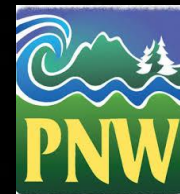


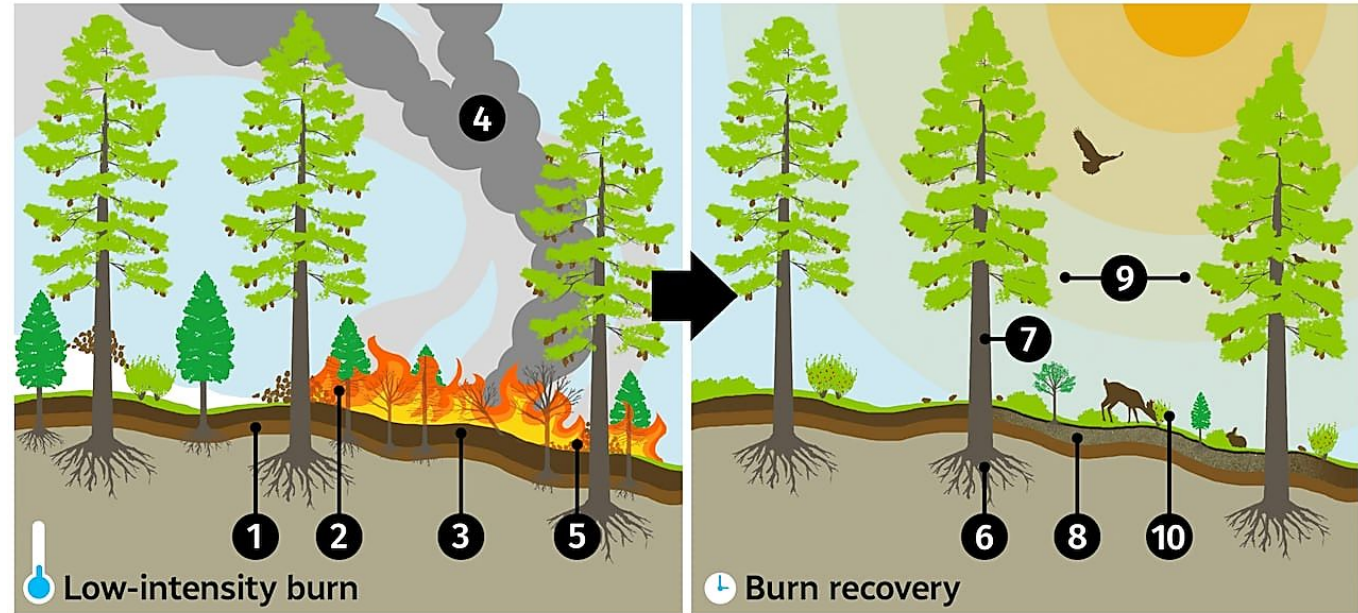
# ADAPTING WESTERN US FORESTS TO RAPIDLY CHANGING CLIMATE AND WILDFIRE CONDITIONS

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## Before the era of fire suppression...

- ▶ Lightning & Indigenous ignitions created large areas of open forest and savannah in the mountains & foothills of the wUS.
- ▶ This went on for 10,000 yrs. For Indigenous people, closed canopy forests minimized food & resource production.
- ▶ Absent fires, forests have grown denser & many meadows, prairies, shrublands, & savannahs have filled in with trees.
- ▶ Indigenous and lightning fires also burned in the upper elevations where conditions were naturally denser and fires of moderate or high severity.
- ▶ Often as much as 50% of the area was recently burned or recovering after fires



## Low-intensity fire

- |  |                              |
|--|------------------------------|
| ① Mineral soil                         | ⑥ Carbon storage             |
| ② Ladder fuels (e.g. branches)         | ⑦ Thicker bark               |
| ③ Duff layer intact                    | ⑧ Nutrient-rich mineral soil |
| ④ CO <sup>2</sup> release              | ⑨ Fire break                 |
| ⑤ Fine fuels (e.g. twigs, dead leaves) | ⑩ New plants                 |

**LOW ELEVATION,  
DRY ASPECT,  
FREQUENT FIRE  
FORESTS**



1934



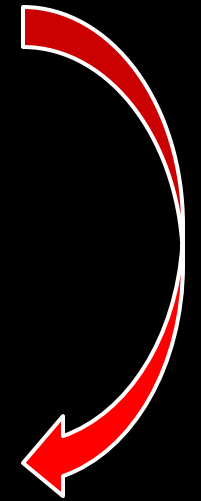
2010

John Marshall photo



An important  
local stabilizing  
feedback

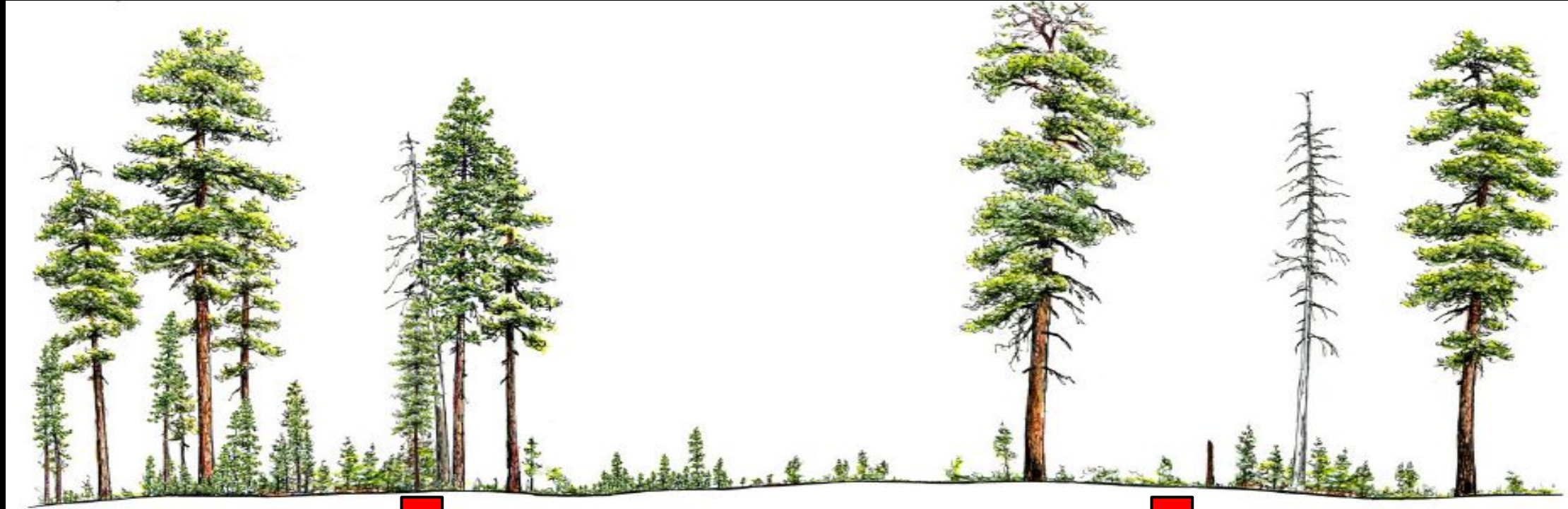
Frequent low  
severity fire  
leads to more  
low severity fire



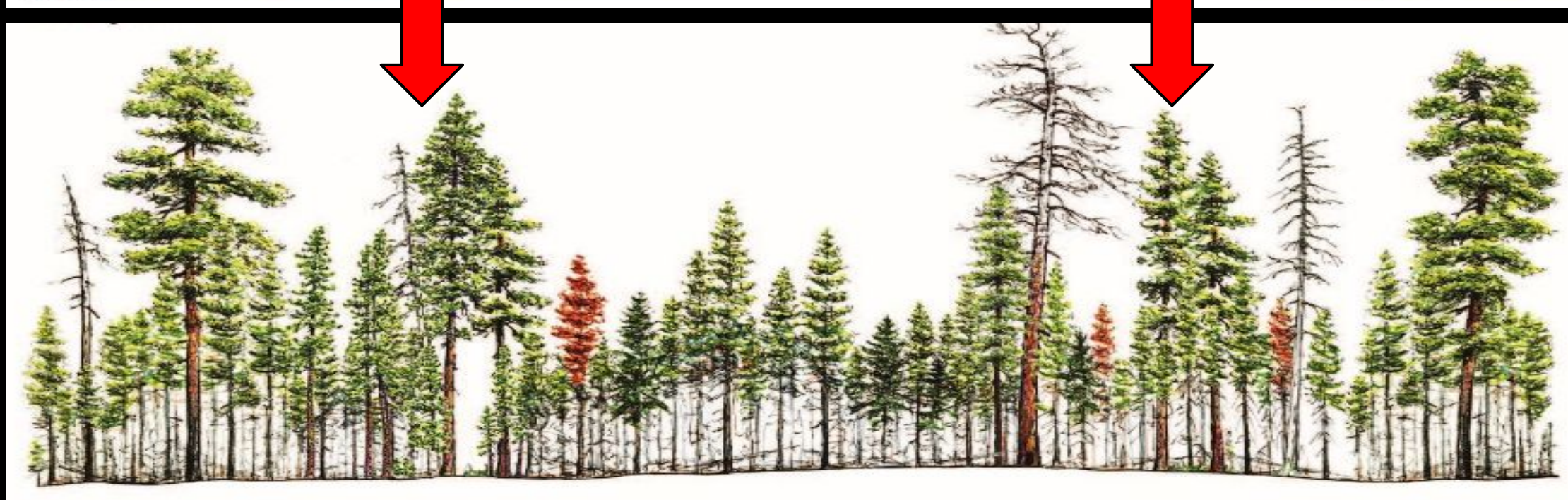
Bob Van Pelt  
drawing

Lacking  
these fires

Trees quickly  
accumulate



Bob Van Pelt  
drawing



**MODERATELY  
FREQUENT FIRE  
MOIST & COLD  
FORESTS**



John Marshall photo

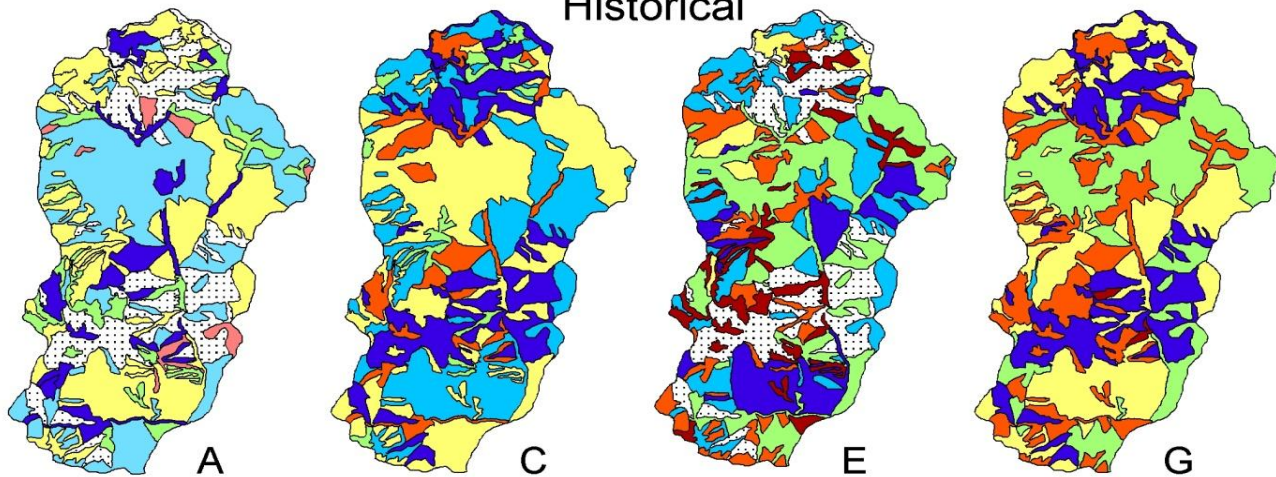
## An important large landscape stabilizing feedback

- Fires of varied size and severity created mosaics of non-forest & forest conditions
- This mosaic regulated future fire size & severity by moderating flame length & fire intensity
- Resilient forest landscapes were much less forested than we think

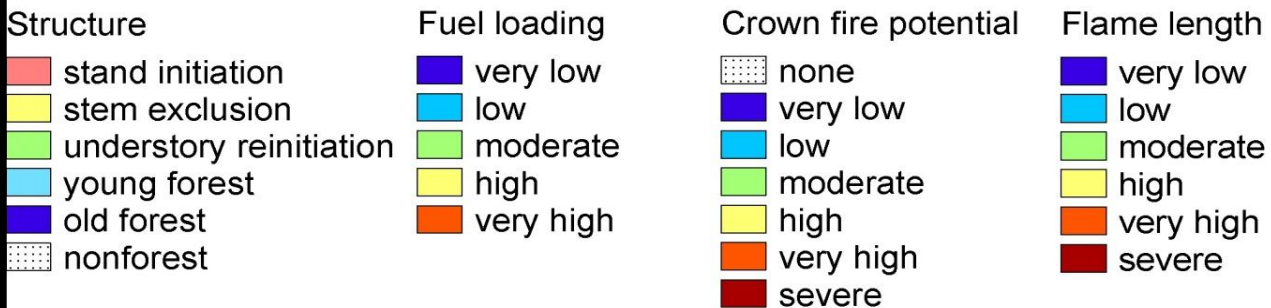
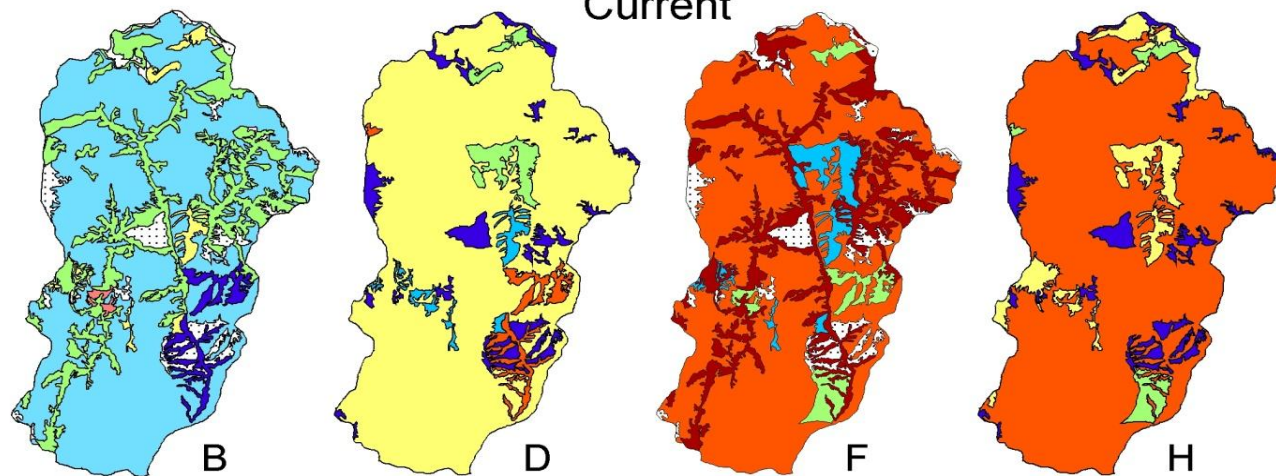
1936



### Historical



### Current



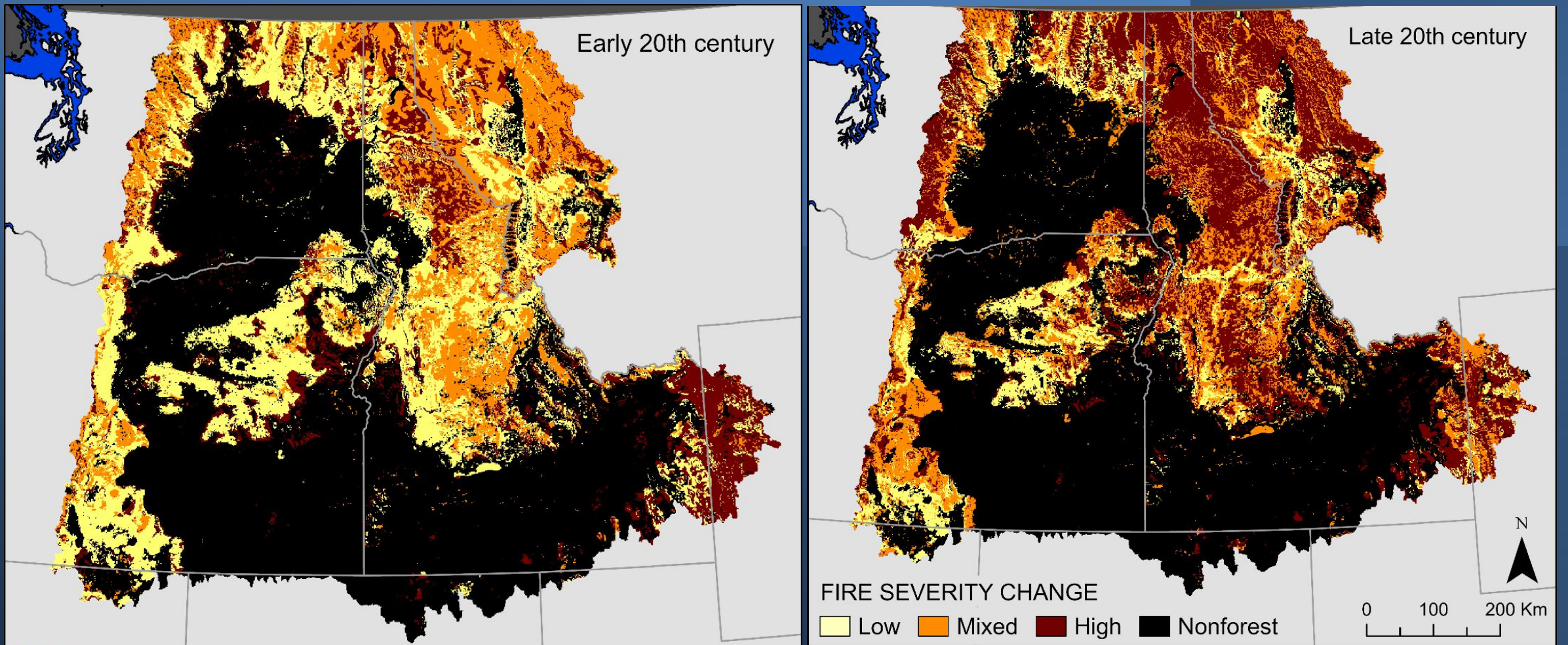
19<sup>th</sup> to 21<sup>st</sup> century changes in fuels & forest structure drive fire severity



Change in climate drives area burned absent frequent reburning

These conditions are well connected over large areas





- ▶ This is the interior Columbia River Basin, ~60 MM ha
- ▶ 1800 to 1900s, expected fire severity is mostly low and mixed (moderate)
- ▶ Early 21<sup>st</sup> century, expected fire severity is mostly high and mixed
- ▶ Footprint of fuel reduction treatments needed is large, must exceed influence of wildfires
- ▶ Many tools – Rx + Indigenous burning, Thin + Rx burn, managed wildfires, postfire mgt

# NONFOREST CONDITIONS AND RESILIENT LANDSCAPES

- ✓ Much nonforest historically, 25-75% of area
  - Open woodlands, wet & dry meadows, prairies, shrublands, wetlands (beaver)
  - Hardwood patches interspersed
- ✓ These features limited future fire size & severity
  - Tug-o-war btw factors growing / removing forests
  - Nonforests & hardwood forest were the emergent property
  - Need to restore nonforests as vital ingredients for forest resilience
- ✓ With CC, this intensifies, we can help
- ✓ So, what changed? How did we get here?



Andrew Larson photo

# Change Agents

Pre-1850

2023

**Fire exclusion** – Starts with greatly reduced Indigenous burning, livestock grazing, land development, agriculture, roads, rails, fire suppression

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

**Climate change** – Warmer, drier, windier, more lightning, escalating, year-round fire season in CA, other places 40-80 days longer

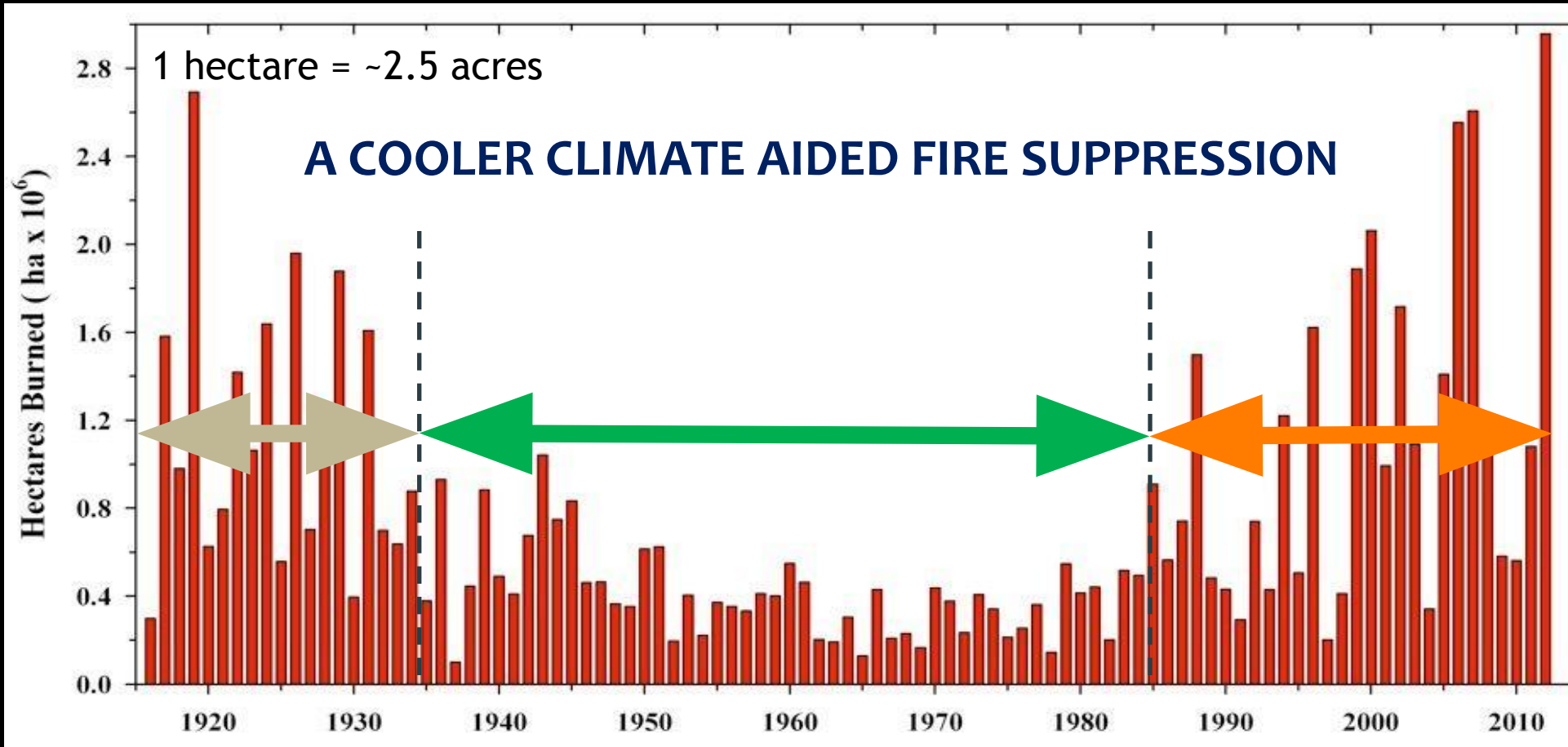
**Smoke management** – Strict regulations lead to increased future fire sizes & severity via less intentional burning-->poorer air quality, more large fires, more smoke, worsened human health, more structures destroyed

# CLIMATE CHANGE



More extreme climate & fire weather currently drives large burned area. It wasn't always this way. Indigenous burning influenced area burned & burn severity

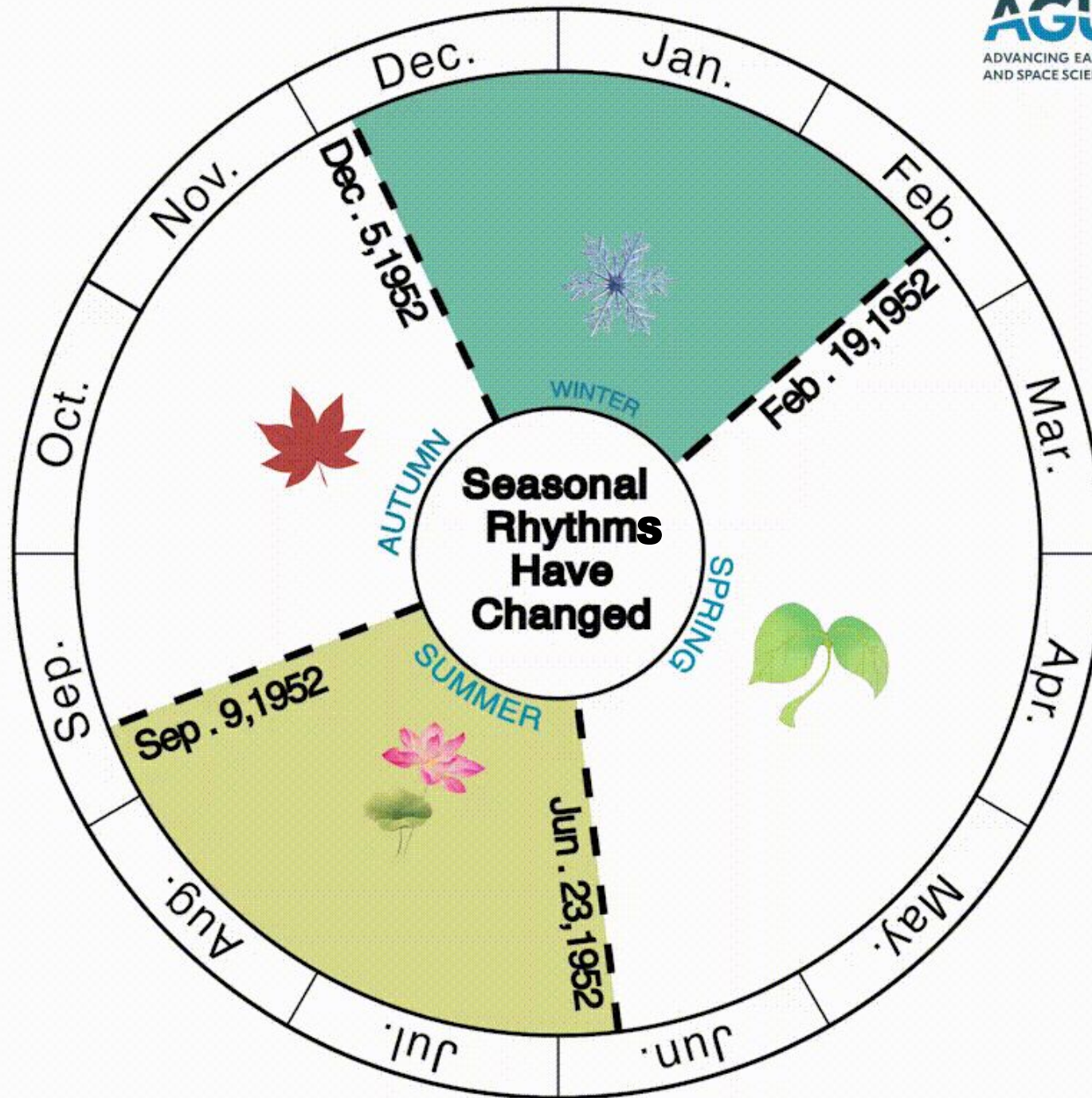
# Fire suppression came of age in the wUS during a period of mild climate



**Warm/dry climate**

**Cool/wet climate, active fire suppression, burned area declines**

**Warm/dry climate  
Burned area increases**



Northern Hemisphere summers projected to last nearly half of the year by 2100!

OR Bootleg Fire of 2021, 168,000 ha, 3<sup>rd</sup> largest since 1900.

Fire rapidly transitions from crownfire (untreated forest)...

to surface fire (thinned and burned) forest.



# OR Bootleg Fire of 2021

Thinning + Rx Fire

Thinning only





Fire-suppressed Forest



Ecologically managed Forest



And here is why they work:

Figure courtesy of: Kelsey, R., 2019. Wildfires and Forest Resilience: the case for ecological forestry in the Sierra Nevada. Report of The Nature Conservancy. Sacramento, California, 3.



Thank you!

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