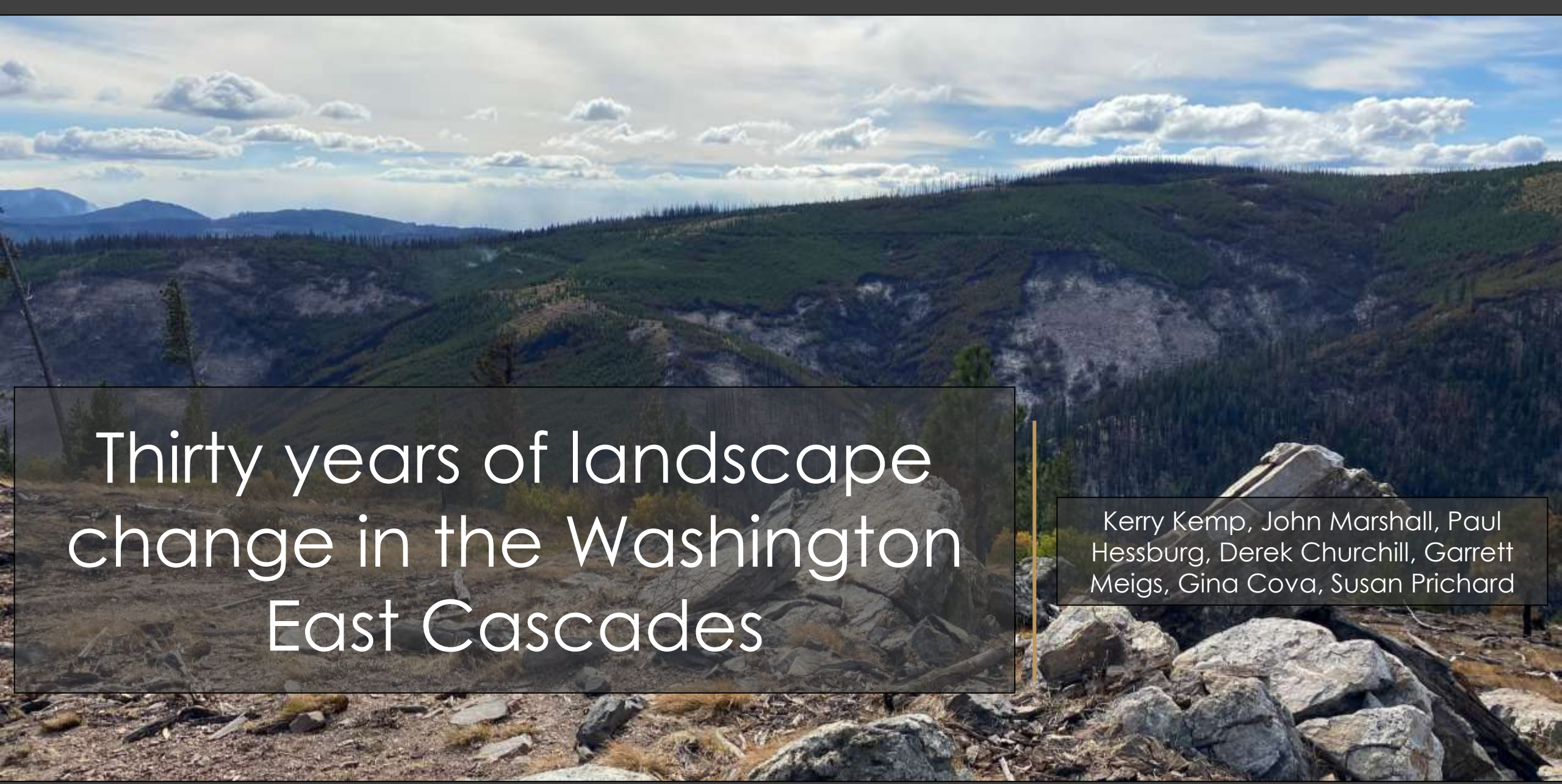
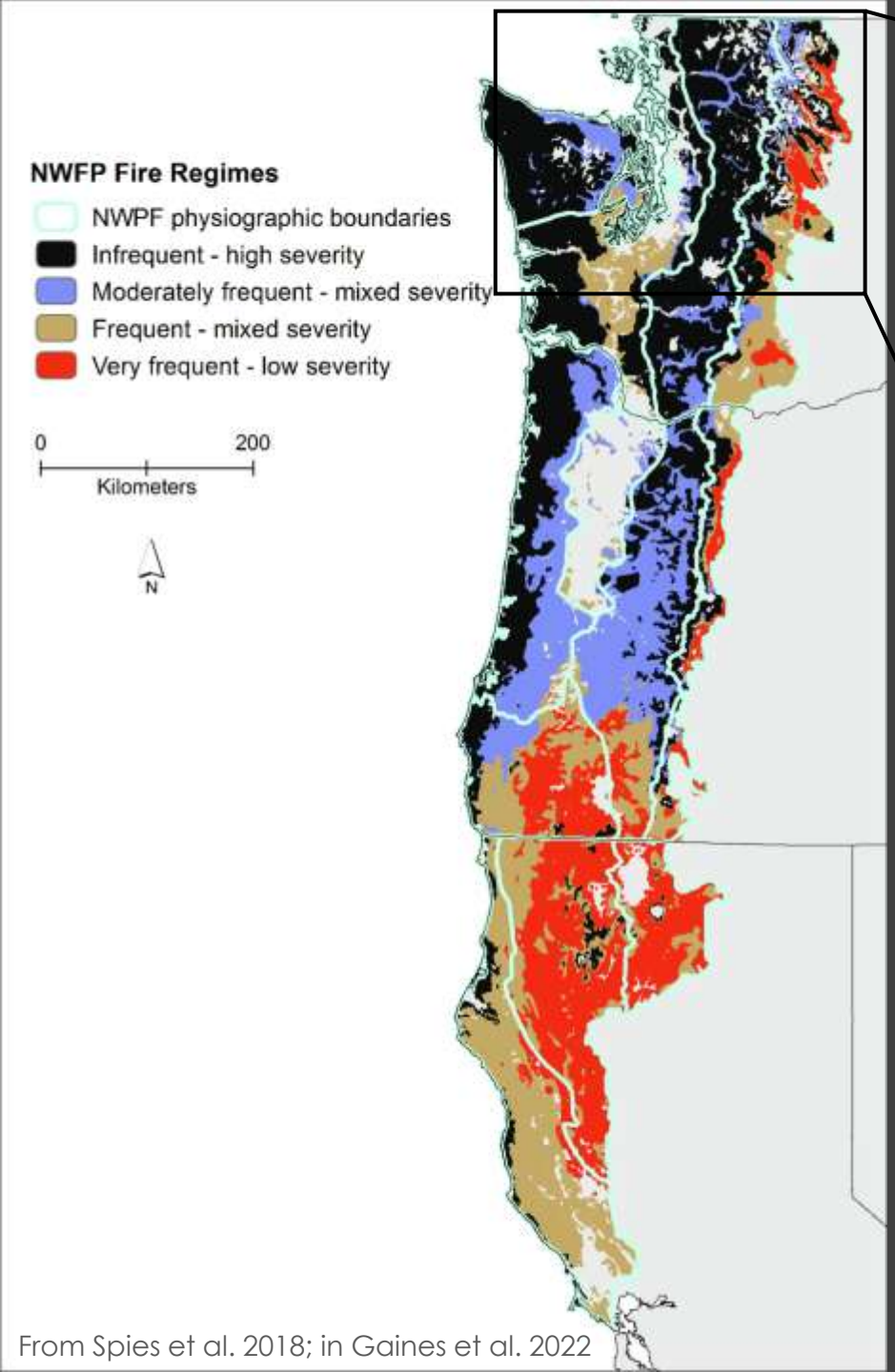
Thirty years of landscape change in the Washington East Cascades

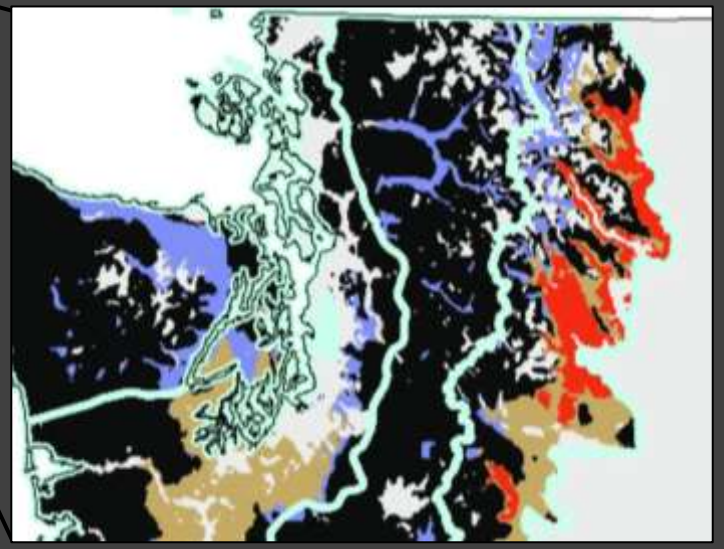
Kerry Kemp, John Marshall, Paul Hessburg, Derek Churchill, Garrett Meigs, Gina Cova, Susan Prichard



Reburned patches of the 1988 Dinkelman Fire footprint within the 2025 Lower Sugarloaf Fire, Okanogan-Wenatchee National Forest © Kerry Kemp, 2025

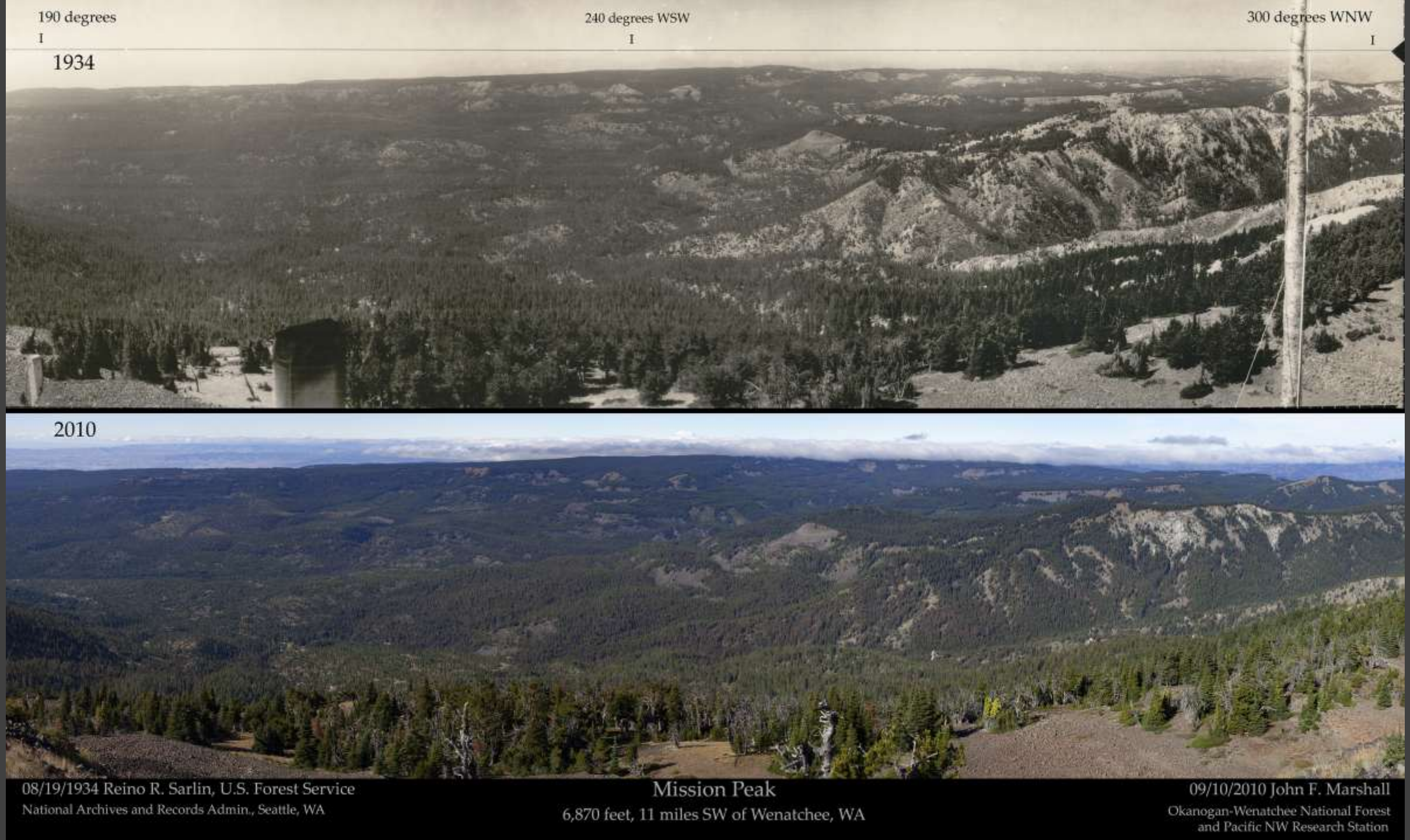


From Spies et al. 2018; in Gaines et al. 2022



- Wildfire **was** and **is** an incredibly important process for structuring vegetation communities east of the Cascade Crest
- Historically frequent mixed or low severity for much of East Cascade's forests, less frequent at high elevations or in moister forest settings
- Vegetation communities composed of a variety of species that are well adapted to or tolerant of fire

West of Blewett Pass (top) and Carne Mountain (bottom); Okanogan-Wenatchee National Forest © Kerry Kemp, 2023

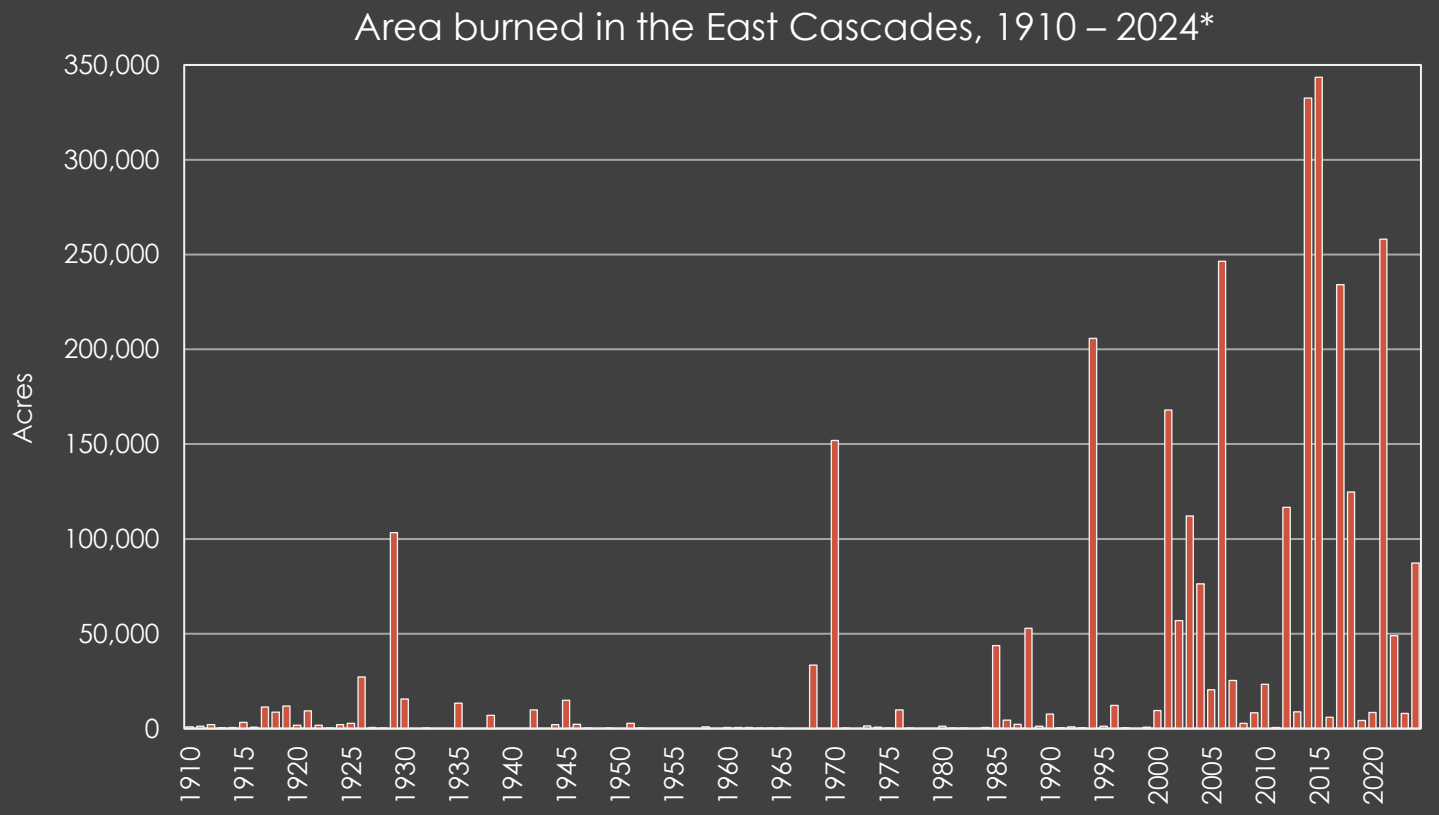


08/19/1934 Reino R. Sarlin, U.S. Forest Service
National Archives and Records Admin., Seattle, WA

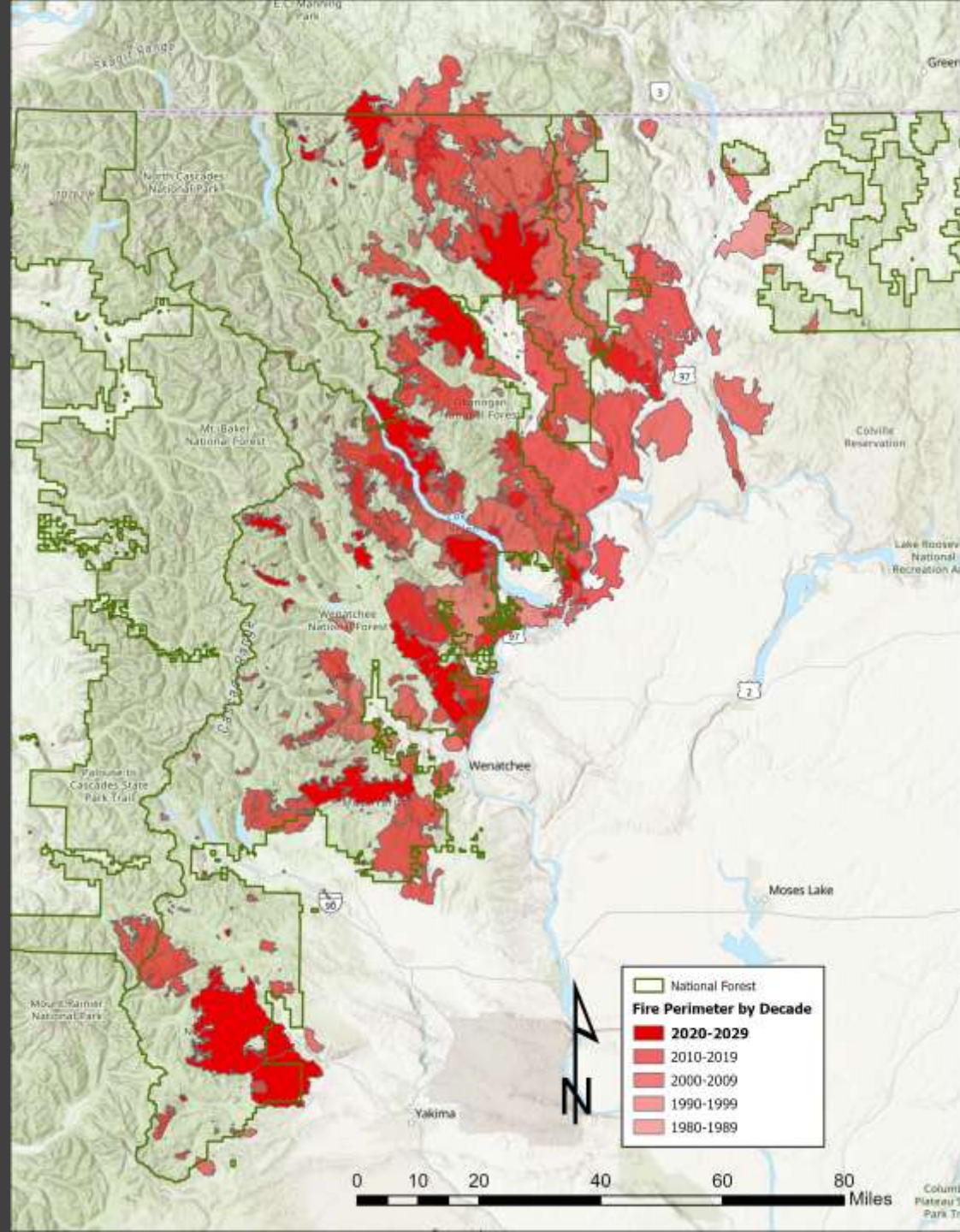
Mission Peak
6,870 feet, 11 miles SW of Wenatchee, WA

09/10/2010 John F. Marshall
Okanogan-Wenatchee National Forest
and Pacific NW Research Station

- Fire resurgence in East Cascades forest ecosystems over last 30 years
- Restructuring landscapes and vegetation communities in real time

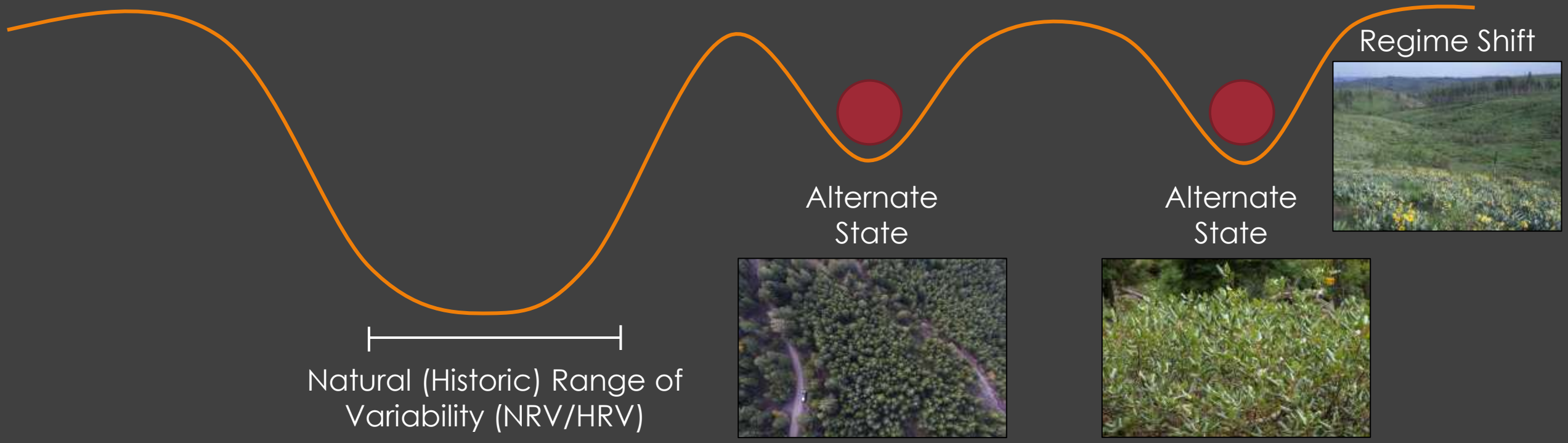


*Data from USFS fire perimeter database for the Okanogan-Wenatchee National Forest. Accuracy declines through time, especially before 1970.



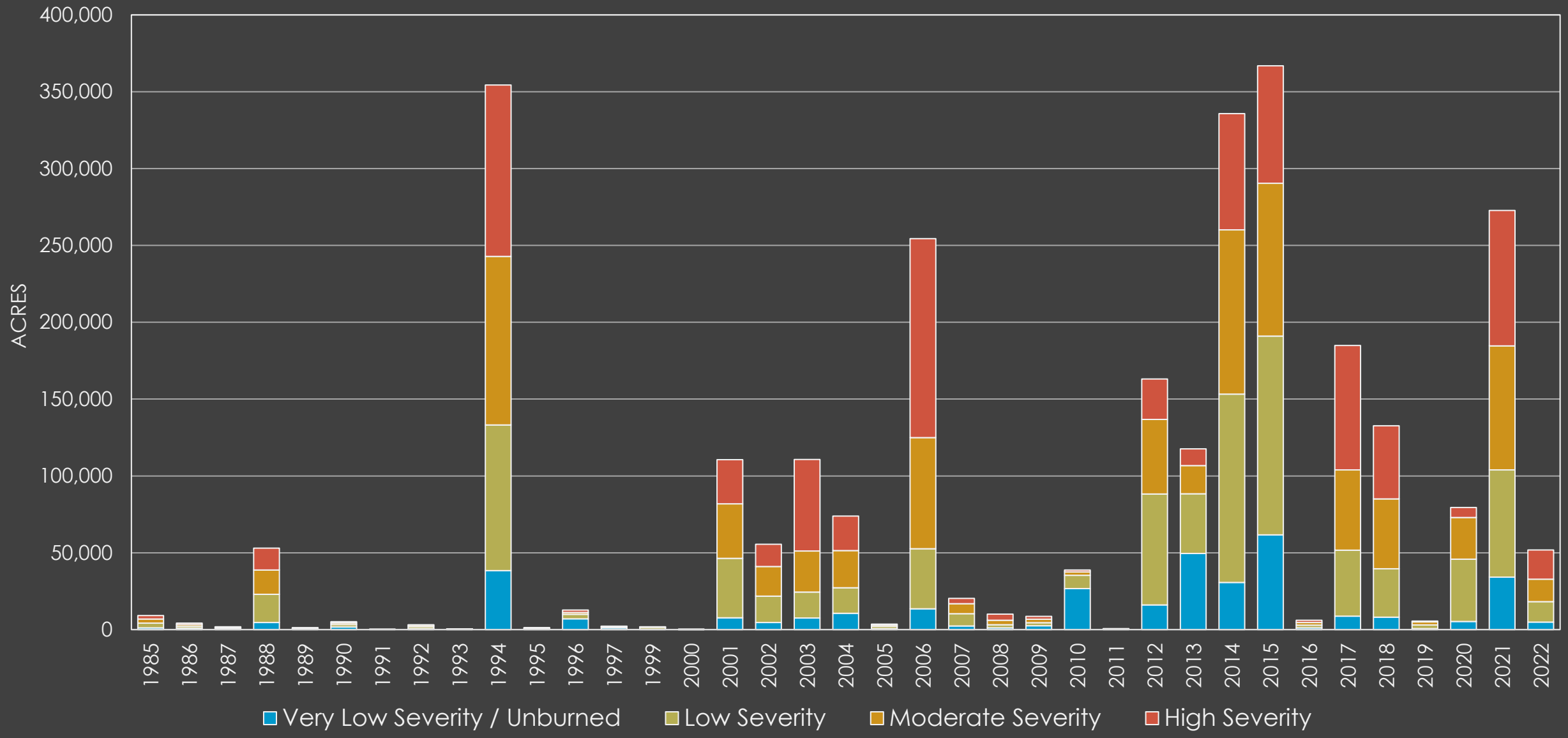
Forest landscape resilience: ball and cup model

Repeated or high severity fire, or climate change, causes a regime shift (e.g., forest to non-forest)

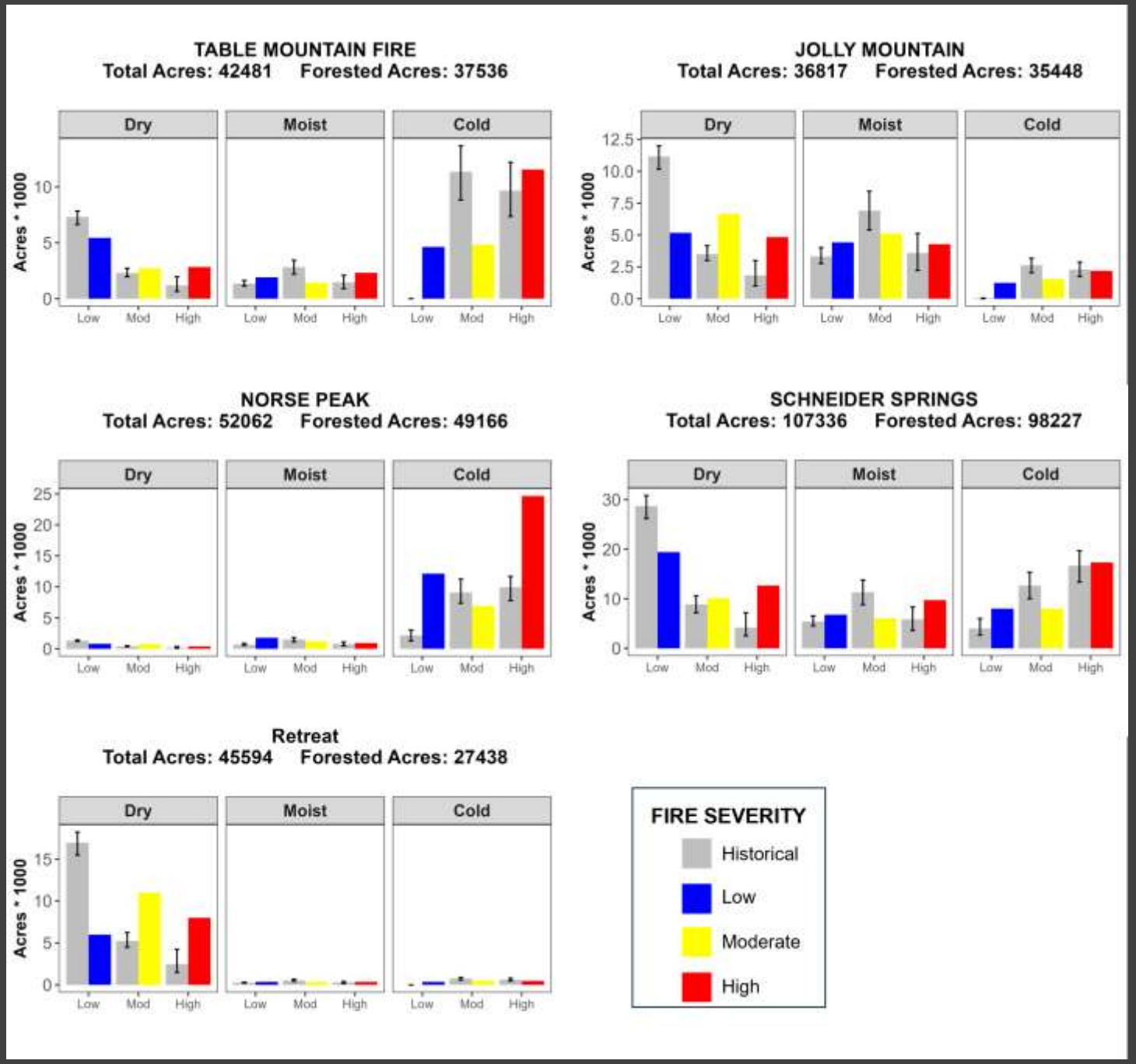


Fire moves landscapes closer towards to its natural range of variability or towards an alternate state

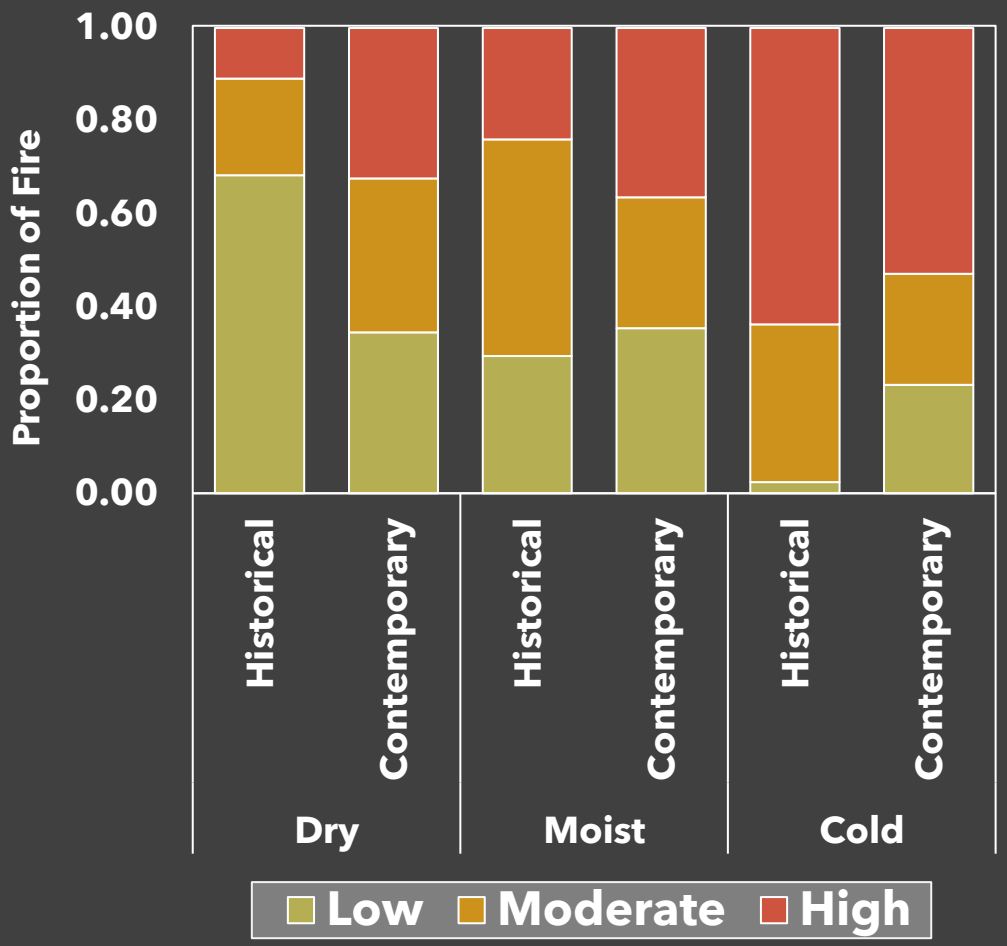
Area burned by severity class in the East Cascades, 1985 – 2022*



*Data from Cova et al. 2025 *Forest Ecology and Management* 598:123262; fires within the Northwest Forest Plan area only



Between 60 – 70% of 3X as much high severity fire contemporary fires are good compared to historically "first (or re-)entry" wildfire



Data from Donato et al. 2023 *Forest Ecology and Management* 546:121372 (constrained to OWNF); WA DNR (for Tapash 15-year CFLRP Monitoring Report)

1994 Tyee Fire (Site MA-4-1)

1994

1995

2000

2007

2024

1994 Rat Hatchery Complex Fire (Site B-5)

1994

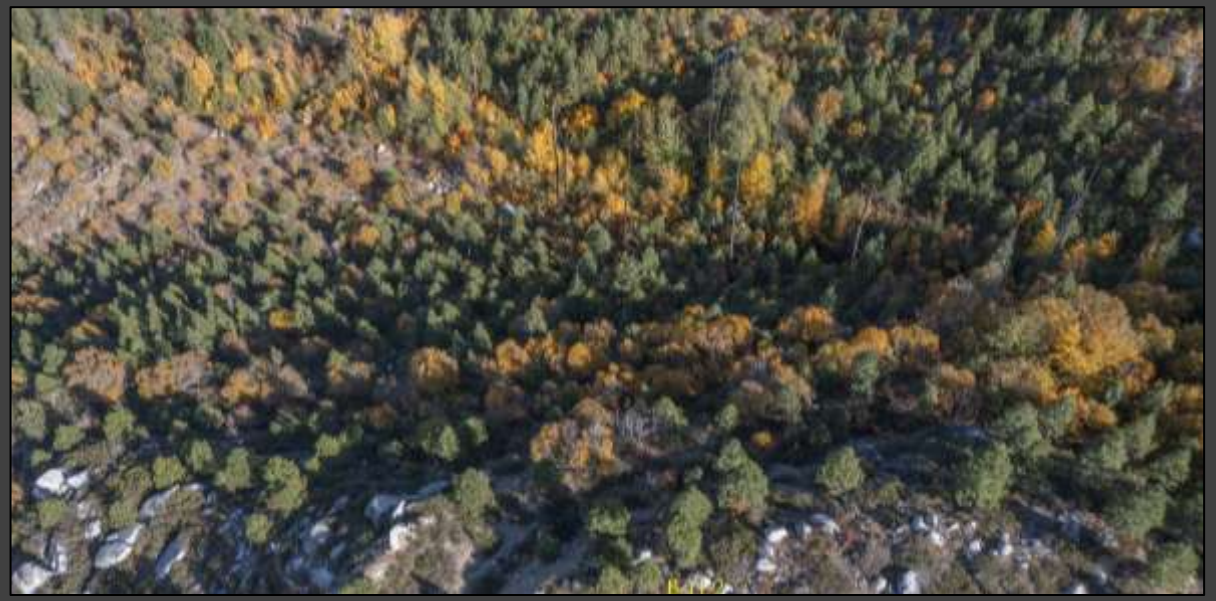
1995

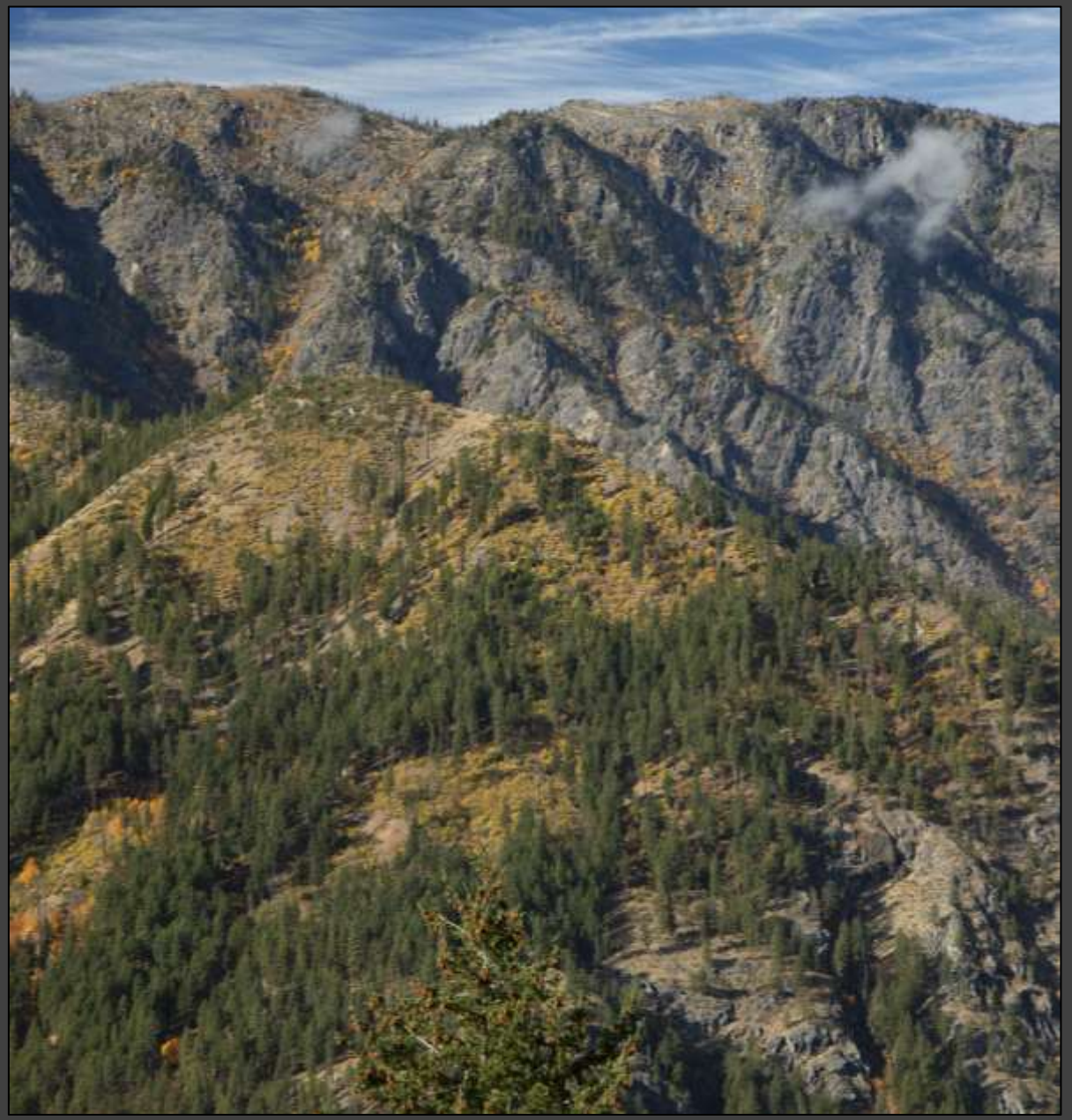
2000

2010

2024

Photo series created by John Marshall





Thirty years after the 1994 Rat Hatchery Creek Complex Fire burned 42,170 acres outside Leavenworth, WA, the patchiness of burn severity patterns and hardwood dominance persist. Photo credit: John Marshall, 2024

2009

2025

Large wildfires, like the 2006 Tripod Fire fire that burned around Rogers Lake northeast of Winthrop, WA, can help restore water availability in wetlands, riparian areas and wet meadows. © John Marshall, 2025

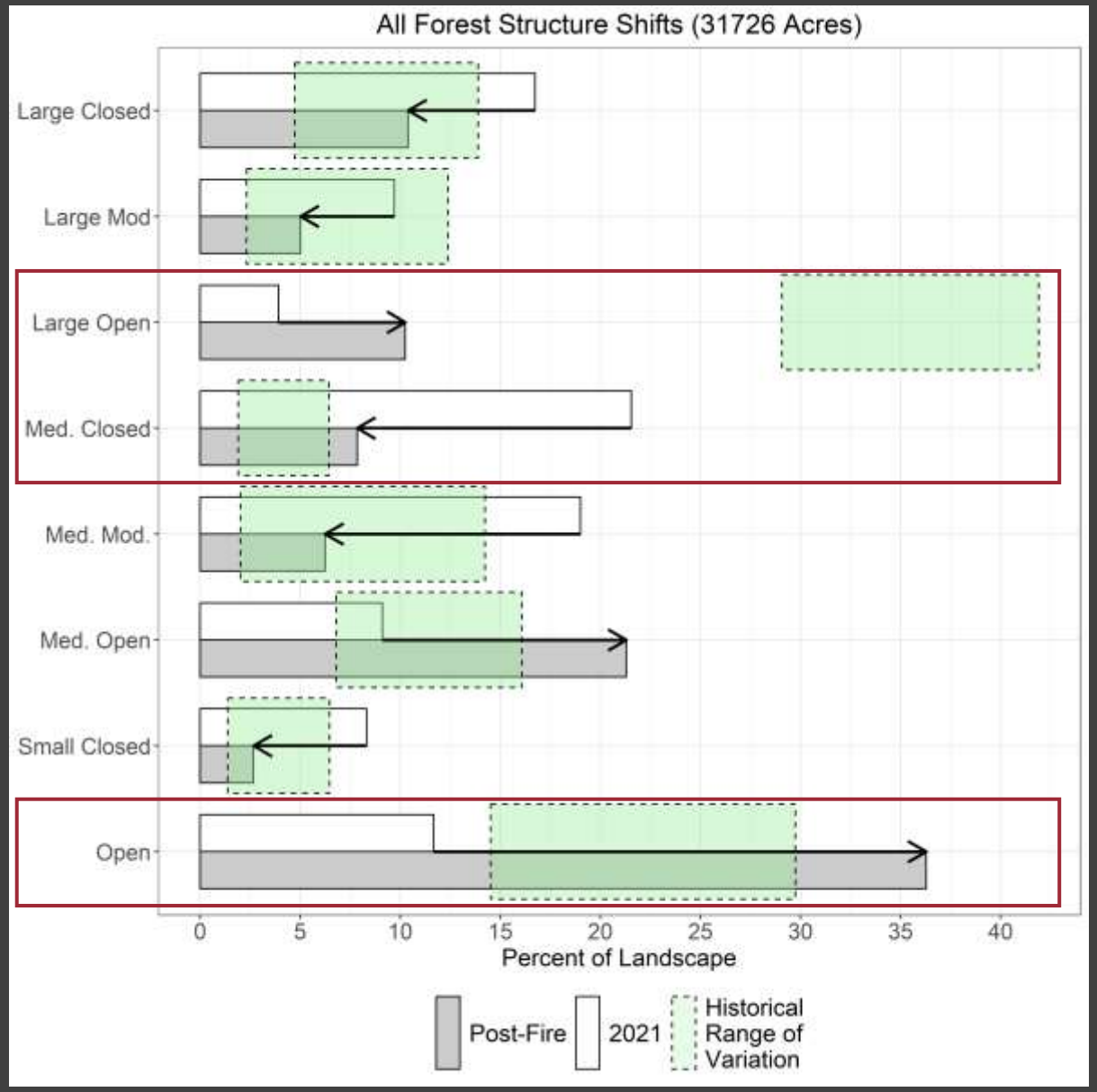
Patchwork of non-forested vegetation important for creating and maintaining resilience to disturbance over time and space…

Northern Cascade Mountains Province

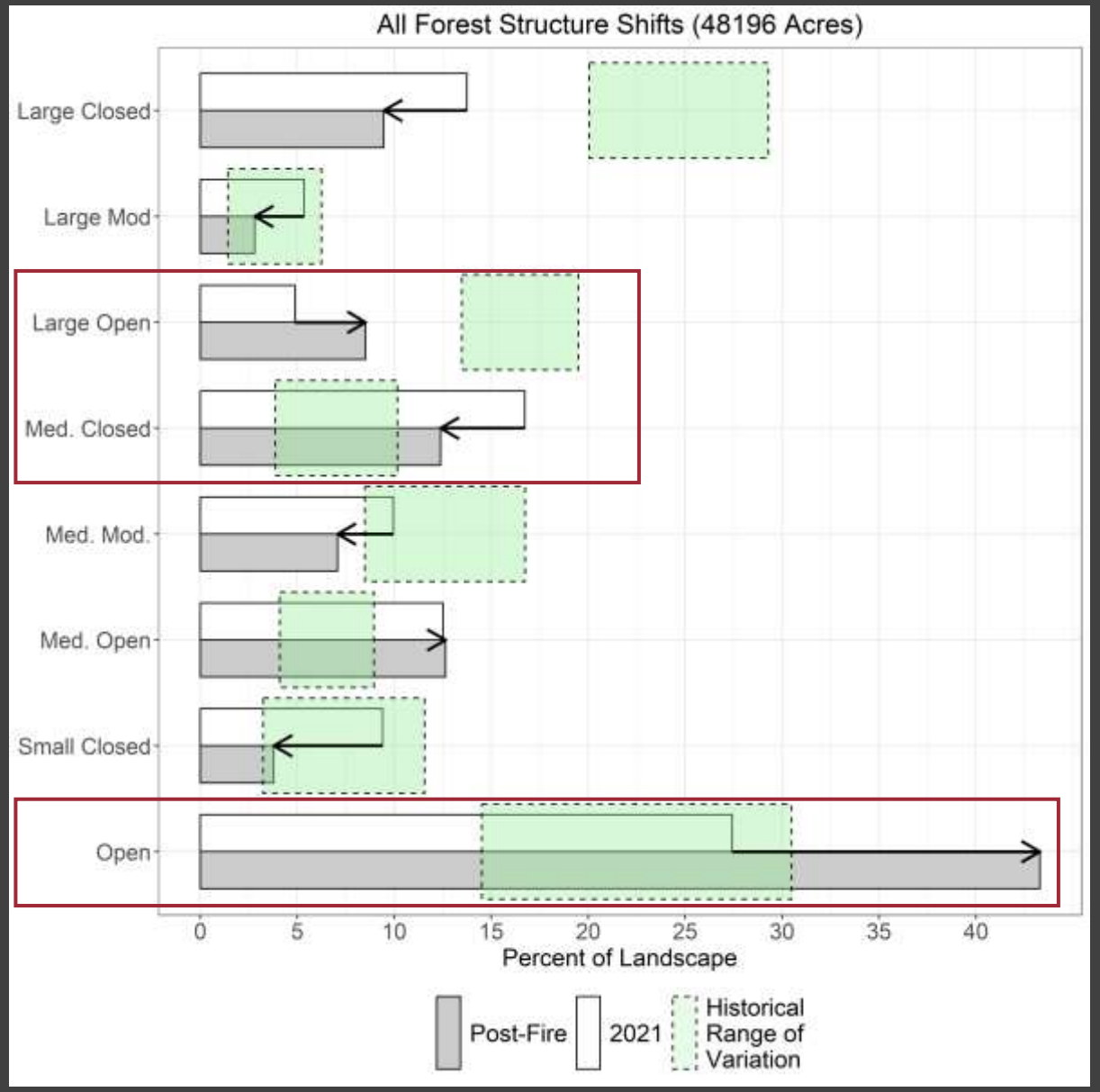
	Ponderosa Pine	Dry Mixed Conifer	Moist Mixed Conifer	Dry Cold Forests	Moist Cold Forests	Other Forest PVGs	Herb/ Shrub	Non-Veg	% of Province
Non-forest or early seral	82.1	27.9	19.8	43.9	36.0	27.5	99.9	99.4	41.8
Mid – late seral	17.9	72.1	80.2	56.1	64.0	72.5	0.1	0.6	58.2
% of province	1.8	10.4	24.3	3.0	14.9	27.0	12.8	5.8	100.0

From Hessburg et al. 2019 *Frontiers in Ecology and Evolution* 7: 239.

Shifts in structural departure from wildfire

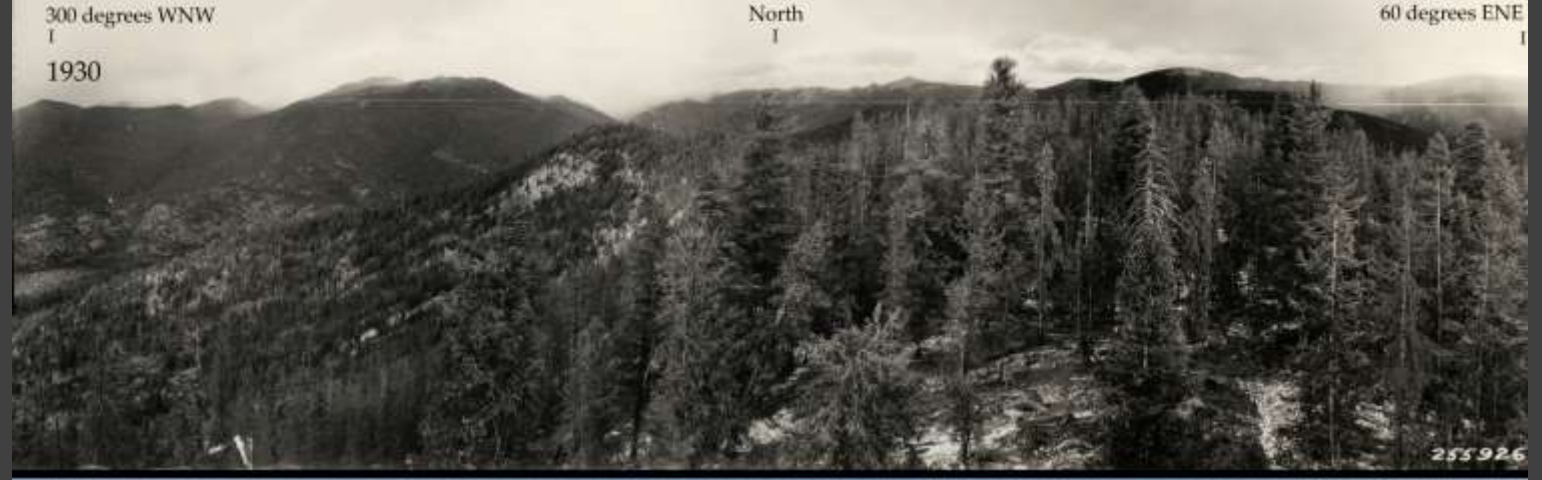


2024 Retreat Fire



2024 Pioneer Fire

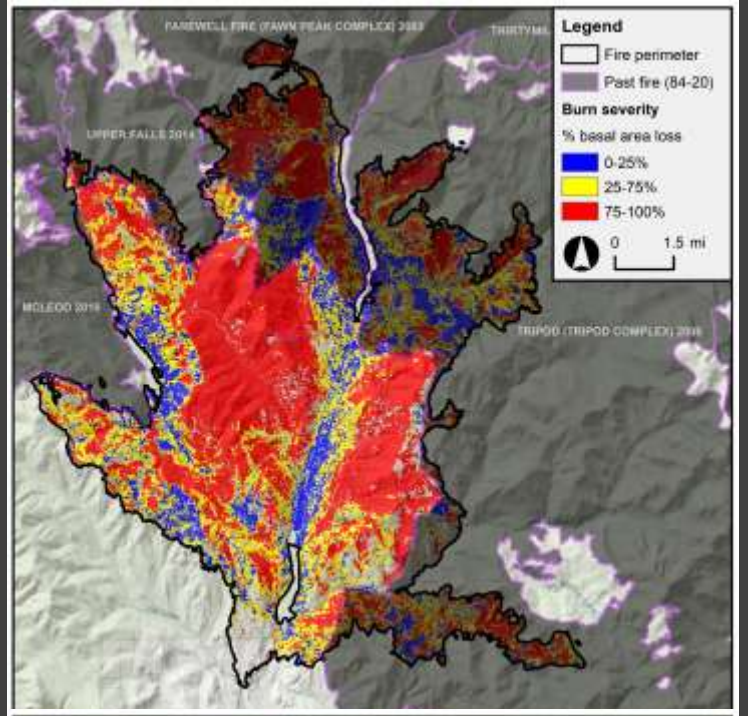
Data from DNR 2024 Work of Wildfire Report (https://dnr.wa.gov/forest-resilience-digital-library)

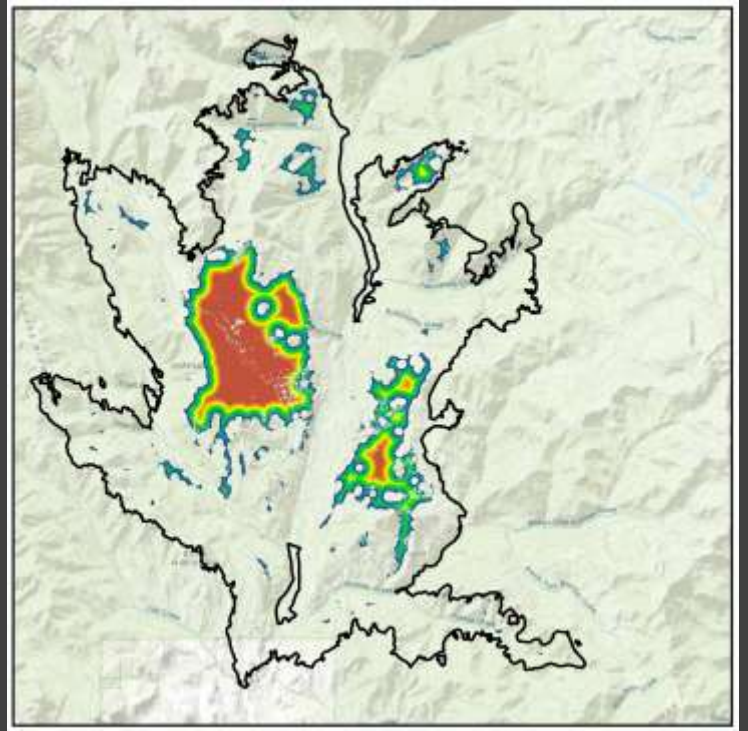


10/19/1930 William B. Osborne, U.S. Forest Service
National Archives and Records Admin., Seattle, WA

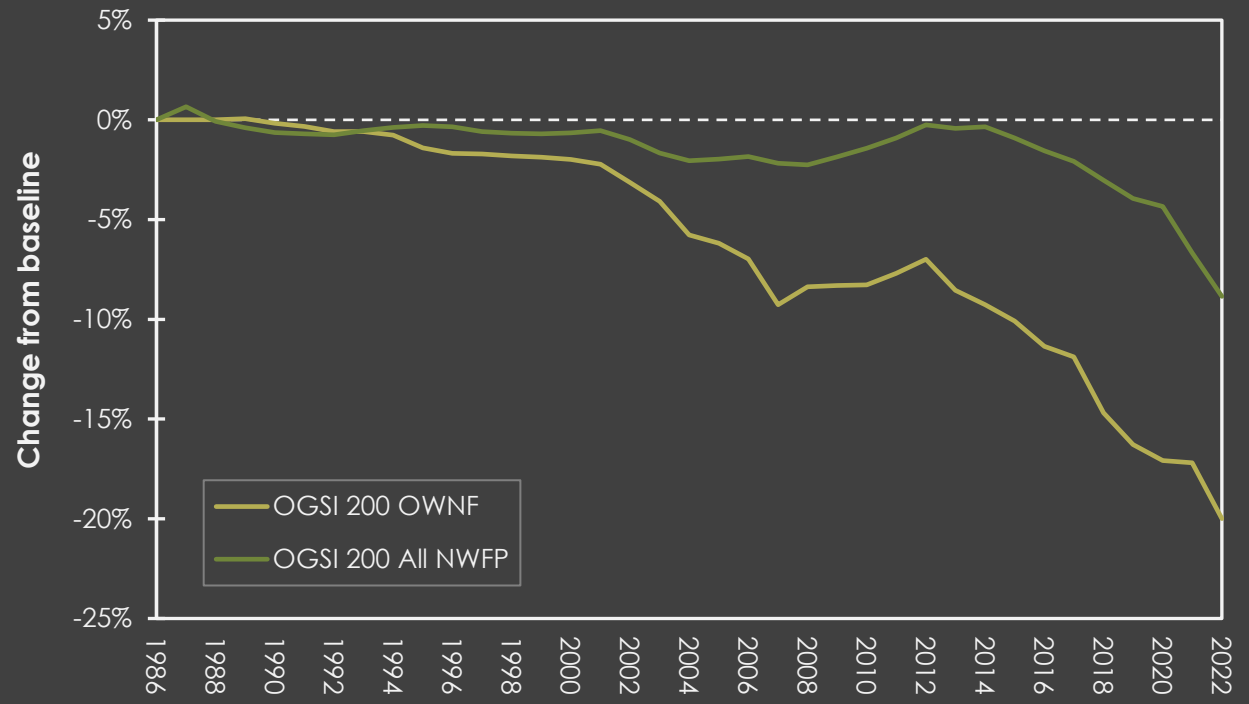
First Butte
5,491 feet, 10 miles NNE of Winthrop, WA

08/06/2011 and 09/19/2024. J.F. Marshall
Okanogan-Wenatchee National Forest
and Pacific NW Research Station





- Large high severity patches may lack conifer seedling regeneration. In dry, trailing edge forests, fire may facilitate ecological transformation towards a non-forest state (Meigs et al. 2022). In high elevation forests, fire can synchronize regeneration of species with serotinous cones.
- High severity fire is facilitating loss of large mature and old forest structure – greater loss observed on the Okanogan-Wenatchee NF than any other forest in the PNW (Aparício et al. 2026)



Data pulled from: https://usfs.earthengine.app/view/r06-nwfp-ogsi-trend-view
Data credit: Ray Davis, USDA Forest Service, PNW Research Station

1994

1996

2007

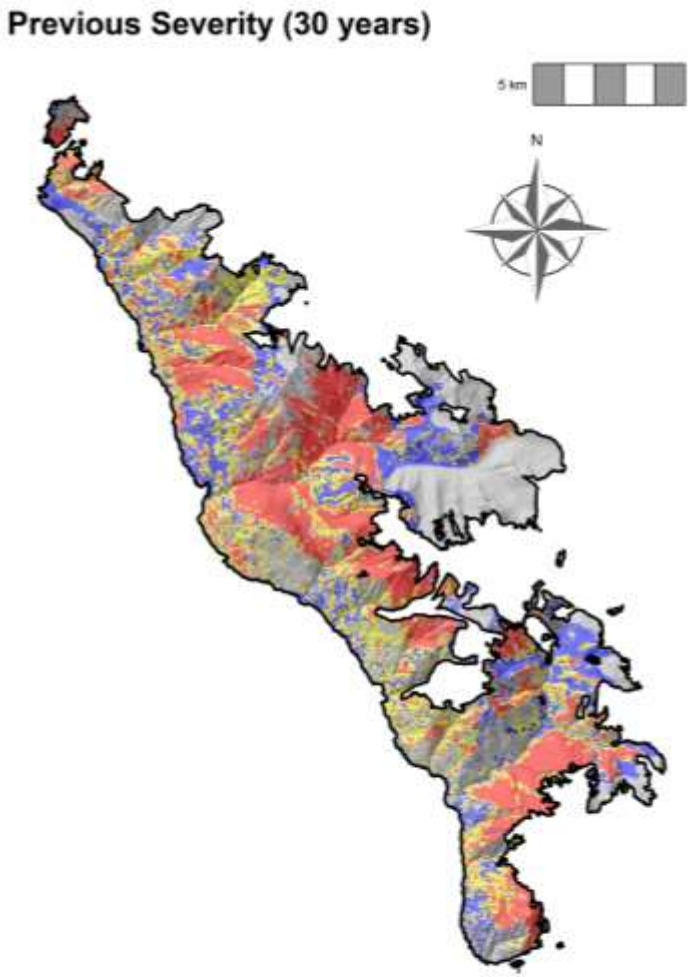
2019

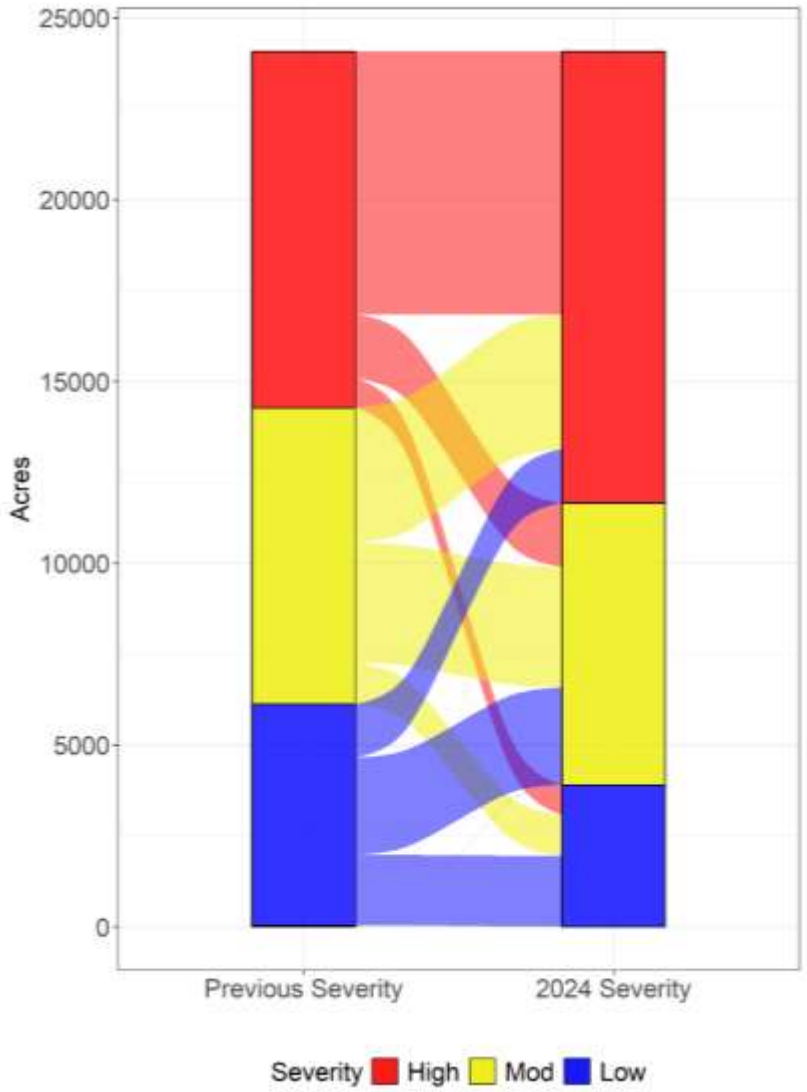
Tyee Fire, Site SB-17-1, photo series created by John Marshall

Reburning perpetuates vegetation change and high severity fire…

Reburned area of the 2012 First Creek Fire within the 1994 Tyee Fire footprint © John Marshall, 2013

Reburned area of the 2025 Lower Sugarloaf within the 1988 Dinkelman Fire footprint © John Marshall, 2025





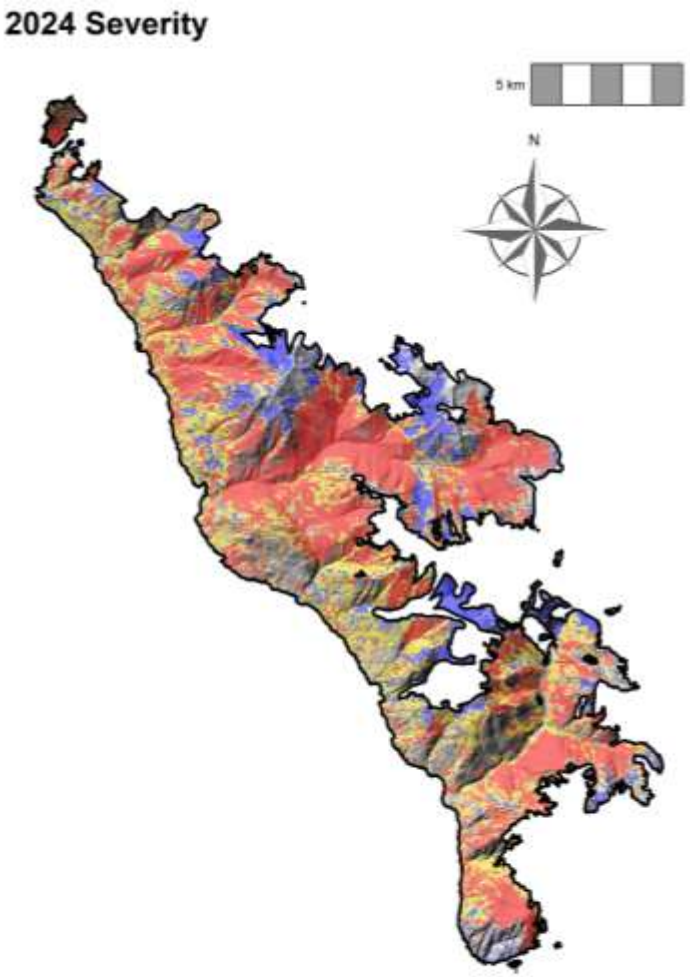
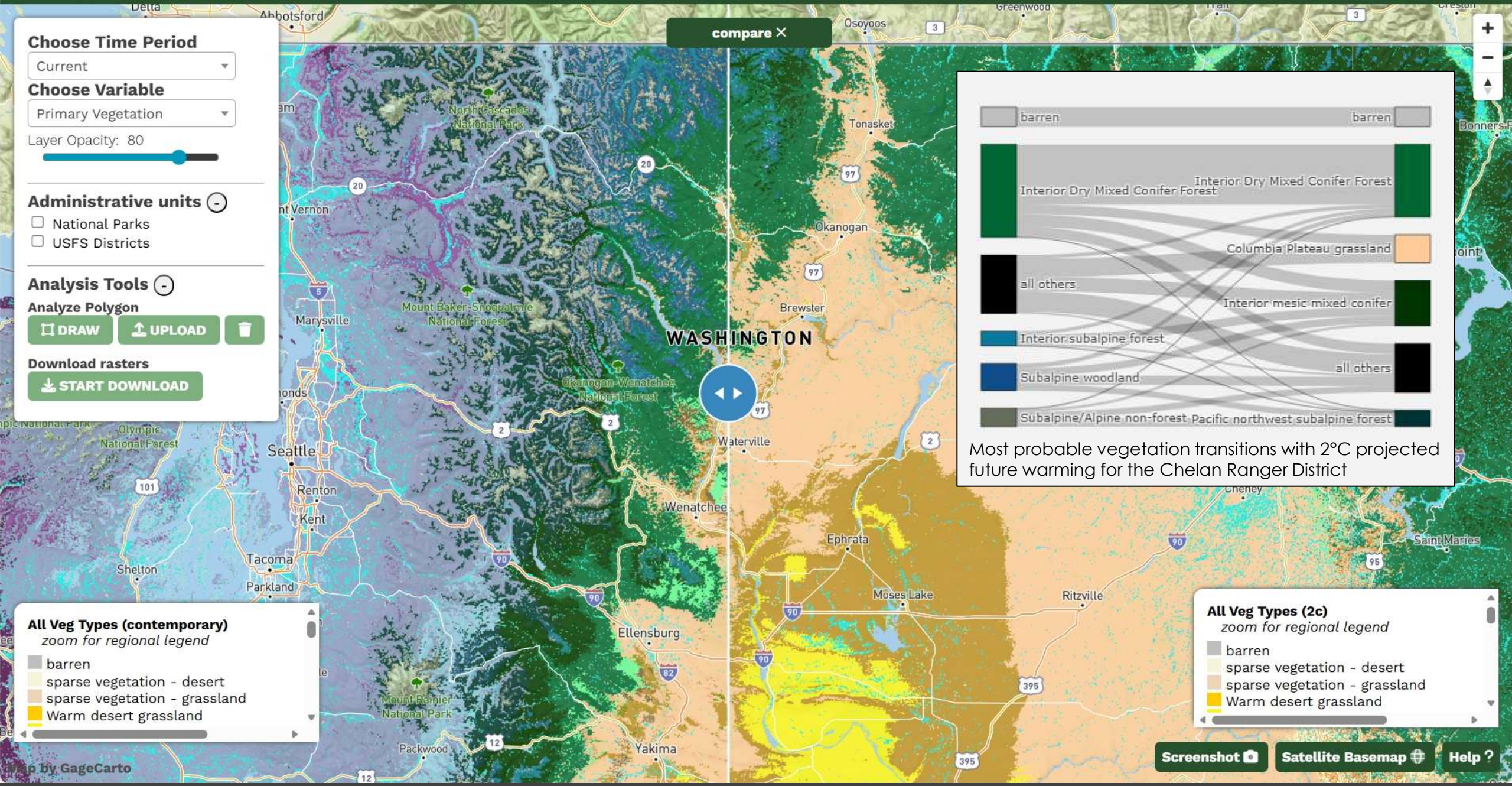


Image and data from DNR 2024 Work of Wildfire Report (https://dnr.wa.gov/forest-resilience-digital-library)

Vegetation Futures Tool



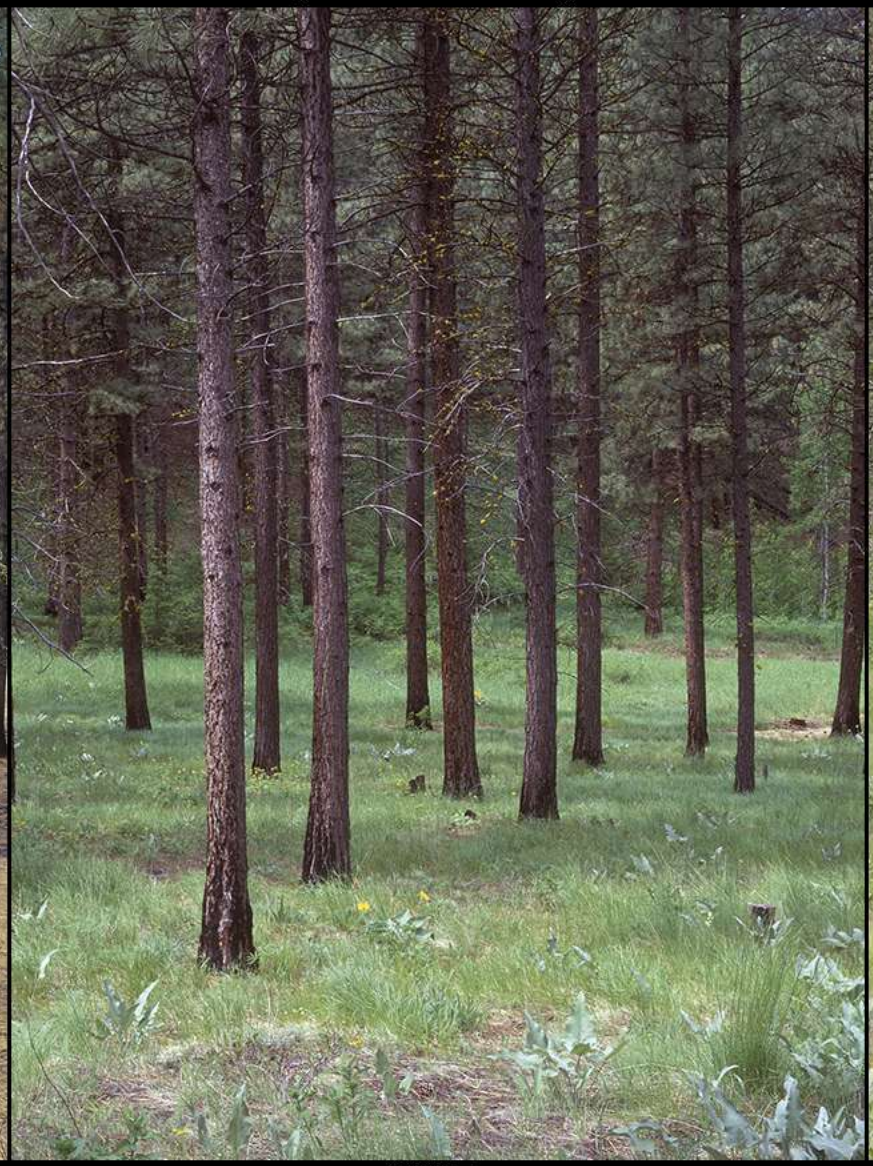
Data pulled from vegetationfutures.org; Hoecker et al. 2026 *Global Change Biology* (in press)

Photo Point Site PAL-3-1, Palmich Canyon in Mud Creek drainage of Entiat Ranger District.

J.F. Marshall supported by
U.S. Forest Service

1994

Ponderosa pine stand after Tyee Fire
Prior to wildfire, stand was thinned and slash was hauled off-site for industrial use.



2007

Ground cover dominated by blue-bunch wheat grass and pine grass.

2024

Prescribed Fire in 2021?

Moving forward:

- Anchor off existing fires to design and implement projects
- Maintain the beneficial work that fire has started for us
- Use existing “black” to expand fire footprints when weather conditions are favorable

Prescribed burn at Sinlahekin Wildlife Area © John Marshall

Summary…

- Seeing convergence and divergence from NRV in contemporary fires
- Low and moderate severity fire (and in some cases high severity fire) can restore structural conditions, diverse vegetation communities, and patch structure that becomes self-reinforcing
- Large high severity patches and reburns (especially high-high severity combinations) are catalyzing rapid shifts towards alternative vegetation states and degrading rare and important structural conditions (e.g., large, old trees) on the landscape.
- Persistence of alternative vegetation states may be a function of tolerance to shifting climate conditions and reburn likelihood
- Active management should focus on using fire footprints to maintain future resilience

Questions?

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Thank you to my collaborators:
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Gina Cova, Research Scientist, University of Washington
Kim Davis, Research Ecologist, US Forest Service, Rocky Mountain Research Station
Dan Donato, Natural Resource Scientist, Washington DNR
Josh Halofsky, Natural Resource Scientist, Washington DNR
Tyler Hoecker, Landscape Fire Scientist, Vibrant Plant
Paul Hessburg, Research Ecologist (Emeritus), US Forest Service, Pacific Northwest Research Station
Emily Leung, Ecologist, Okanogan-Wenatchee National Forest
Drew Lyons, Forest Health Scientist, Washington DNR
John Marshall, Photographer/Naturalist
Garrett Meigs, Forest Health Scientist, Washington DNR
Susan Prichard, Research Scientist, University of Washington

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