Exploring drivers of reburn potential in northwestern Cascadia, USA

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BACKGROUND

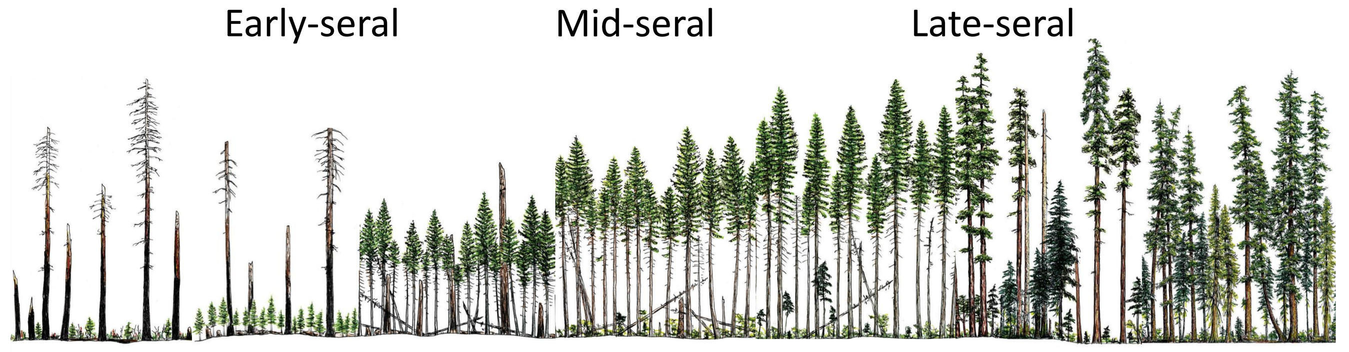
Critical insights on postfire fuel dynamics and drivers of reburn potential are missing in high-productivity systems that characteristically burn infrequently

- Moist conifer forests in the western Cascades of Washington and northern Oregon, USA ('northwestern Cascadia') are among the most productive in the world, and in many locations are characterized by large, infrequent (>200-yr fire return interval), stand-replacing fires that occur during warm and dry periods that coincide with strong east winds
- Historical evidence suggests these forests tend to reburn multiple times in the decades following a high severity fire, though underlying mechanisms are uncertain due to limited contemporary fire events
- Over 200,000 hectares have burned across northwestern Cascadia in the last decade, presenting an opportunity to fill this knowledge gap

QUESTIONS

(1) How do postfire fuel profiles vary across pre-fire stand age and burn severity?

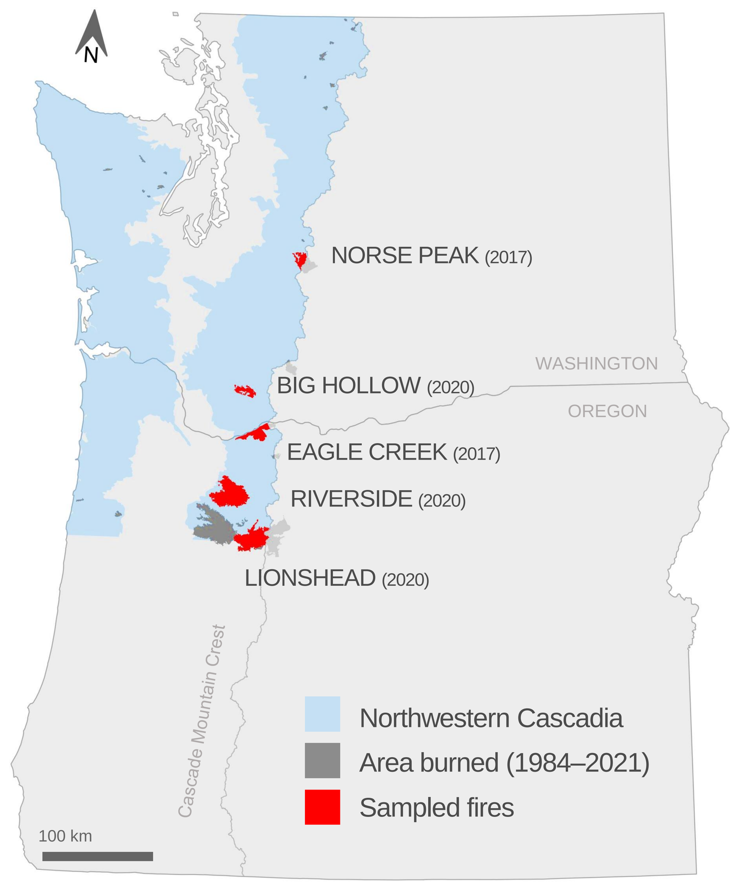
(2) How does fuel variability influence potential fire behavior?



Stand successional development over time since fire (yr). *Adapted from Van Pelt (2007).*

STUDY AREA & METHODS

- Measured surface and canopy fuels 2–5 postfire in 1-ha plots distributed across recent (2017–2020) fires in northwestern Cascadia (N = 95)
- Plots were stratified by pre-fire stand age and burn severity
- Fuel profiles were generated using regional allometric equations
- Compared fuel profiles across strata using generalized linear models



	unburned	low (≤30% mortality)	high (≥90% mortality)
late-seral	n = 14	n = 15	n = 19
mid-seral	n = 10	n = 9	n = 12
young	n = 7	na	n = 9

Left: Sampled fire perimeters (red) and area burned (gray) within northwestern Cascadia (blue). *Right*: Number of sampled 1-ha plots by pre-fire stand age and burn severity strata.

Pre-fire stand structural legacies drive variability in postfire fuel profiles and reburn potential in high-productivity systems with climate-limited fire regimes

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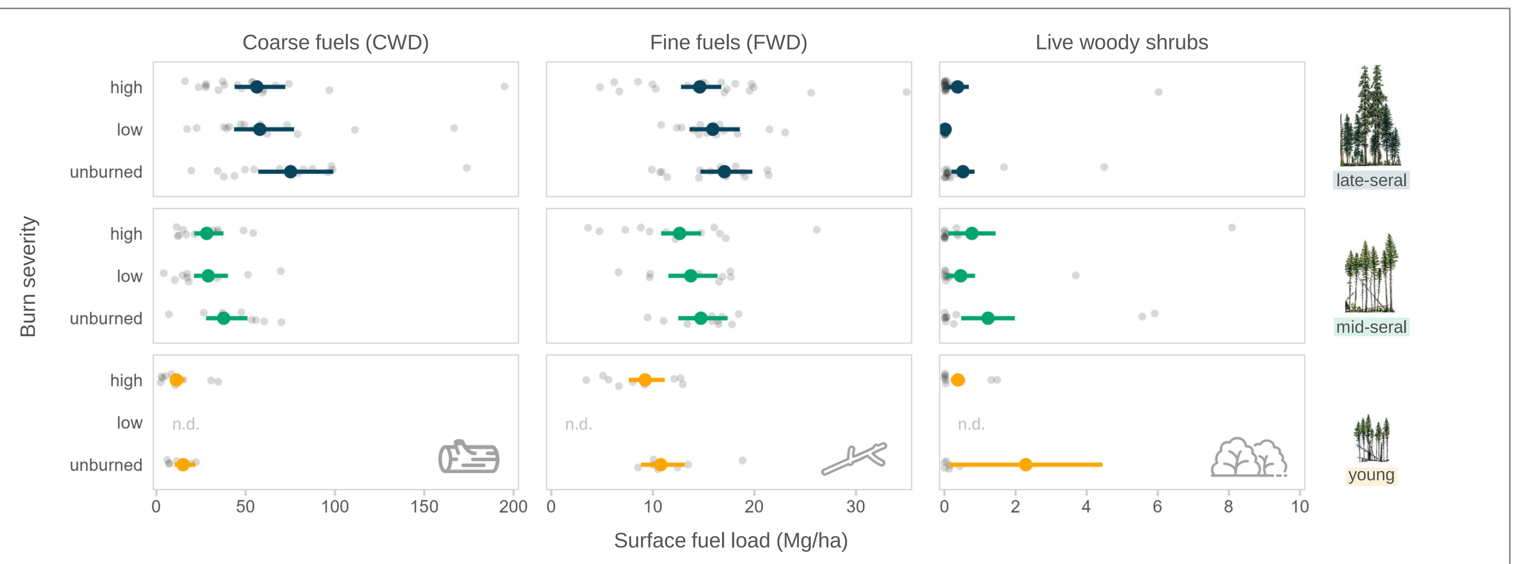
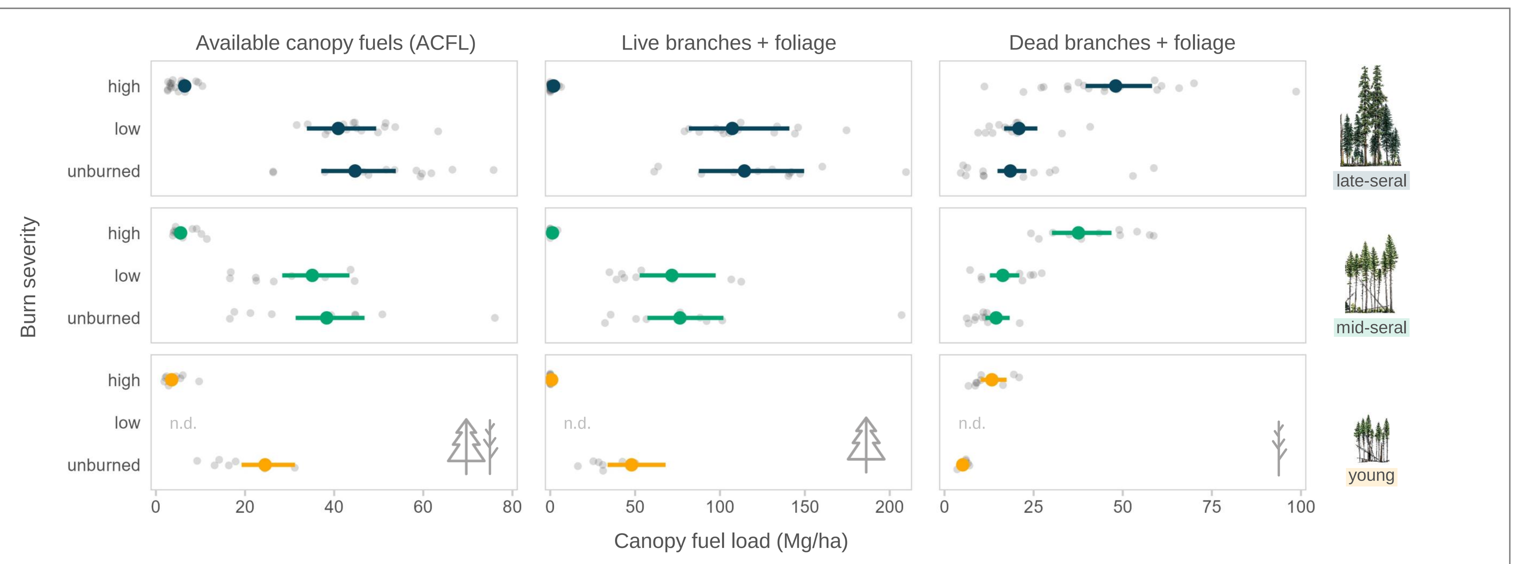
Left–right: Outcomes of stand-replacing fire in young, mid-, and late-seral pre-fire stands.

PRELIMINARY RESULTS

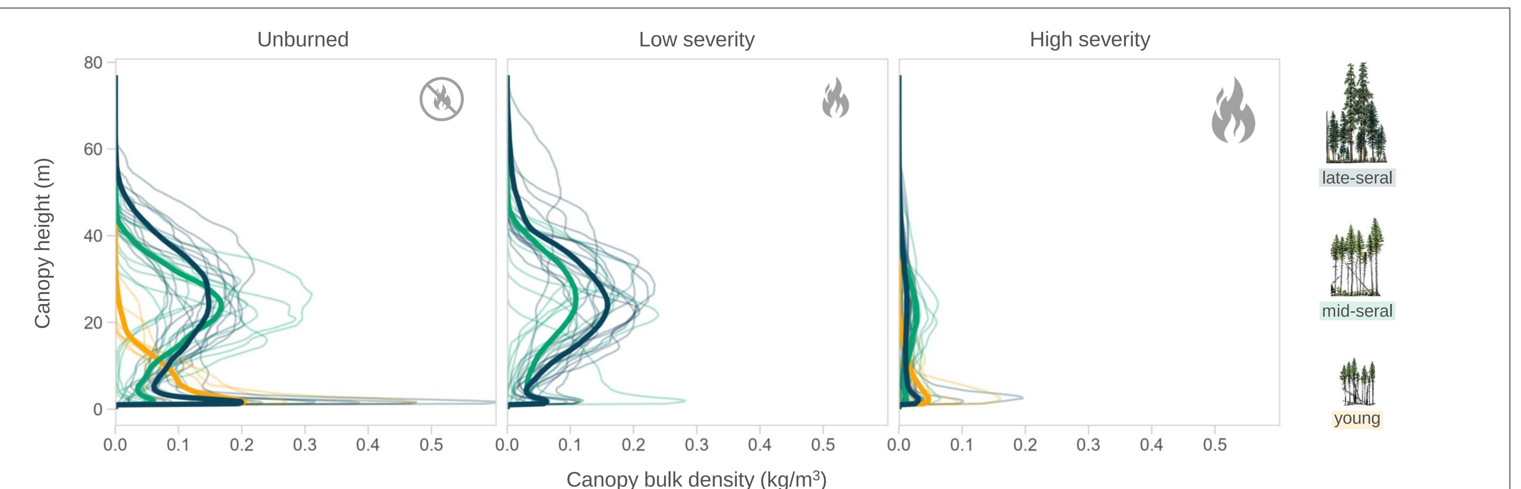
Results display model-predicted means (colored circles) and 95% confidence intervals across stand-level observations (gray points)



Dead surface fuels increased with pre-fire stand age and decreased with burn severity. **Live woody surface fuels** were least in low severity stands.



Canopy fuels increased with pre-fire stand age. **Total** and **live fuels** decreased—and **dead fuels** increased—with burn severity.



Canopy bulk density increased in magnitude and height with pre-fire stand age. Vertical fuel profiles were similar in unburned and low severity stands.

IMPLICATIONS & FUTURE WORK

These findings (a) improve our understanding of drivers of reburn potential in climate-limited fire regimes and (b) will inform the development of management strategies for mitigating fire risk and promoting ecological, economic, and cultural values in northwestern Cascadia forests.

Future work will involve:

- Incorporating model covariates (eg, site conditions, distance to live edge)
- Modeling potential fire behavior across a range of fire weather conditions
- Simulating postfire stand trajectories under different management scenarios

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This work took place on lands stewarded since time immemorial by Indigenous peoples of the Northwest, including the Cascades, Clackamas, Stl'pulmsh (Cowlitz), dxʷdəwʔabš (Duwamish), Confederated Tribes of Grand Ronde, Qwû'lh-hwai-pûm (Klickitat), Molalla, bəqəlšuɬ (Muckleshoot), spuyaləpabš (Puyallup), Confederated Tribes of Siletz Indians, dxʷsəq̓ʷəbš (Suquamish), Tenino, dxʷlilap (Tulalip), Confederated Tribes of Warm Springs, and Confederated Tribes and Bands of the Yakama Nation. This research was done in collaboration with the Washington Department of Natural Resources, US Forest Service, Tulalip Tribes, UW Climate Impacts Group, and National Park Service. Funding was provided by the McIntire-Stennis Cooperative Forestry Research Program, NW Climate Adaptation Science Center, USFS PNW Westside Fires Initiative, and Joint Fire Science Program. We thank our 2019–2022 field crews, Jerry F. Franklin, and the NW Fire Science Consortium for additional support.