

West-wide patterns of post-fire tree regeneration: impacts of fire severity and climate change

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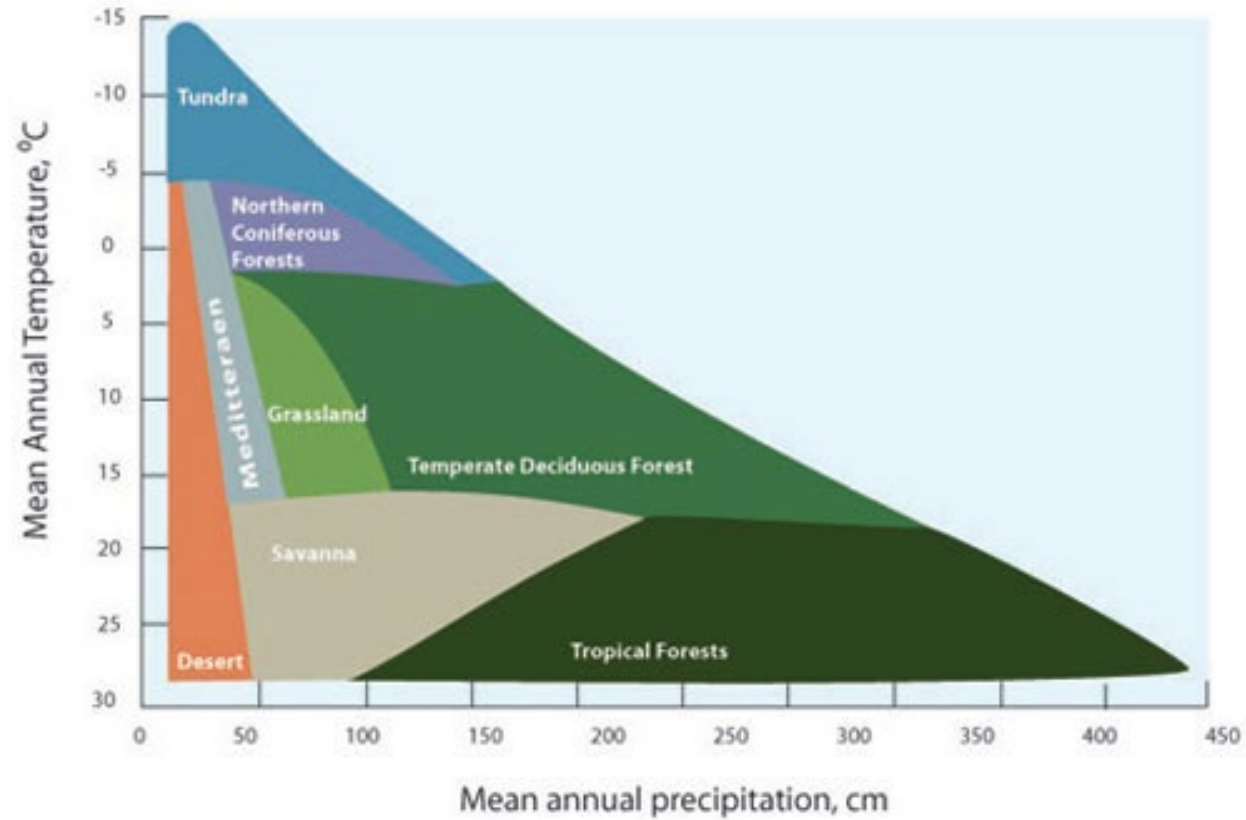


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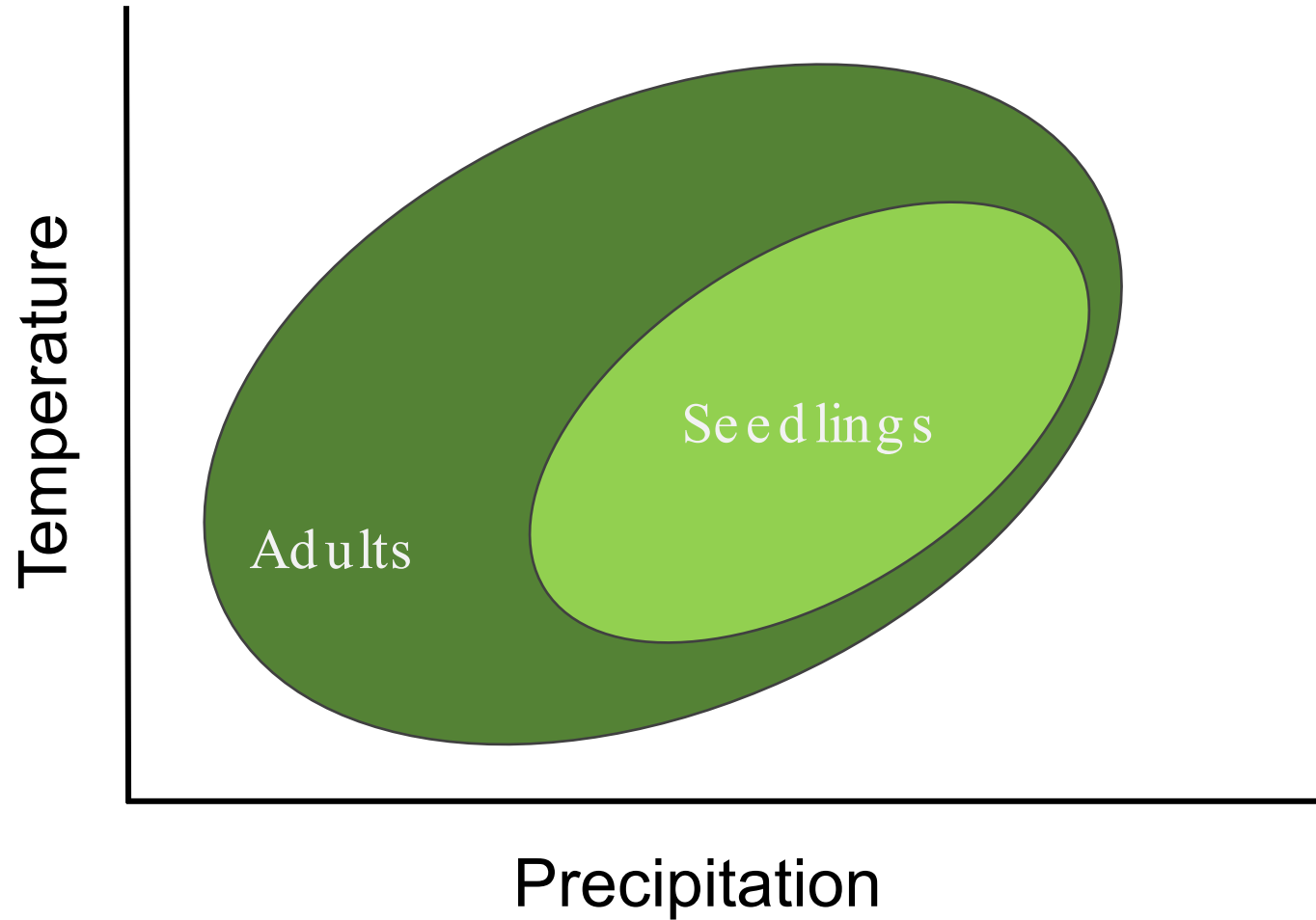
October 5, 2023
Chelan County Climate Resiliency Roundtable



Climate influences where species occur

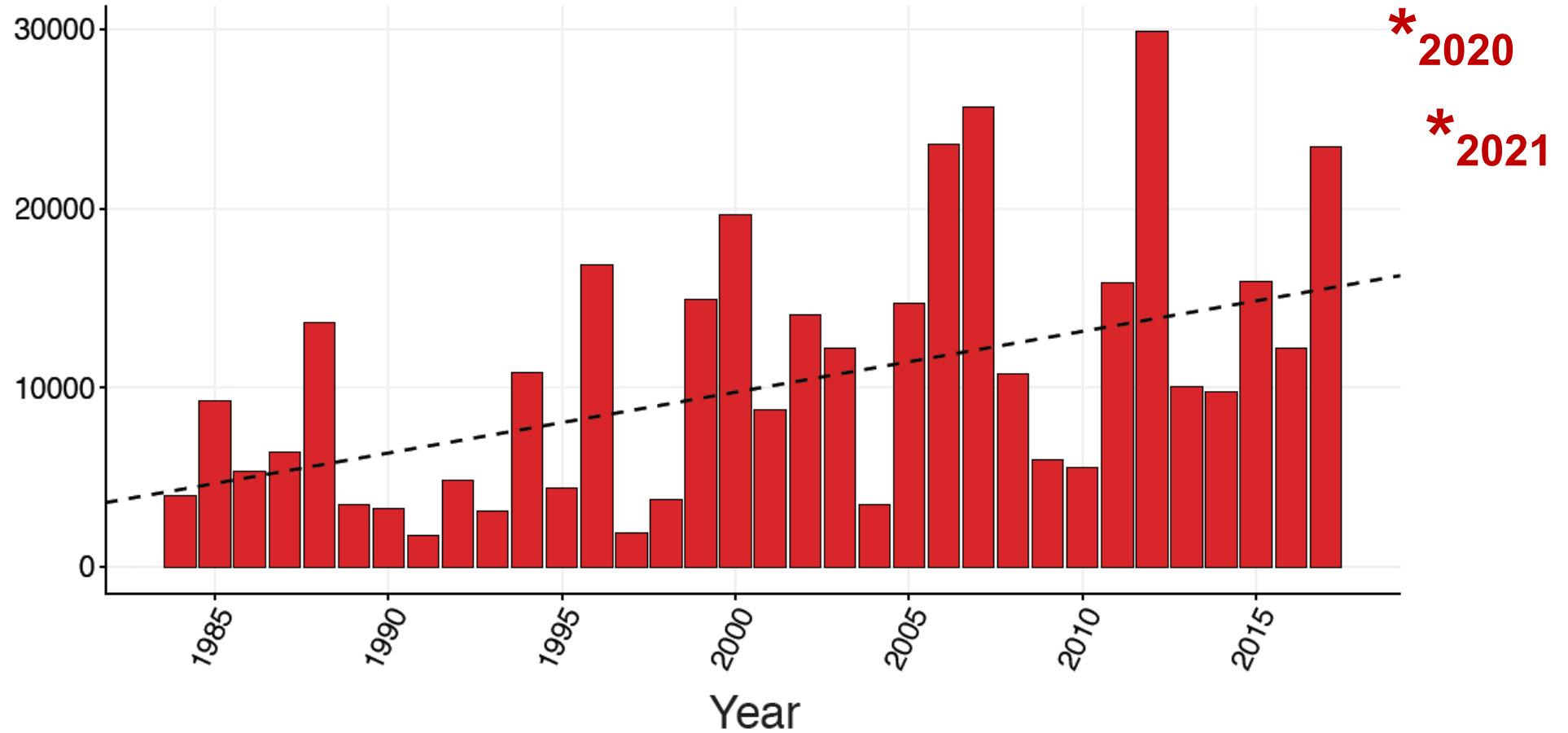


Seedlings have a narrower climate tolerance than mature trees

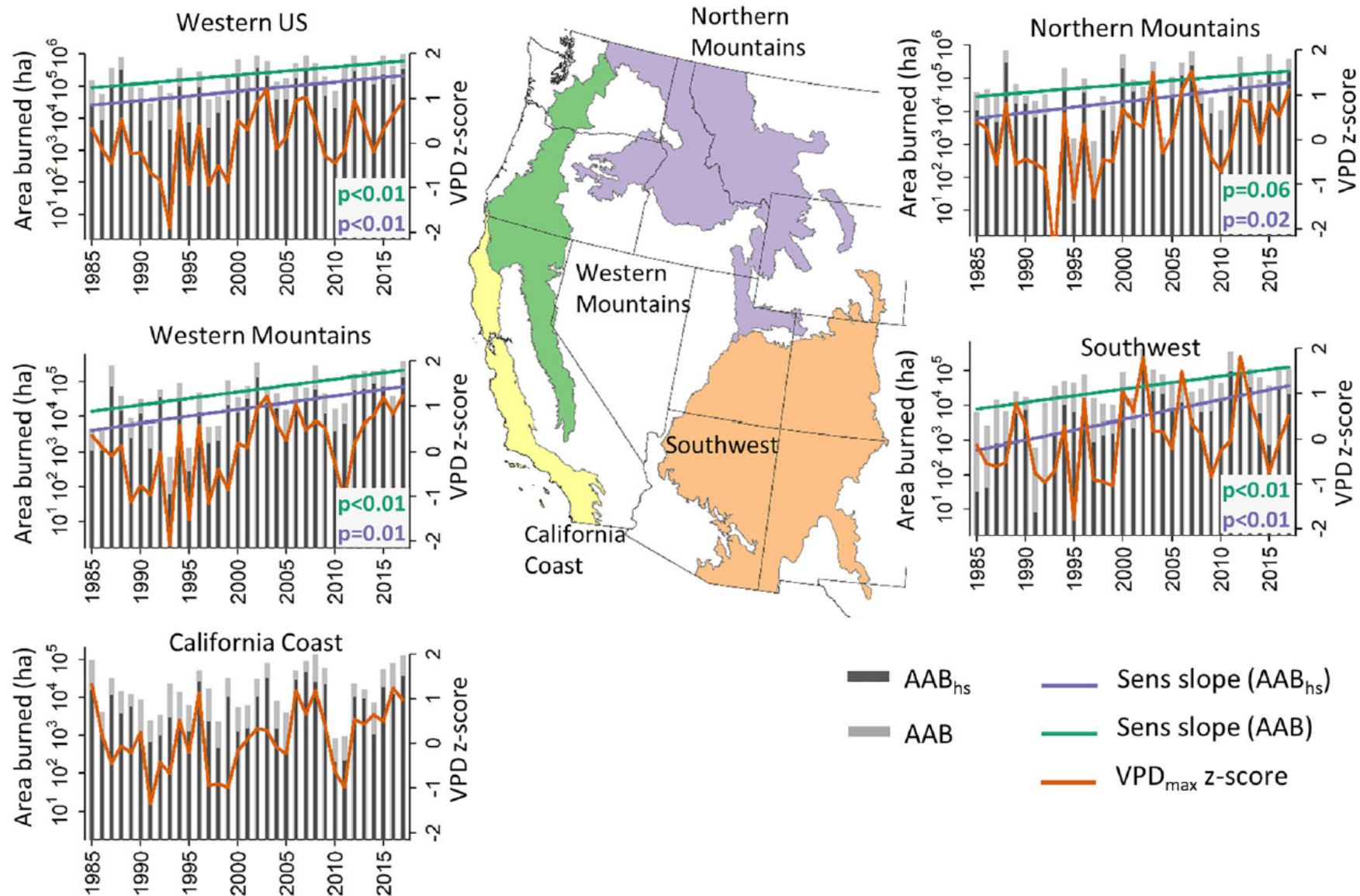


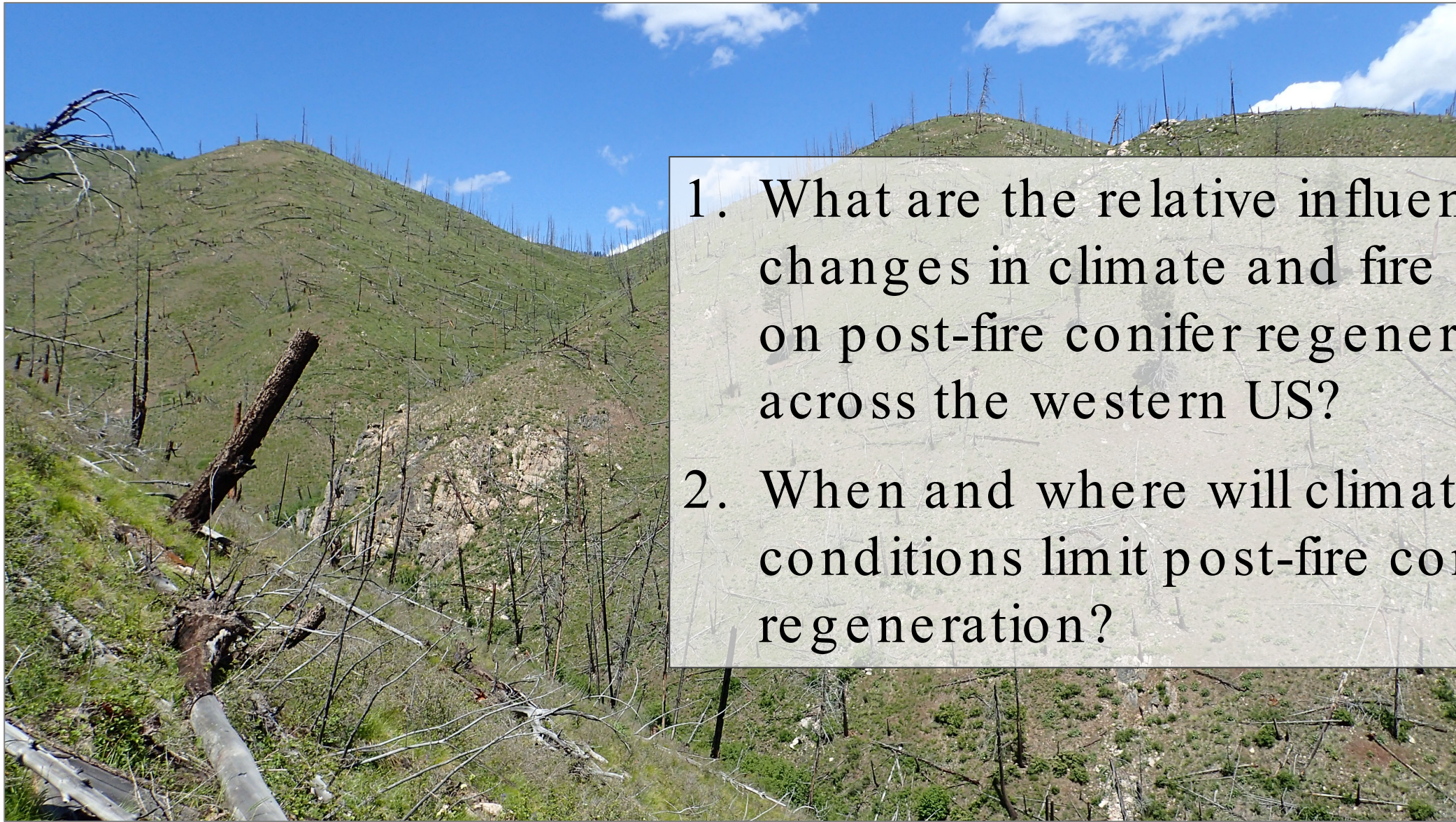
Wildfires are burning more area in the western US...

Area burned
in wildfires,
Western
contiguous US
(km²)



...with more area (3-14x) burning at high severity





1. What are the relative influences of changes in climate and fire severity on post-fire conifer regeneration across the western US?
2. When and where will climate conditions limit post-fire conifer regeneration?



RESIST

Some changes can be resisted. Managers will work to maintain ecosystem processes, function, and composition without experiencing dramatic, threshold-crossing changes.



ACCEPT

Many changes can be accepted, perhaps because they cannot feasibly be resisted or because they are acceptable to—or even desirable by—society. Managers will work to ease the transition.

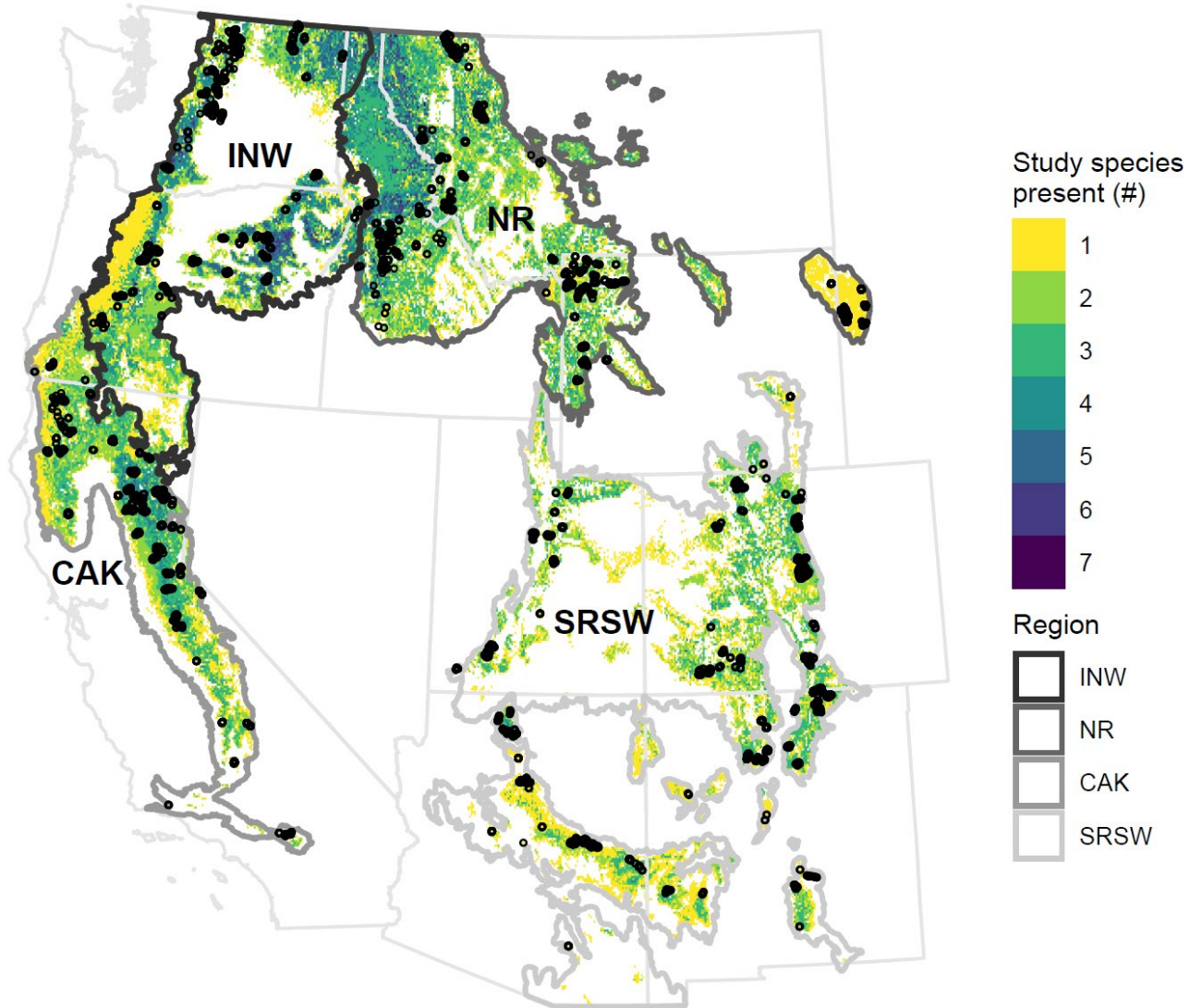


DIRECT

A few changes can be directed toward a different state, either because resistance is unrealistic or there is an opportunity to direct the change to a more desirable future state. Managers will face a new frontier in overseeing this process.



Modeling post-fire conifer regeneration

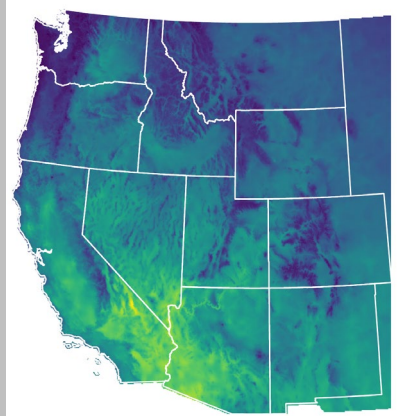


Species	Plots
All combined	10,230
Douglas-fir	5,951
Engelmann spruce	1,520
Lodgepole pine	3,232
Ponderosa/Jeffrey pine	7,719
Subalpine fir	2,268
White/grand fir	3,846
Total Fires:	334

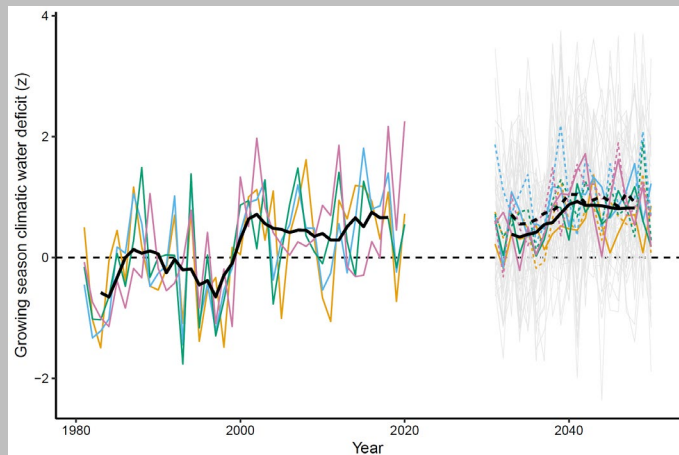
Model predictors

Climate

30-year mean climate



Post-fire climate anomalies

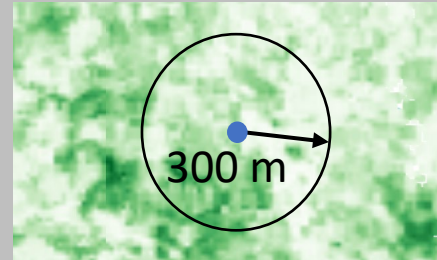


Seed source & fire severity

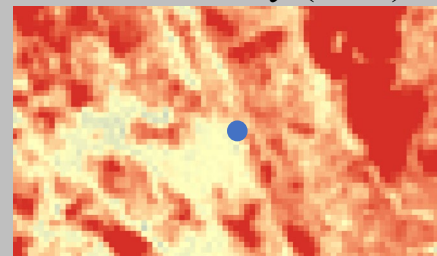
Distance to seed source



Surrounding tree cover

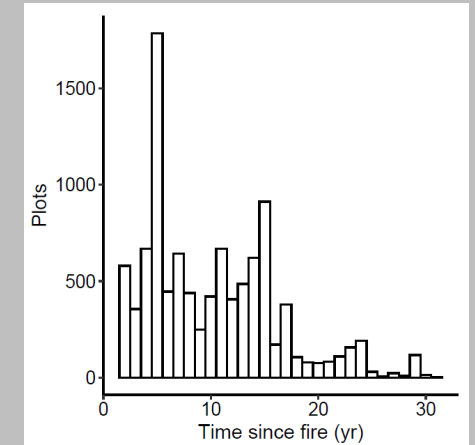


Fire severity (RBR)

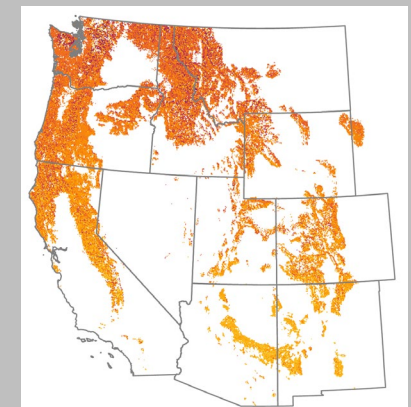


Site characteristics

Time since fire

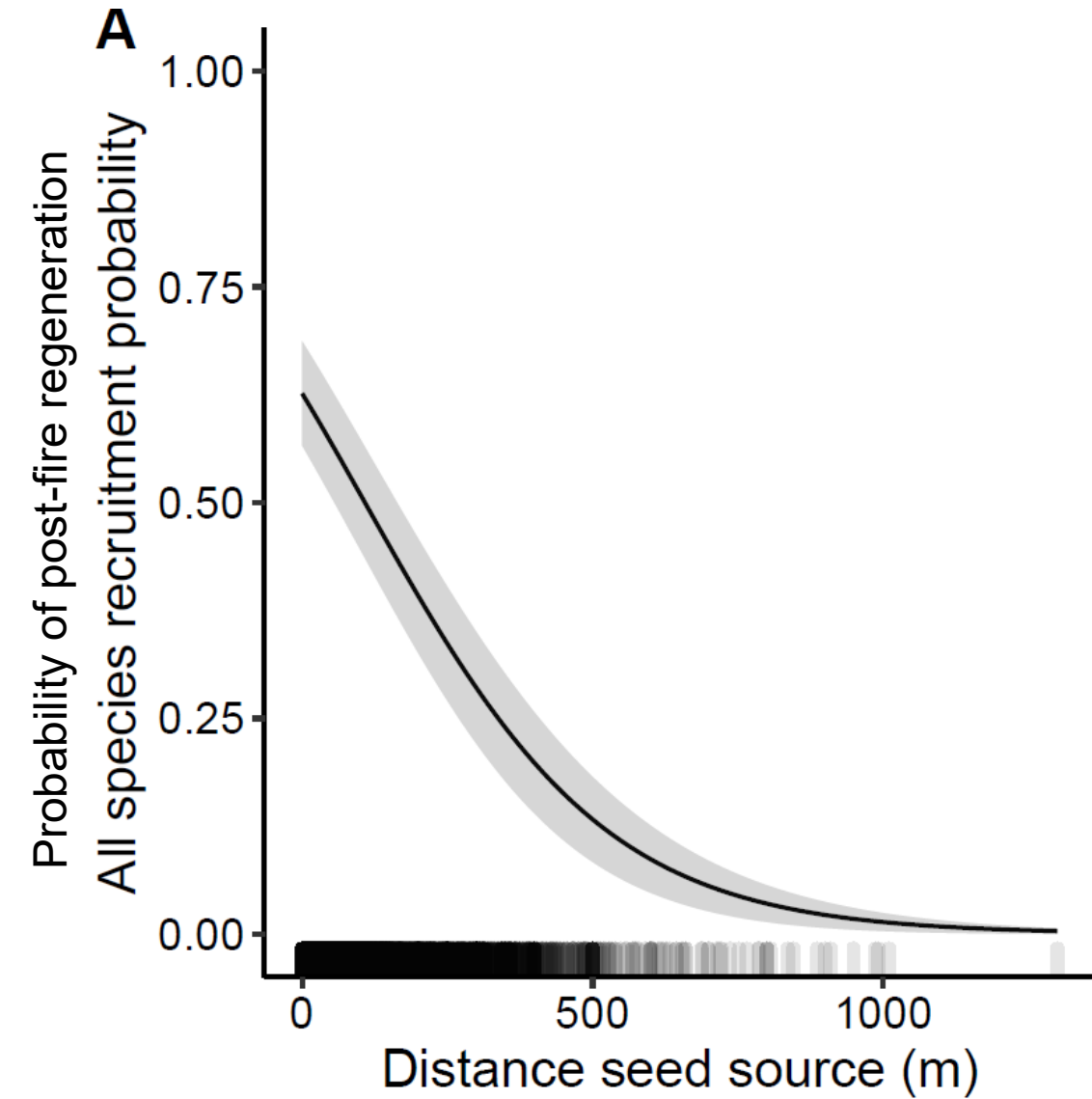


Heat load index

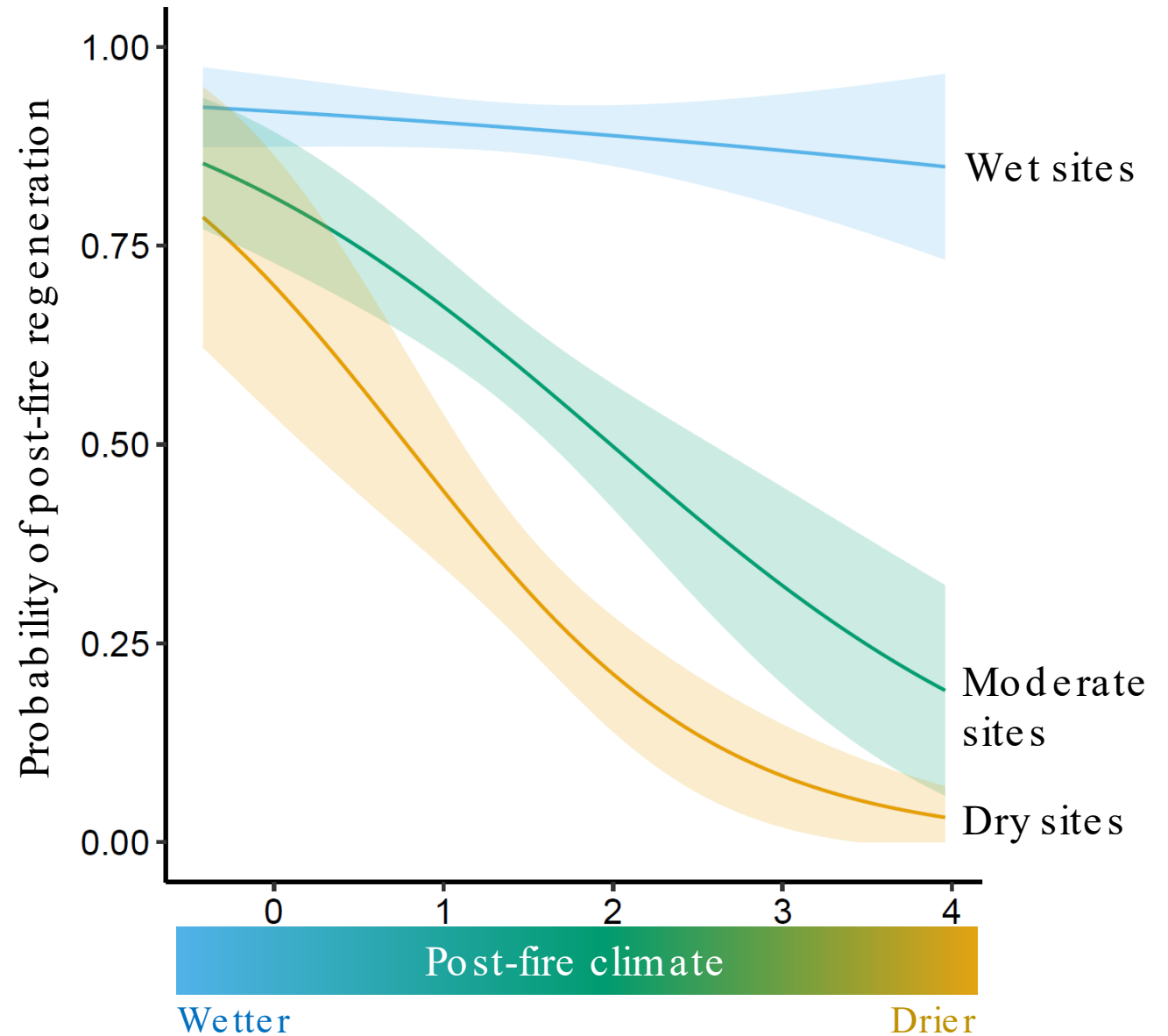


Pre-fire disturbance, Plot Size

Seed availability increases post-fire regeneration



Warm, dry climate limits post-fire regeneration



Probability of post-fire regeneration projections

Climate 1981-2000

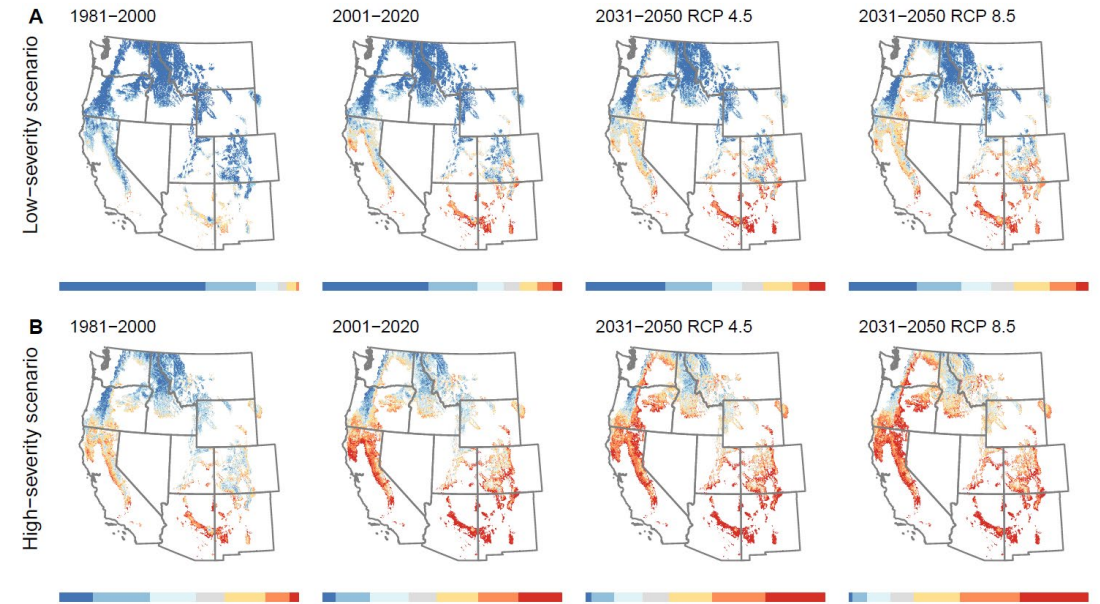
Climate 2001-2020

Climate 2031-2050
5 GCMs
RCP 4.5 and 8.5

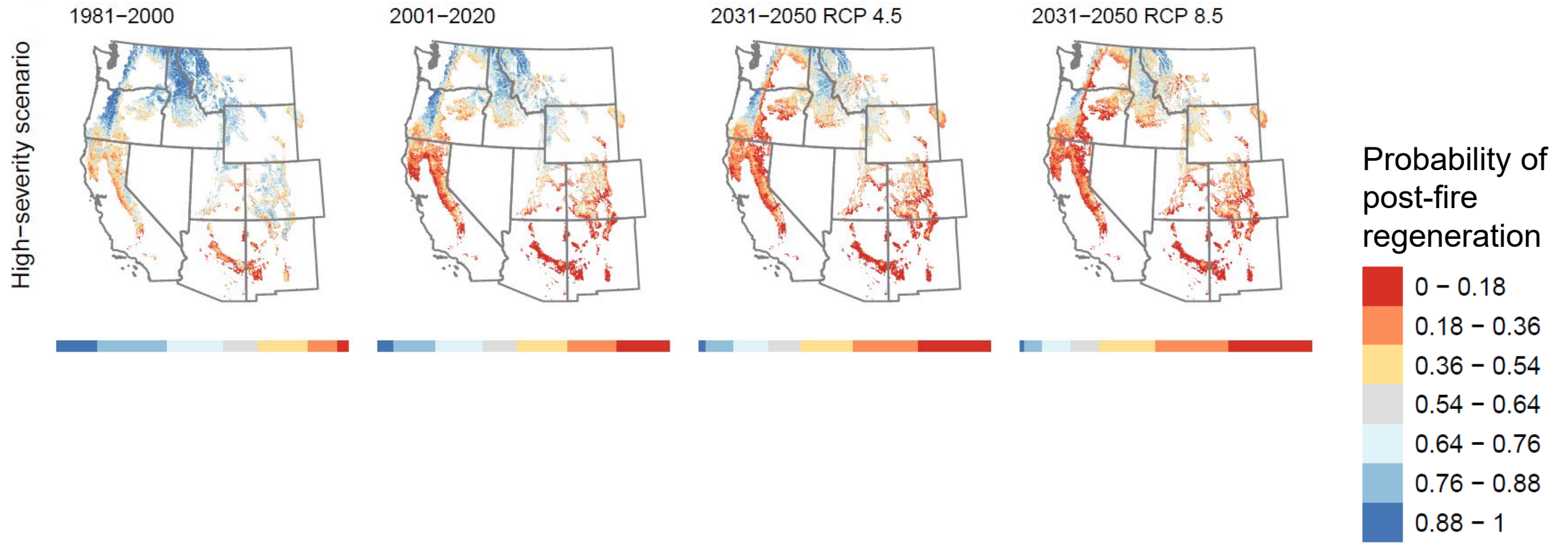
Low severity scenario

High severity scenario

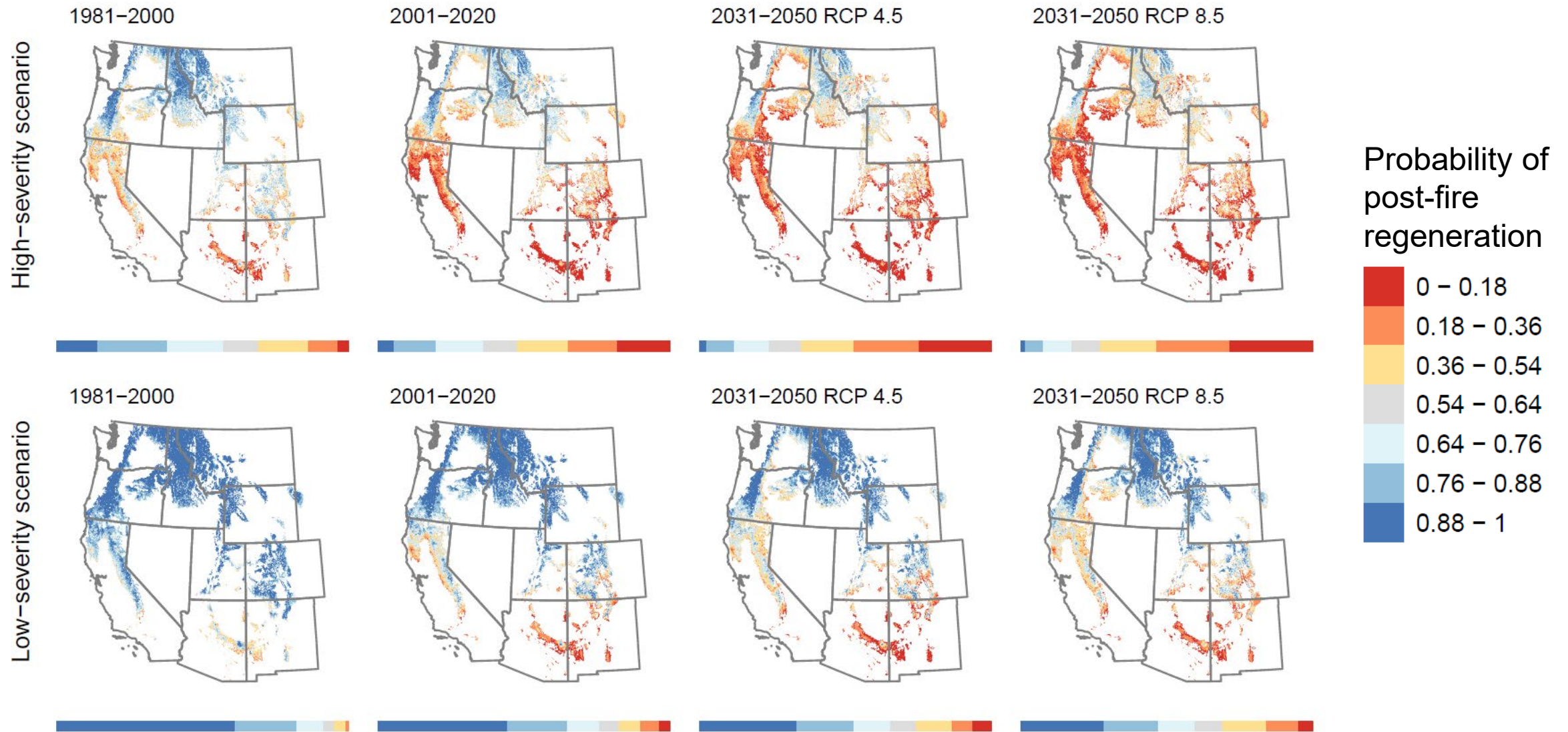
Model



Probability of post-fire regeneration projections



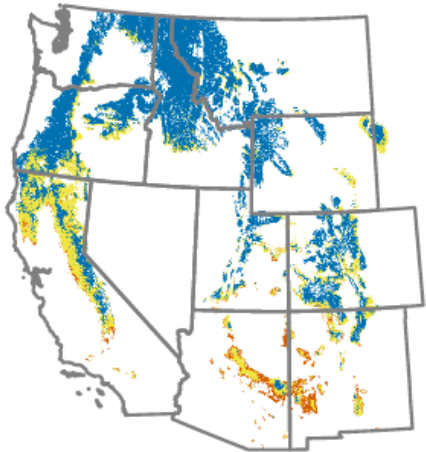
Probability of post-fire regeneration projections



Probability of post-fire regeneration projections

Severity scenario effect

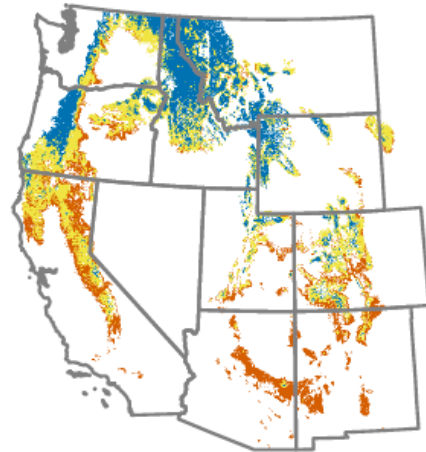
1981-2000



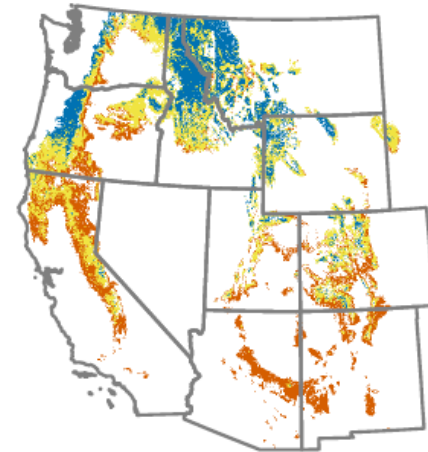
2001-2020



2031-2050 RCP 4.5



2031-2050 RCP 8.5



Probability of
post-fire
regeneration

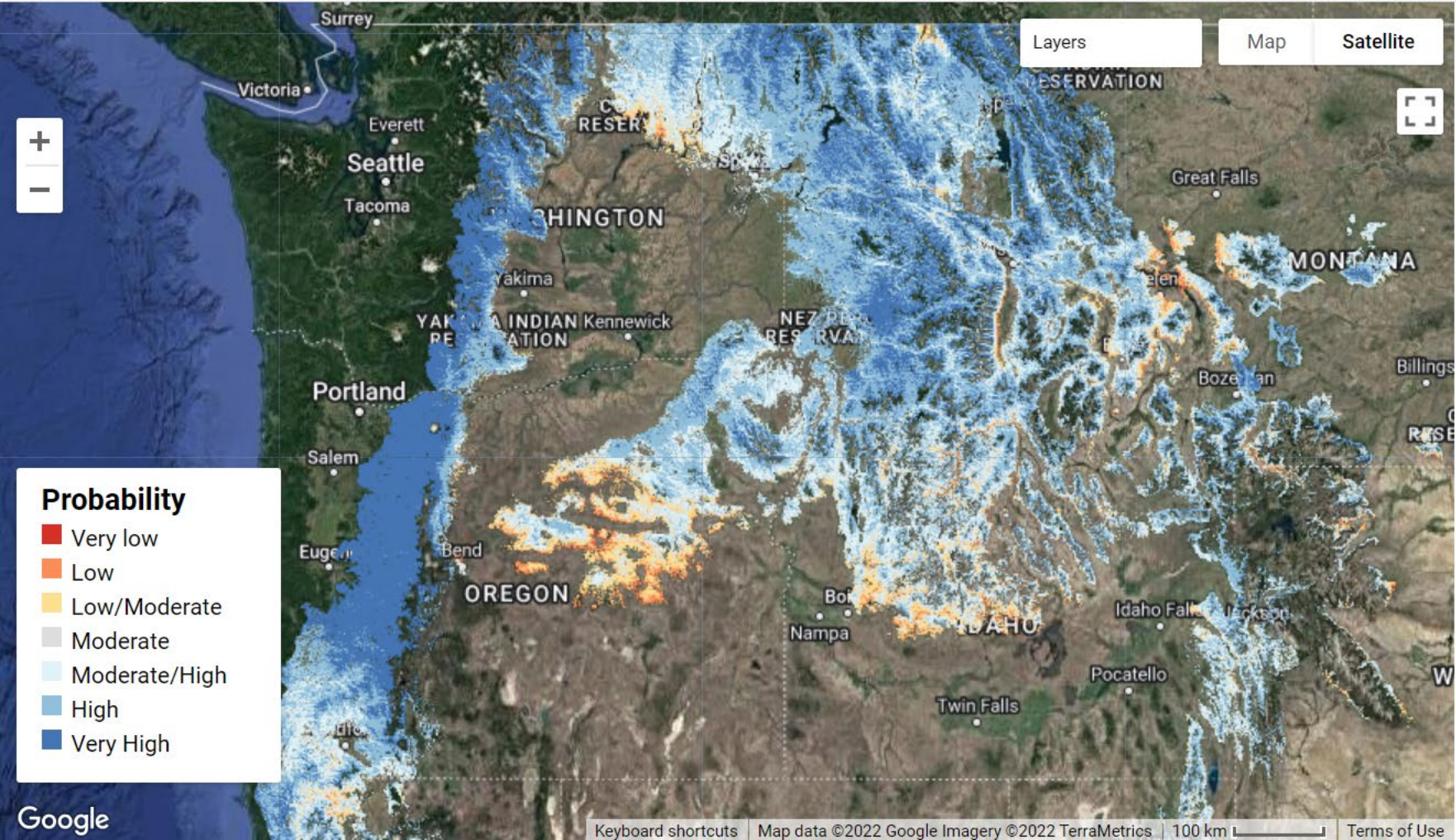
- Unlikely
- Likely low severity only
- Likely

The percent of the study area considered unlikely to experience conifer regeneration, regardless of fire severity, increased from 5% in 1981-2000 to 26 - 31% by mid-century.



Conclusions

- Treatments that are designed to reduce fire severity can buffer impacts of more fire and climate change by increasing the likelihood that there will be a viable seed source nearby for natural tree regeneration post-fire. (RESIST)
- However, the influence of a warming climate will increasingly overwhelm the ability of germinating seedlings to survive, even if they can successfully get to a burned site in the first place. (DIRECT)
- Some regions are already experiencing ecological transitions after large burned areas have failed to regenerate trees over the past two decades, though the NW US has largely been spared to date. (ACCEPT)



Select Species

For each tree species, recruitment probability maps were developed based on relationships between climate/topography, fire severity, and post-fire seedling presence in >10,000 plots in 334 recent wildfires (Davis et al. In Review).

Douglas-fir

Select Past, Current Or Future Climate Period

Changing the climate period modifies recruitment probability maps based on observed or projected climatic conditions.

Current Climate (2001-2020)

Choose a fire severity scenario

Changing the fire severity scenario modifies recruitment probability maps by changing distance to seed source, satellite-derived fire severity (RBR), and surrounding tree cover. The low severity scenario sets distance to seed source at 10 m, RBR at 100, and surrounding tree cover at 30% for all cells. The high scenario sets distance to seed source at 150 m, RBR at 400, and surrounding tree cover at 10% for all cells.

Low severity

Acknowledgements

Paper:

Davis, K.T., Robles, M.D., Kemp, K.B. et al. 2023. Reduced fire severity offers near-term buffer to climate-driven declines in conifer resilience across the western United States. Proceedings of the National Academy of Sciences: 120 (11) e2208120120. DOI: <https://doi.org/10.1073/pnas.2208120120>

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The Nature
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Forest Service

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