends is much, more challenging than quantifying past trends.

Forecasting philosophy: No single model will perfectly predict what the future looks like. A multi-model approach will better represent the potential future and our uncertainty.

Two approaches today:

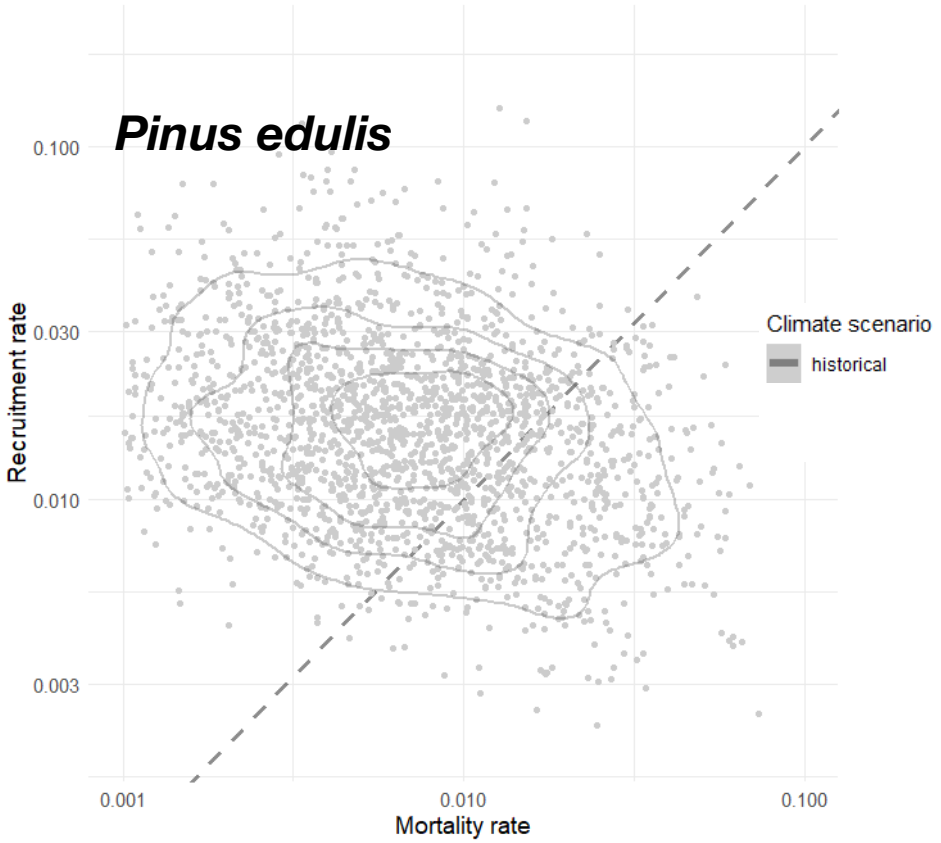
1. Demographic model
2. Species distribution model

Demographic model



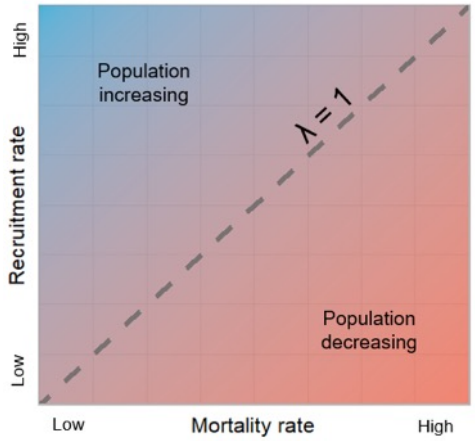
% of sites in decline

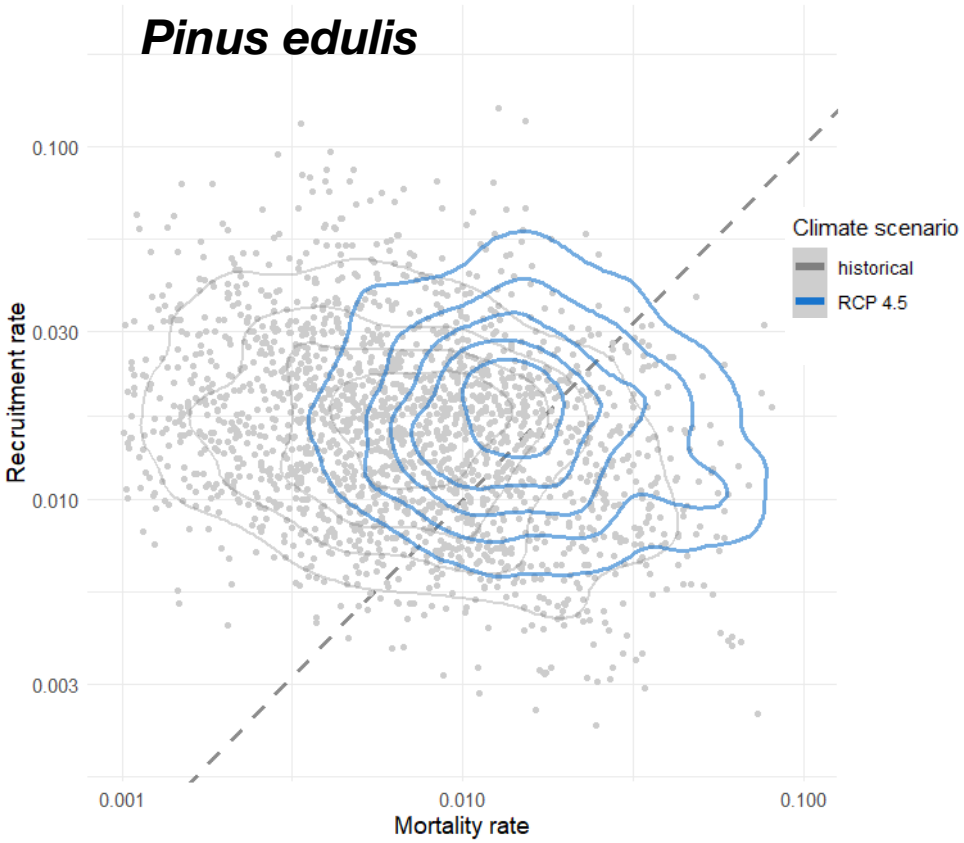
Historic: 24% of sites



Citation: Noel, A. R., Shriver, R. K., Crausbay, S. D., & Bradford, J. B. (2023). Where can managers effectively resist climate-driven ecological transformation in pinyon–juniper woodlands of the US Southwest?. *Global Change Biology*, *29*(15), 4327-4341.

Demographic model





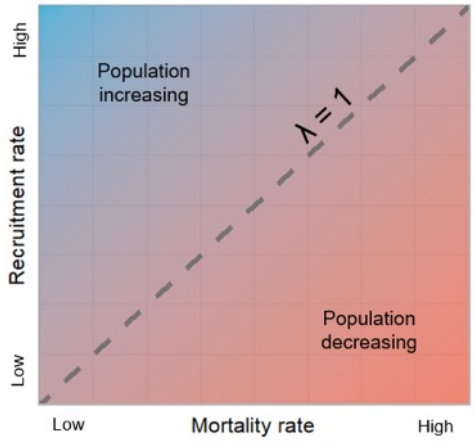
<u>% of sites in decline</u>

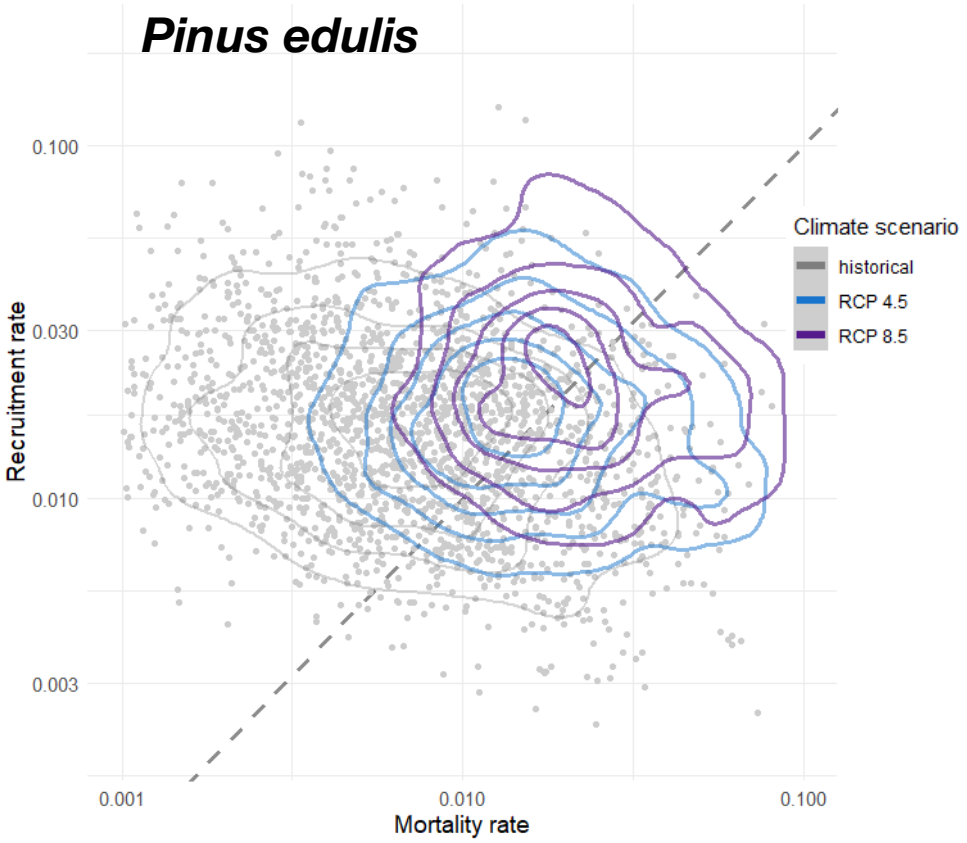
Historic: 24% of sites

RCP 4.5 end-century: 42% of sites

Citation: Noel, A. R., Shriver, R. K., Crausbay, S. D., & Bradford, J. B. (2023). Where can managers effectively resist climate-driven ecological transformation in pinyon–juniper woodlands of the US Southwest?. *Global Change Biology*, *29*(15), 4327-4341.

Demographic model





% of sites in decline

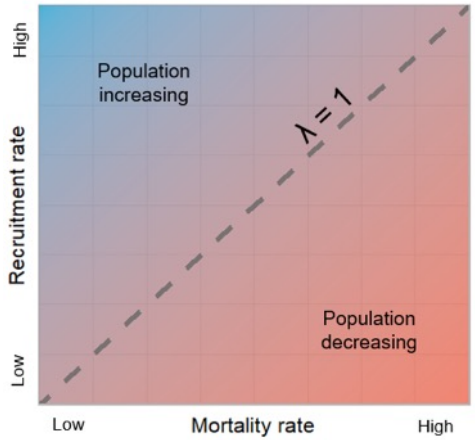
Historic: 24% of sites

RCP 4.5 end-century: 42% of sites

RCP 8.5 end-century: 44% of sites

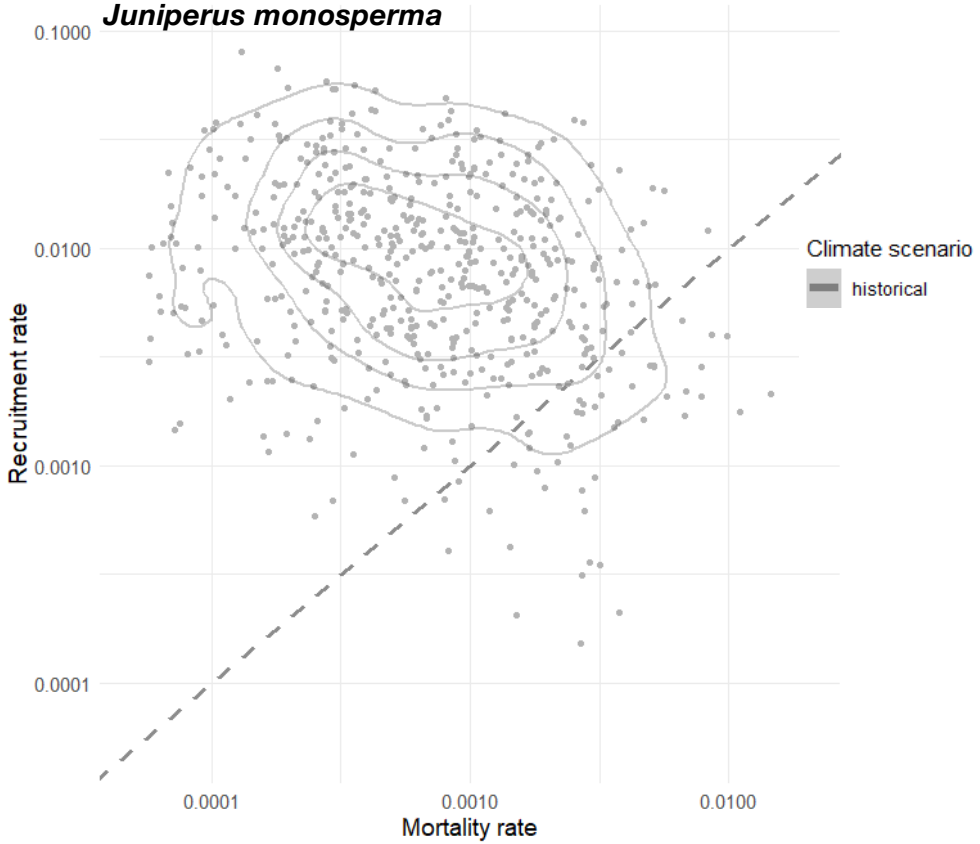
Citation: Noel, A. R., Shriver, R. K., Crausbay, S. D., & Bradford, J. B. (2023). Where can managers effectively resist climate-driven ecological transformation in pinyon–juniper woodlands of the US Southwest?. *Global Change Biology*, *29*(15), 4327-4341.

Demographic model



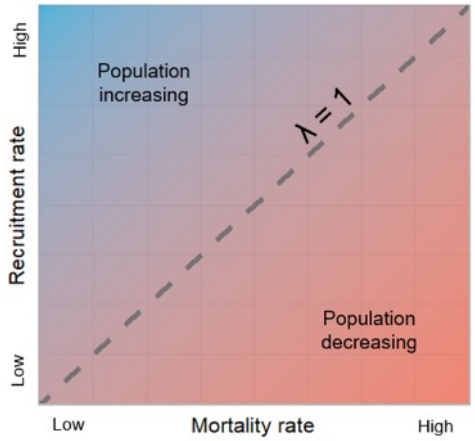
% of sites in decline

Historic: 11% of sites



Citation: Noel, A. R., Shriver, R. K., Crausbay, S. D., & Bradford, J. B. (2023). Where can managers effectively resist climate-driven ecological transformation in pinyon–juniper woodlands of the US Southwest?. *Global Change Biology*, *29*(15), 4327-4341.

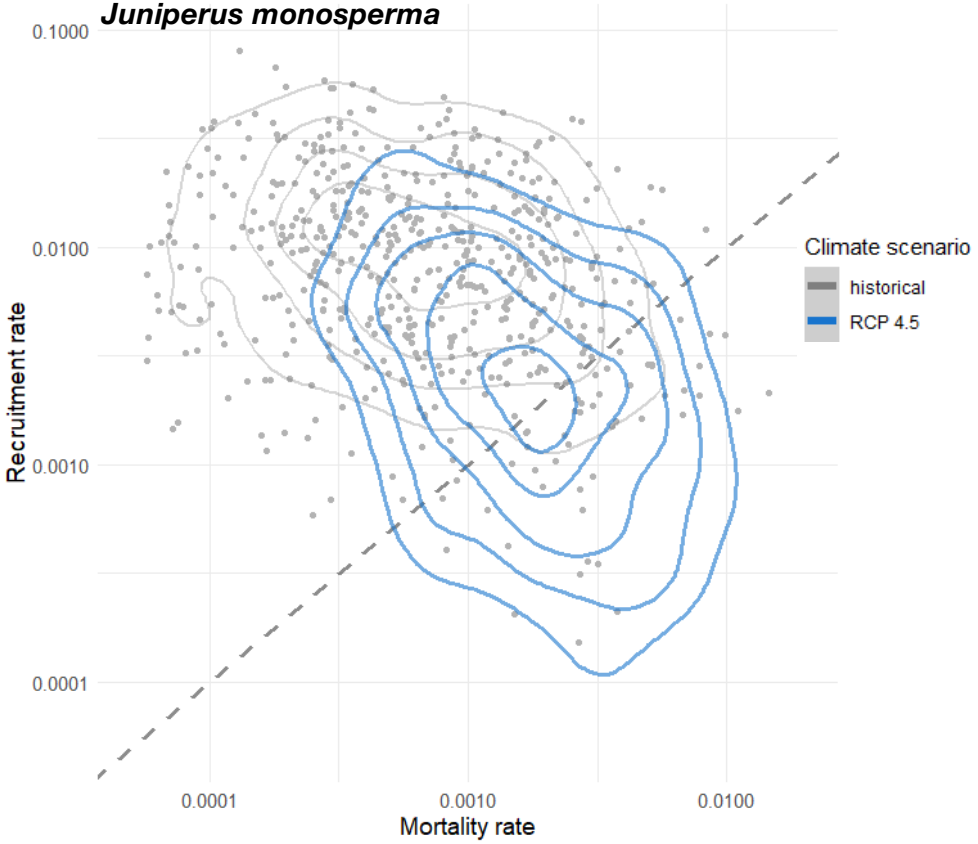
Demographic model



<u>% of sites in decline</u>

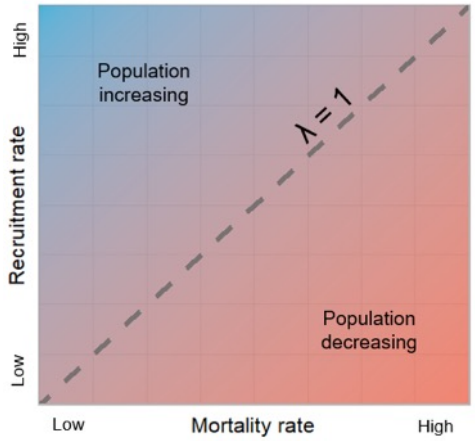
Historic: 11% of sites

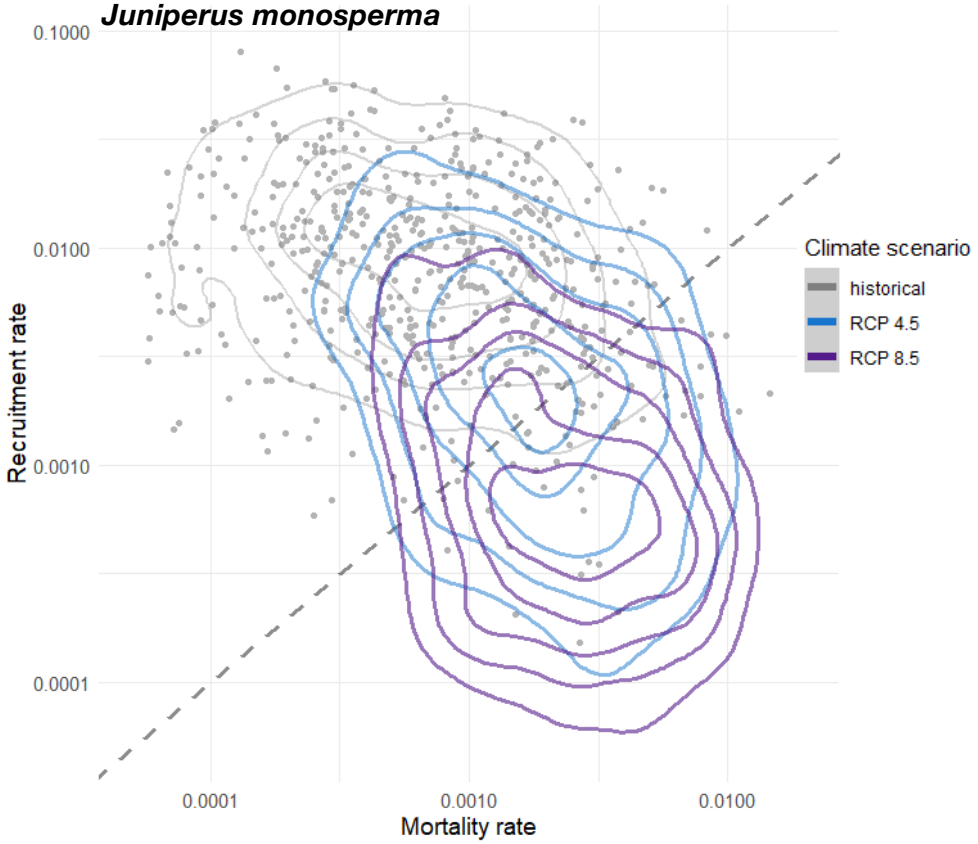
RCP 4.5 end-century: 50% of sites



Citation: Noel, A. R., Shriver, R. K., Crausbay, S. D., & Bradford, J. B. (2023). Where can managers effectively resist climate-driven ecological transformation in pinyon–juniper woodlands of the US Southwest?. *Global Change Biology*, *29*(15), 4327-4341.

Demographic model





% of sites in decline

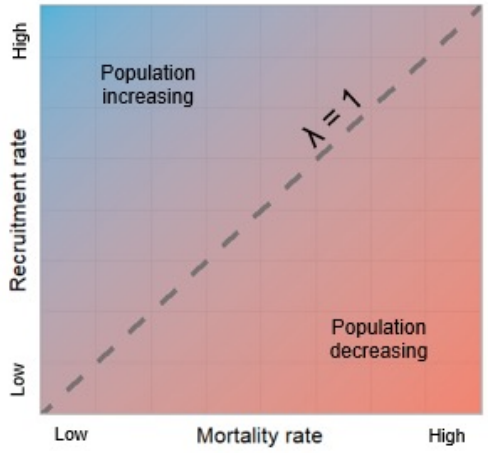
Historic: 11% of sites

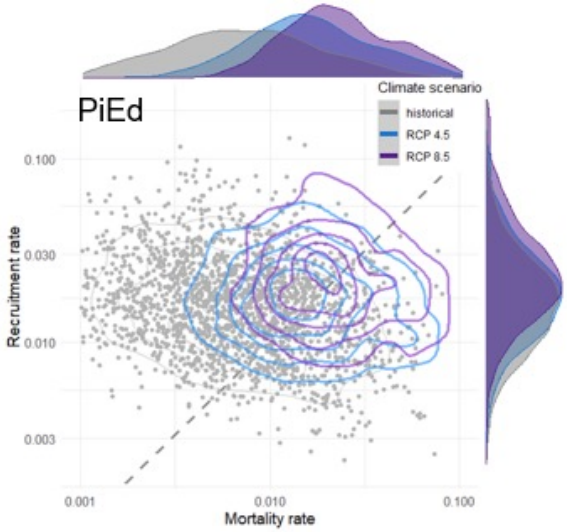
RCP 4.5 end-century: 50% of sites

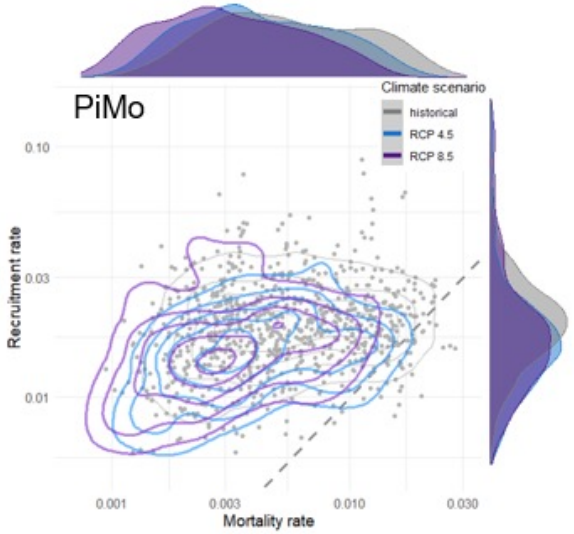
RCP 8.5 end-century: 81% of sites

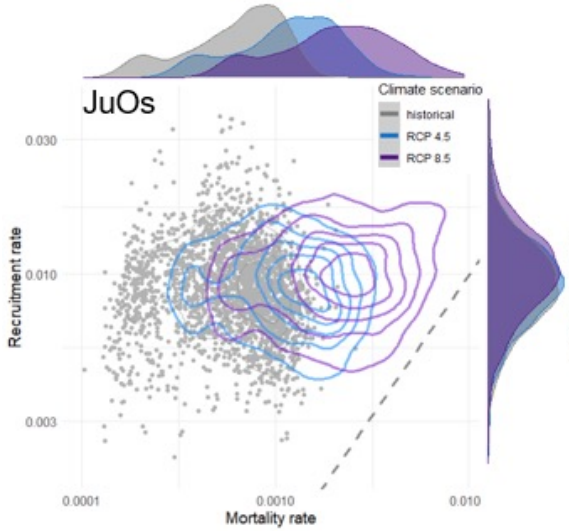
Citation: Noel, A. R., Shriver, R. K., Crausbay, S. D., & Bradford, J. B. (2023). Where can managers effectively resist climate-driven ecological transformation in pinyon–juniper woodlands of the US Southwest?. *Global Change Biology*, *29*(15), 4327-4341.

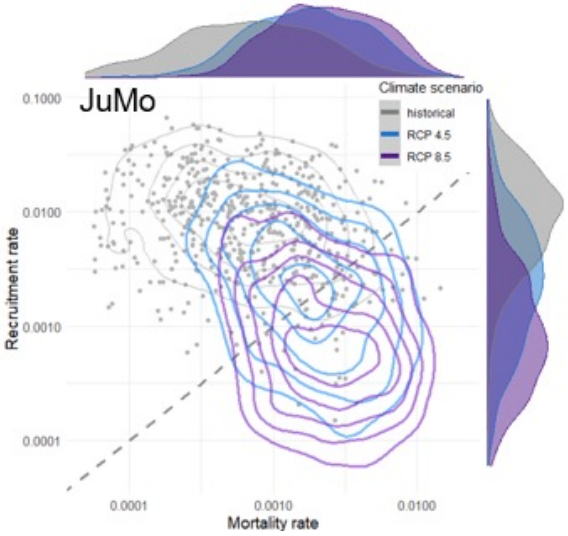
What about the other species? Comparatively little change.

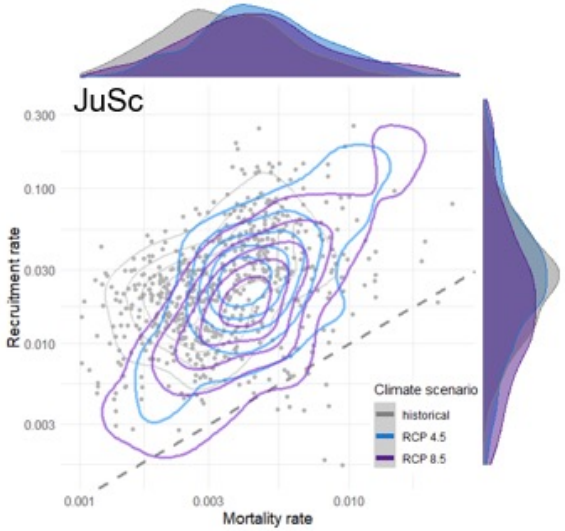






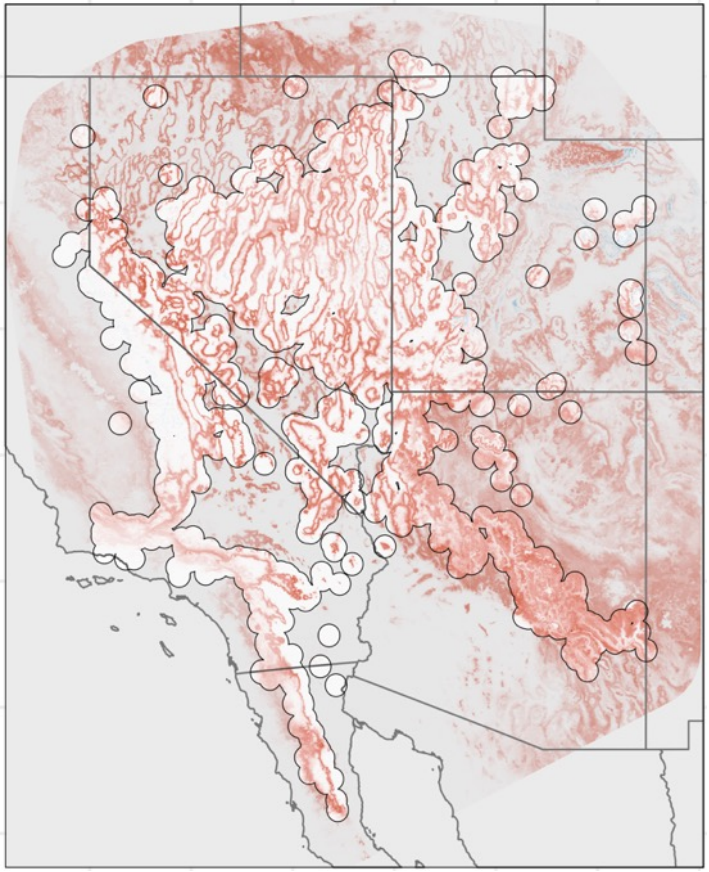




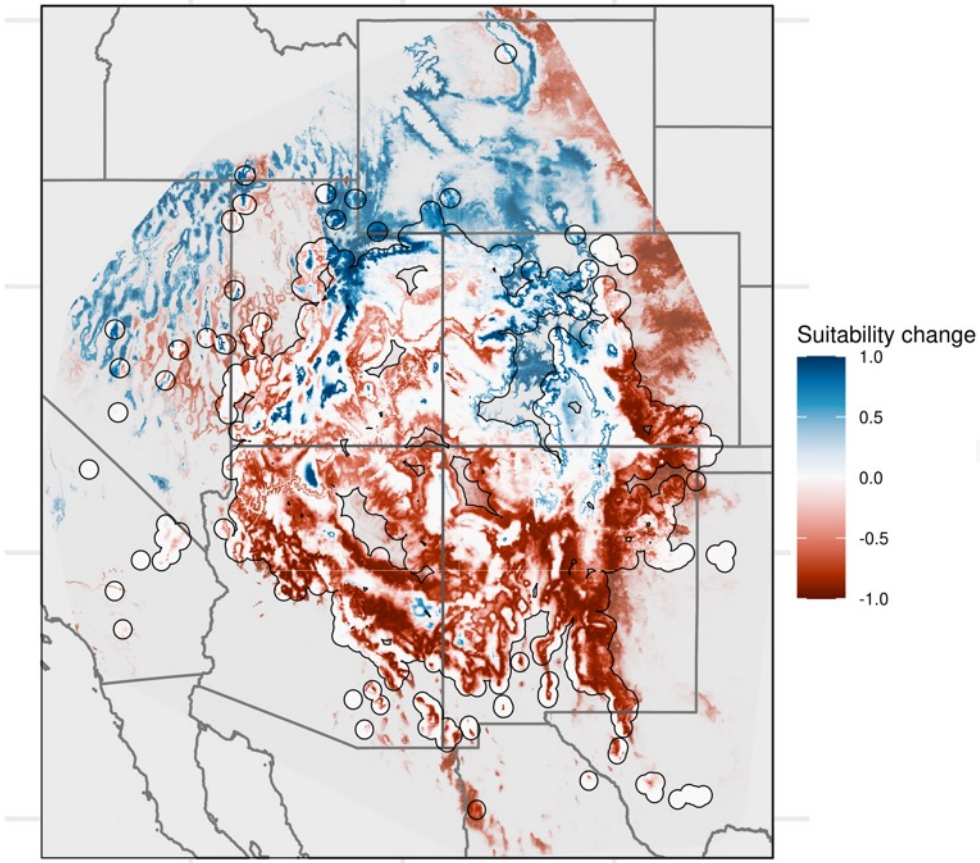


Species distribution models

Pinus monophylla



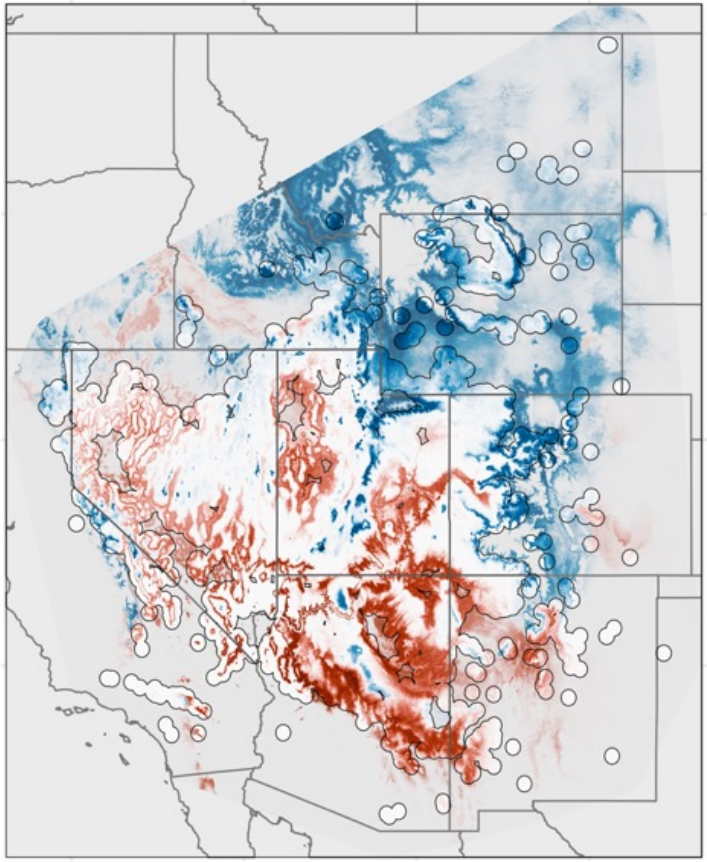
Pinus edulis



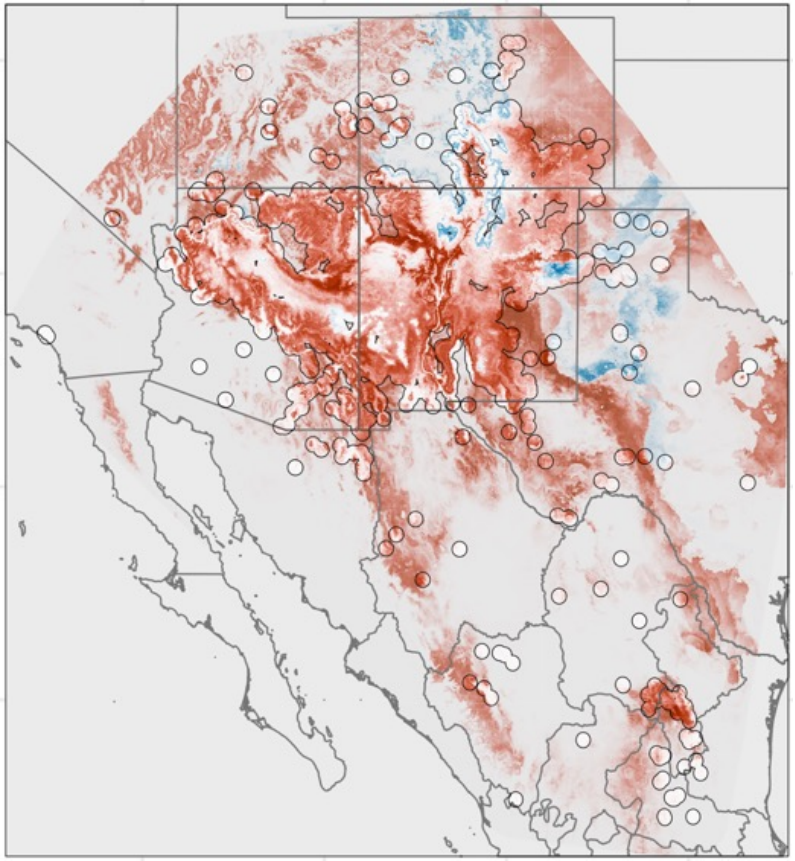
In prep work led by USGS postdoc Adam Noel

Species distribution models

Juniperus osteosperma



Juniperus monosperma



In prep work led by USGS postdoc Adam Noel

What does the future look like for P-J with climate change?

- No species is likely to see improvements in population health in most of their current range.
- Magnitudes and extent of declines are likely to vary by species.
- Potential for migration to offset range loses in some species.


Thank you.