Opportunities for Reducing Future Wildfire Emissions: Solutions for Western Interior US Forest Landscapes

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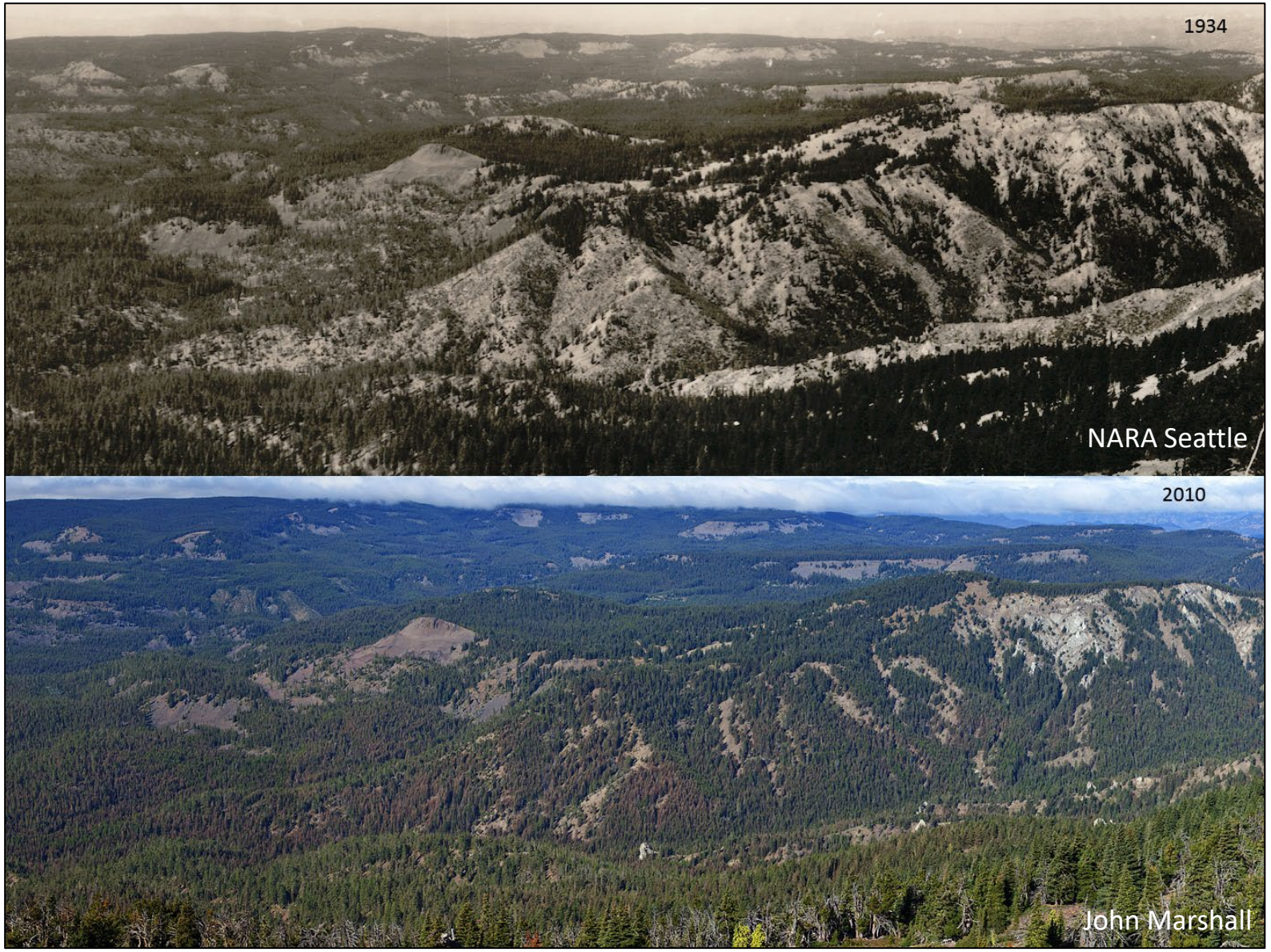
Context. Before the era of fire suppression

- Lightning + Indigenous ignitions created large areas of open forest, meadows, & sparse woodlands (nonforests) This went on for 10,000 yrs. (Lake and Christiansen 2020)
- Closed canopy forests minimized food & resource availability in understories, the focus of much burning (Roos et al. 2022, Swetnam et al. 2016)
- Absent fires, forests have grown denser & many nonforest areas are now forested (Hagmann et al. 2021)
- Indigenous & lightning fires also burned in moist and cold forests, fires --> moderate & high severity (Hessburg et al. 2019)
- Often, as much as 35-50% of a large landscape area was burned or recovering after fires (Hessburg et al. 2016, 2019)
- Large fire deficit, 18-34 MM ha historically burned each yr in the CONUS alone (Leenhouts 1998)

Credit: Frederick Remington (public domain)

Frequent fire
(2-15 yrs)
Dry forests



An important local stabilizing feedback

Frequent low- or moderate- severity fire…

…leads to more of the same forest condition and future fire severity

(Povak et al. 2023, Prichard et al. 2017)

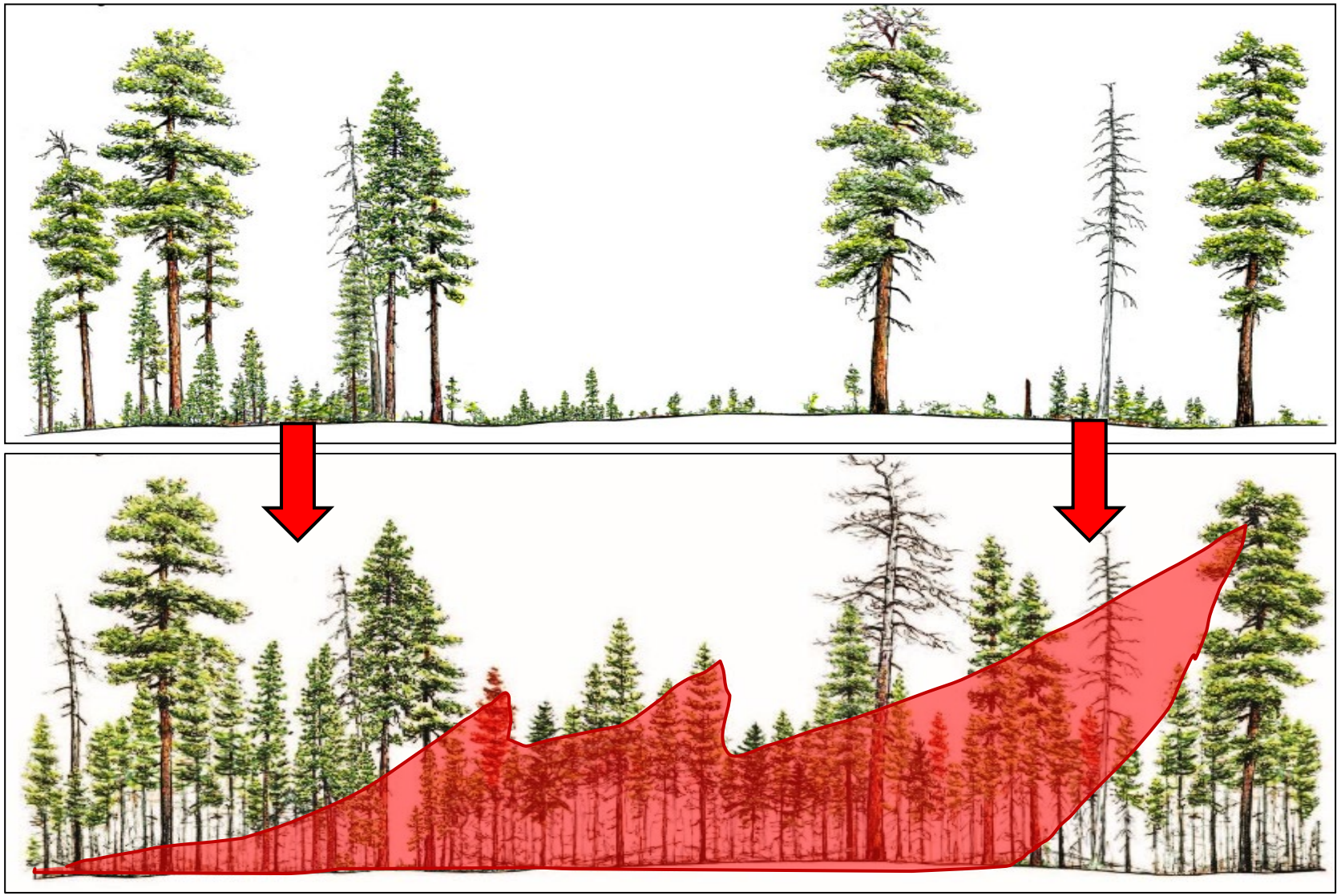
Bob Van Pelt drawing

Lacking these high frequency fires

Trees quickly accumulate

Flames can now *"climb"* the layered subcanopy

Resulting in crown fires

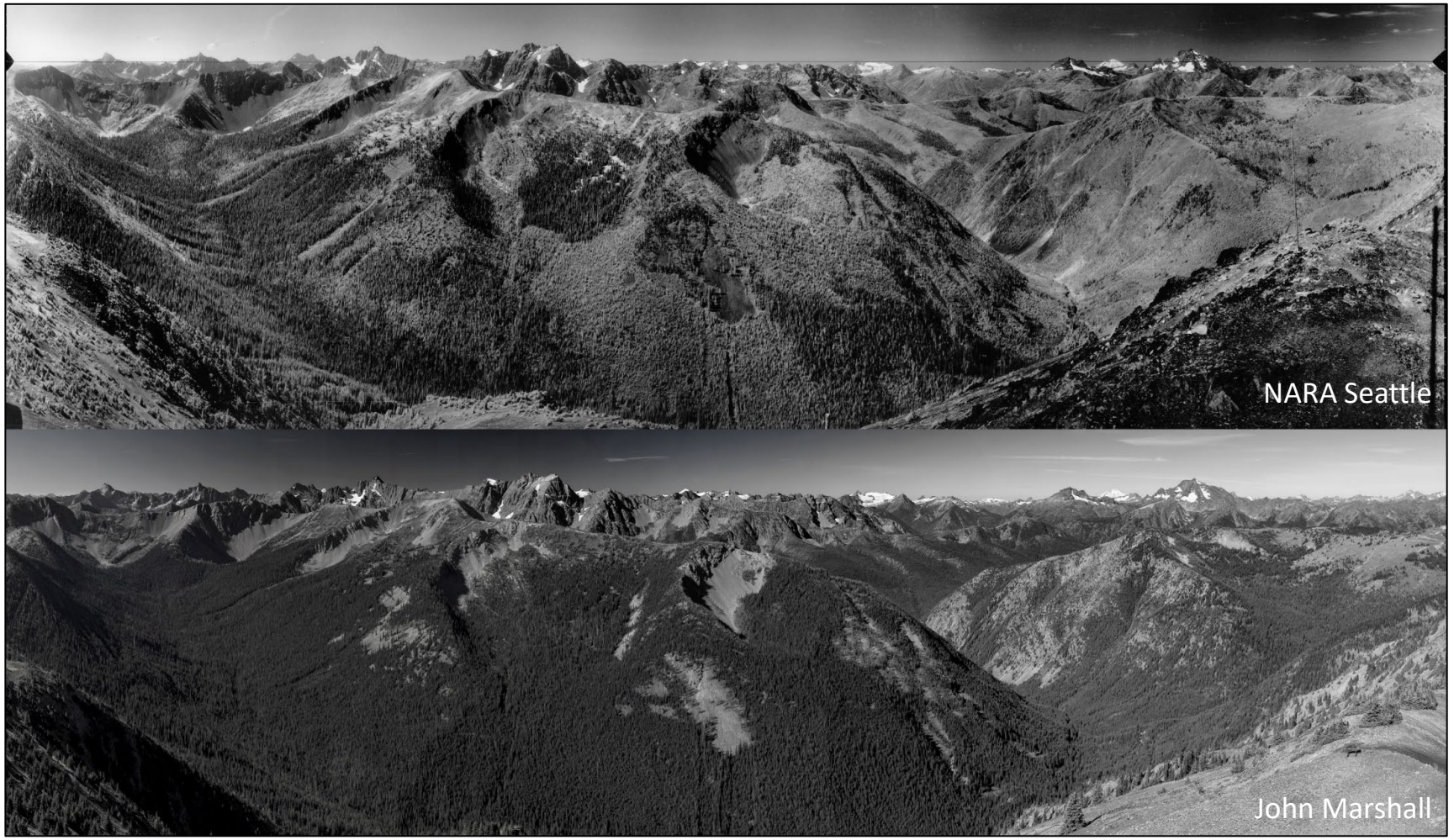


Bob Van Pelt drawing

Moderate frequency fire
(20-50 yrs)
Moist forests

Infrequent fire
(30-150 yrs)
Cold forests

Fuel provides the energy for burn severity

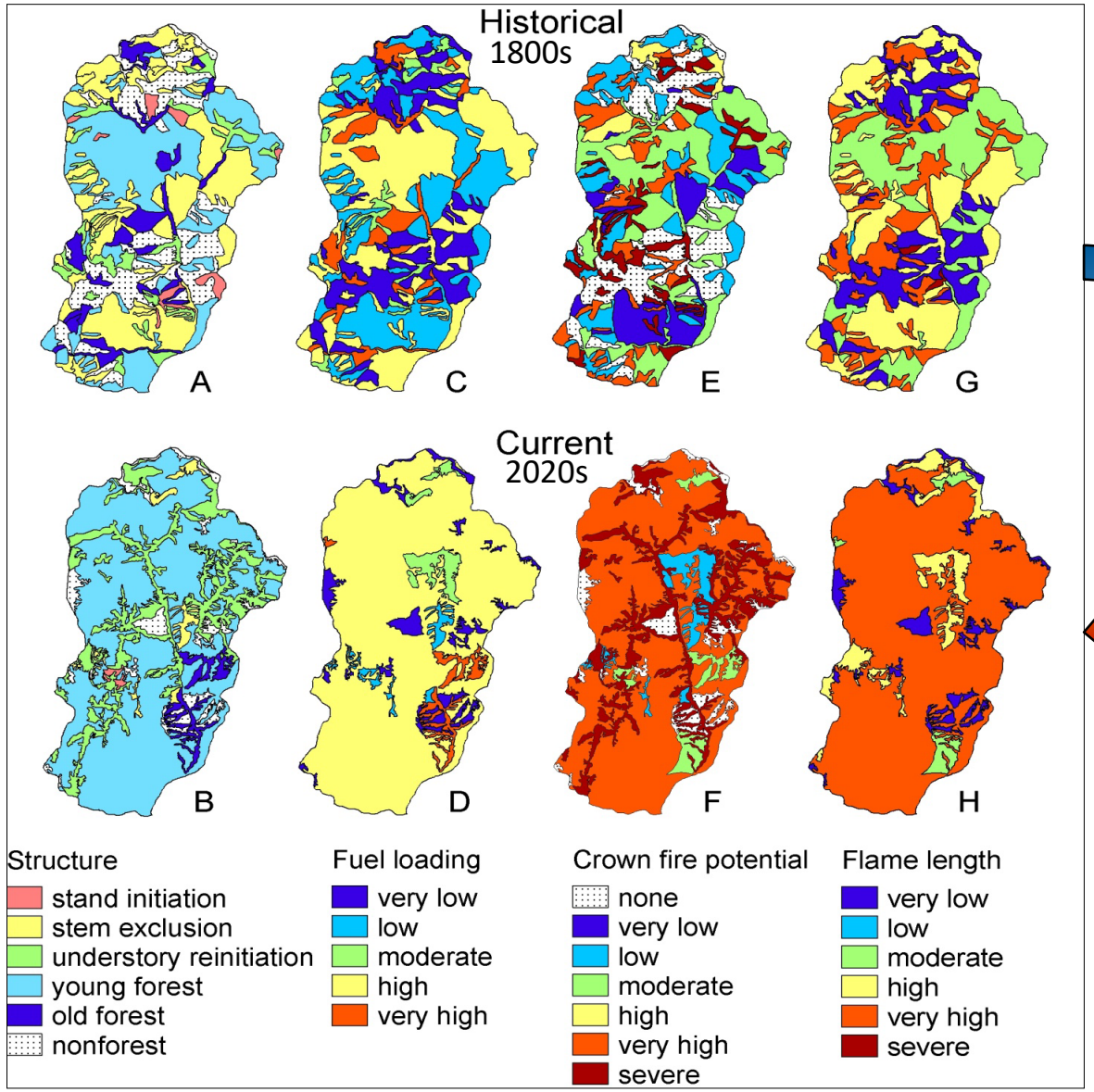


High connectivity of dense forest provides the means for large, severe fires

Forest Reburning: An essential large landscape stabilizing feedback

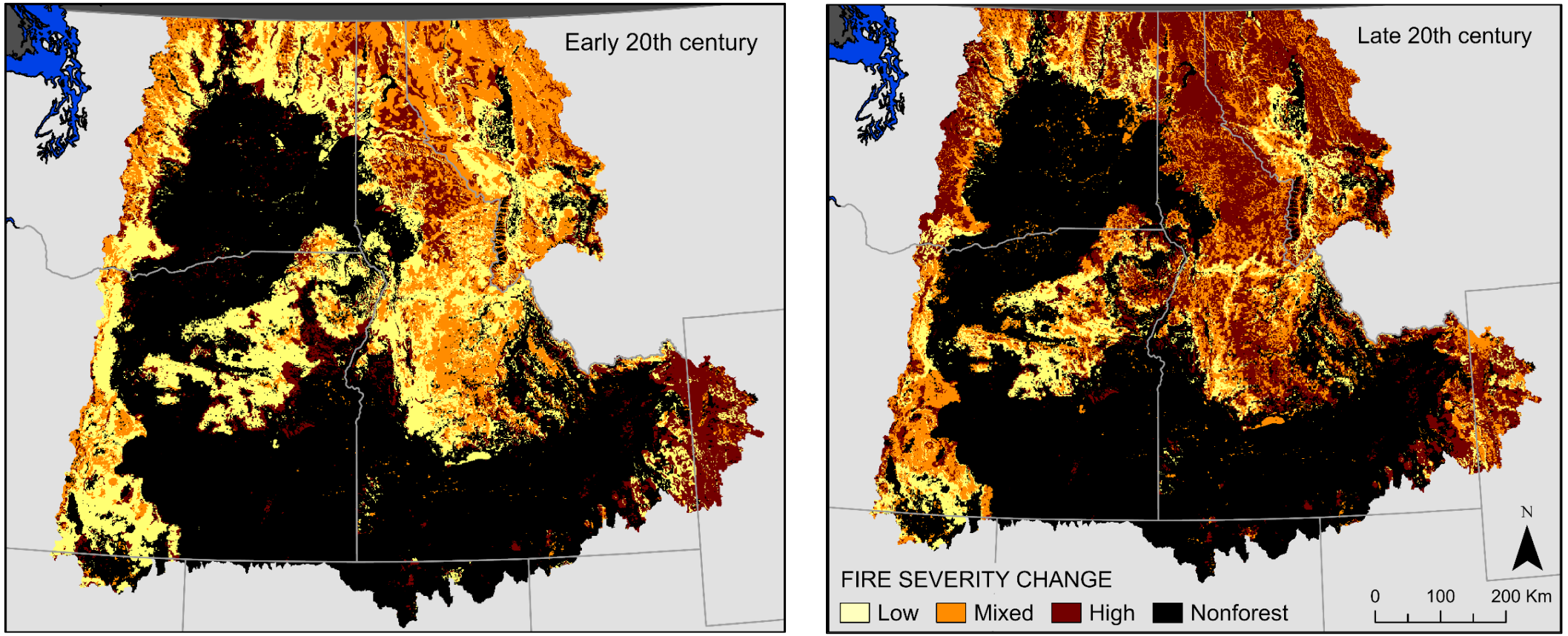
- Fires of varied size and severity created ever-shifting mosaics of non-forest & forest conditions
- Fires overlapped each other over space and time; i.e., forest reburning…
- This shifting reburned and recovering mosaic regulated future fire size & severity, absent today
- It did so by halting or dampening fire spread, fire intensity, flame length, crownfire potential
- Resilient forest landscapes were much less forested than we think
- Current forest cover and carbon references for interior wUS are unsustainable

(Hessburg et al. 2019)



COMPARE TOP-BOTTOM MAP ROWS

- Increased surface and canopy fuels provide the energy for severe fires
- Increased connectivity of fuels creates the opportunity for large spreading fires
- Change in climate and weather drives fuel curing & area burned
- These conditions are well-connected over very large areas



- This is the interior Columbia River Basin in the US, ~60 MM ha
- Early 20th century, modeled fire severity is mostly low and mixed (moderate), **Left**
- Early 21st century, modeled fire severity is mostly high and mixed, **Right**
- High contagion of high burn severity conditions at regional to provincial scales

Nonforest conditions & resilient landscapes

- ✓ Much nonforest historically, 25-75% of area
  - Burned bare ground, early seral conditions
  - Nonforests: sparsely treed woodlands, meadows, prairies, shrublands, wetlands
  - Hardwood patches also abundant
- ✓ These features limited future fire size/severity
  - Tug-o-war btw factors growing/burning forests
  - Nonforests & hardwood forest were the emergent property
- ✓ With CC, this intensifies, we can aid transitions
- ✓ How did we get here?


Andrew Larson photo

Change Agents

Pre-1850 → 2023

Fire exclusion – Reduced Indigenous burning, livestock grazing, land development, ditching/draining wetlands, agriculture, roads + rails, fire suppression

Timber harvest – Logging of large-old fire-tolerant trees, fire-sensitive trees filled in

Climate change – Hotter, drier, windier climate, more lightning, longer fire seasons, reduce snowpack, warmer winters, faster snow attenuation

Smoke management – Strict regulations positive feedback to large fire size & severity via less intentional burning-->more smoke, poorer air quality & human health, more structures destroyed

Solutions to Reduce Future Wildfire Emissions

- ✓ Current interior wUS forest C stocks unsustainable
  - Widespread forest accretion, densification
    - Increase open canopy forest conditions
    - …in trailing edge & dry sites
    - Re-establish burned & recovering mosaics
- ✓ Stabilize the tug-of war
  - Between factors growing / removing forests
    - Nonforests, hardwood forest, wetlands
    - Province level, nonforest area 25-50%
- ✓ Restore positive ecological role of fire
  - Incorporate Indigenous knowledge & mgt leadership
  - Primary tools, cultural burning, Rx burning, managed wildfires, thinning + Rx burning
  - Thinning --> biomass removal --> bioeconomy
  - Storage of C in long lived products --> Mass Timber
    - Substitution values, replacing concrete, steel use
- ✓ With CC, nonforests & open canopy forests become increasingly important to restoring metastability


Andrew Larson photo

OR Bootleg Fire of 2021, 168,000 ha, 3rd largest since 1900.

Fire rapidly transitions from crownfire in untreated forest…

…to surface fire in thinned & burned forest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OR Bootleg Fire of 2021
Thinning + Rx Fire
Thinning only

Thank you

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