

Intermountain Adaptation Partnership

Effects of Climatic Variability and Change on Forest Vegetation

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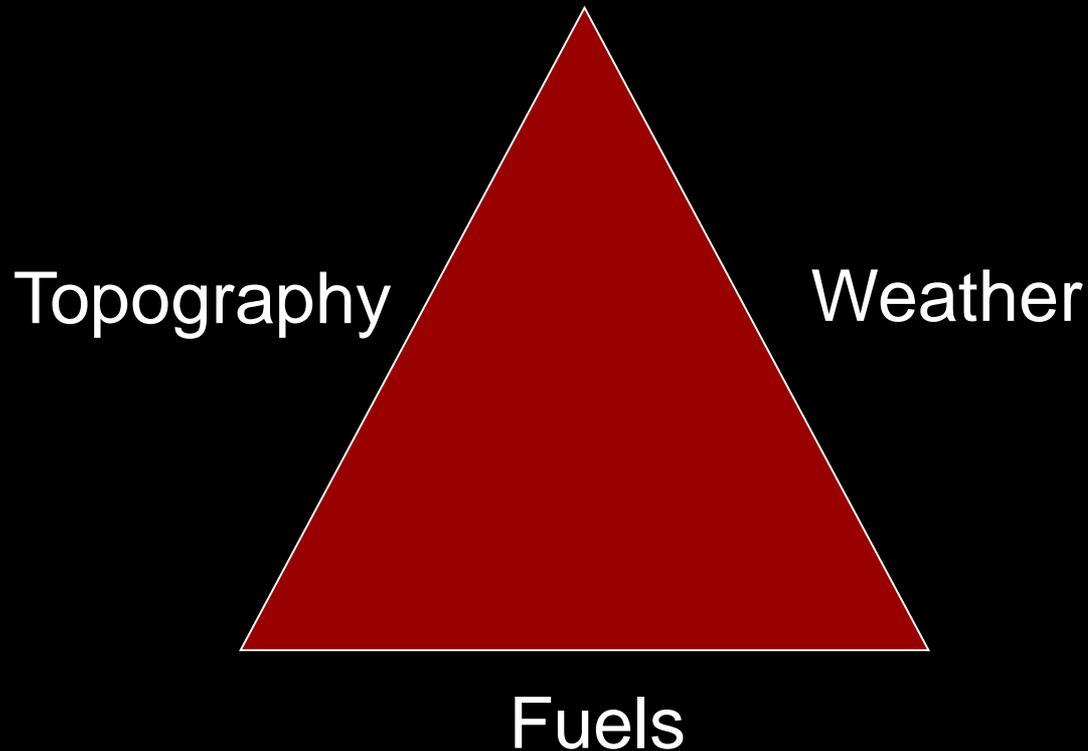
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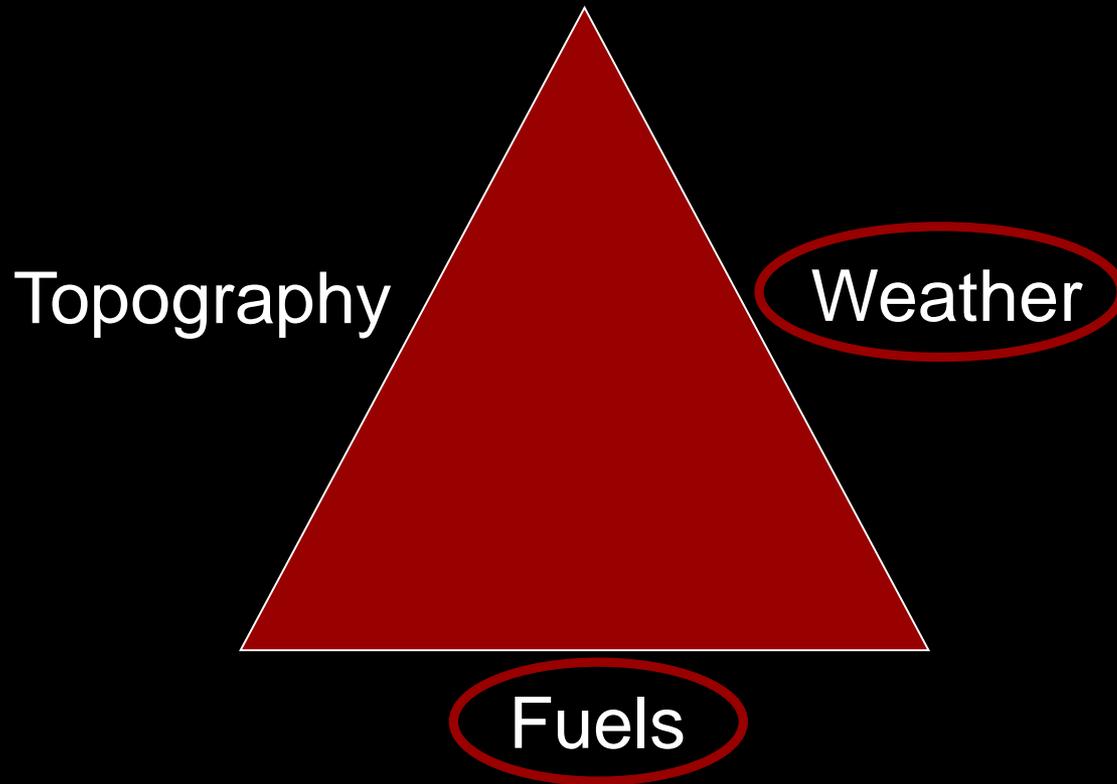
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Fire Behavior Triangle



Fire Behavior Triangle

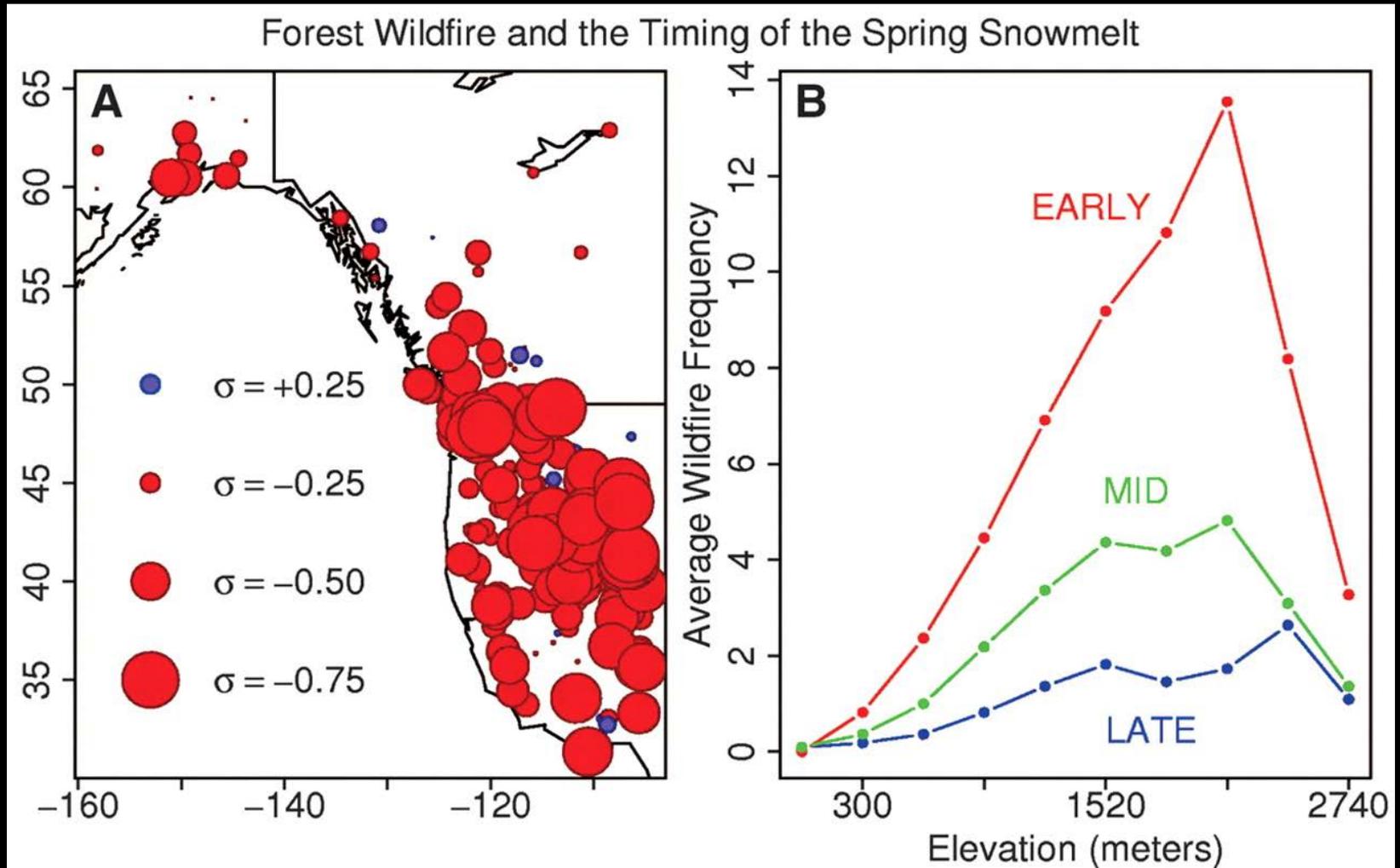


Climate Change and Fire

- Warmer and drier spring conditions =
 - early snowmelt
 - lower summer soil and fuel moisture
 - longer fire seasons
 - increased frequency of large fires
- Fire intensity and severity may also increase

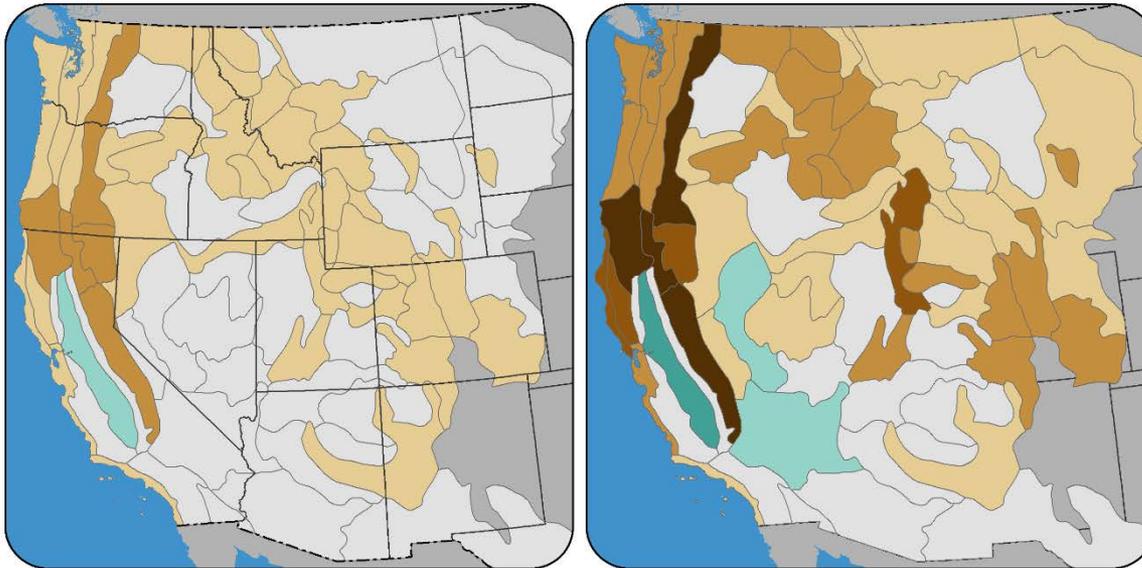
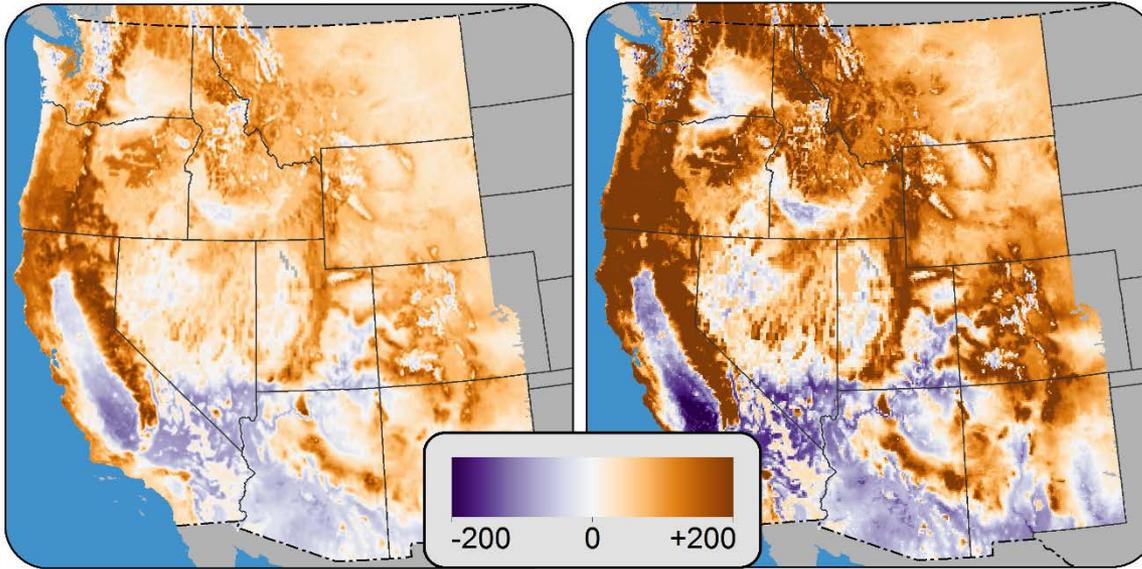


Correlation between annual western U.S. large forest fire frequency and spring snowmelt



2040s

2080s

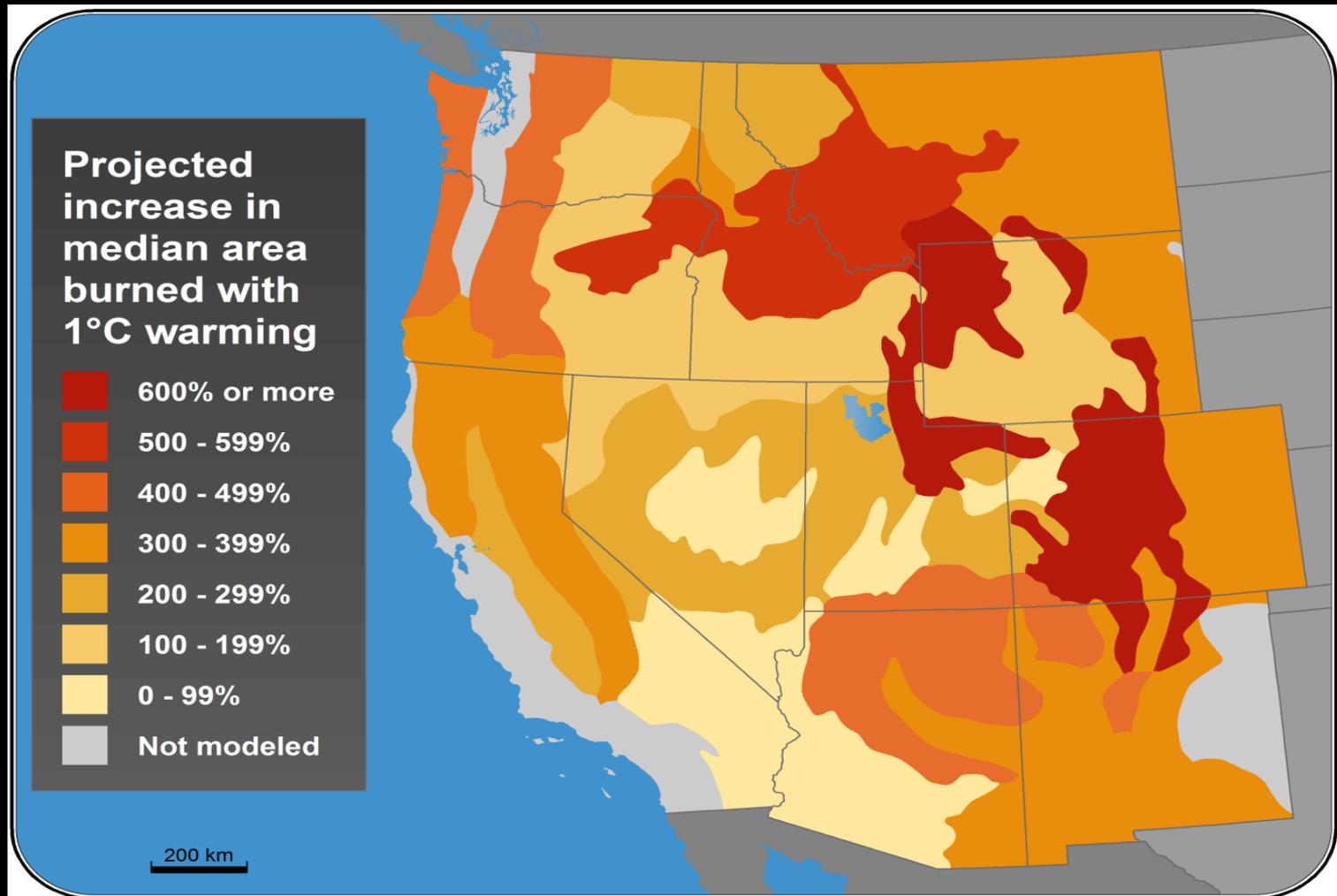


Difference in Water-Balance Deficit (mm)

-75 to -50	-25 to +25	+25 to +50	+75 to +100
-50 to -25		+50 to +75	+100 to +125

Projections for changes in summer water-balance deficit

Wildfire area burned projections, 2050



Future fire regimes will depend on:

- Vegetation changes
- Land use legacies
- Invasives
- Precipitation patterns



Plant species respond to:

- Energy constraints
- Water constraints
 - \uparrow temperatures = \uparrow evapotranspiration
 - \uparrow CO₂ = \uparrow water use efficiency?
- Disturbance regimes



Individual Plant Effects

- **Productivity**
- **Seedling establishment**
- **Mortality**
- **Phenology**
- **Genetic limitation**



Effects on Vegetation Will Vary

Possible outcomes:

- Changing abundance
- Range expansion/contraction
- New vegetation communities



Assessment for Tree Species

Assess *vulnerability* for tree species based on

- Ecological characteristics
- Disturbance interactions
- Current vs. historical conditions
- Potential climate change responses



Forested Vegetation Types

Subalpine Pine

Subalpine Spruce-Fir

Mesic Mixed Conifer

Mesic Grand Fir/Douglas-fir

Mesic Douglas-fir

Mesic White Fir/Douglas-fir

Sierra Mesic Mixed Conifer

Dry Mixed Conifer

Dry Grand fir/Douglas-fir/Ponderosa Pine

Dry Douglas-fir/Limber Pine

Dry White fir/Douglas-fir/Ponderosa Pine

Sierra Dry Mixed Conifer

Persistent Lodgepole Pine

Aspen

Mixed-Conifer

Persistent Aspen

Montane Pine

Riparian

High Elevation Forests

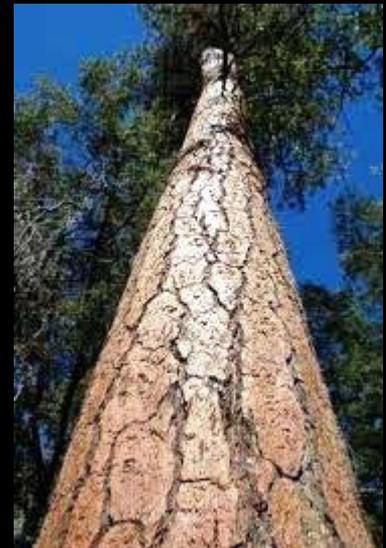
Subalpine pine and spruce-fir

- Some species may move to higher elevations, assuming suitable substrate and conditions for establishment.
- Less snow and longer growing seasons = increased growth?
- Will likely be increasingly susceptible to fire, bark beetles, and drought.



Mesic Mixed Conifer Forests

- Growth rates likely to decrease with less water availability.
- Late-seral forests will be increasingly susceptible to wildfire.
- Increased wildfire will favor some species (e.g., Douglas-fir, lodgepole pine).



Dry Mixed Conifer Forests

- Many drought tolerant species that will be able to cope with drier soils and increased wildfire
- Some sprout vigorously after fire (e.g., Gambel oak, mt. mahogany)
- Pinyon species killed by intense fire



Persistent Aspen Forests

- Aspen is expected to maintain dominance because of its ability to sprout aggressively after fire.
- Productivity in these systems is expected to be lower.

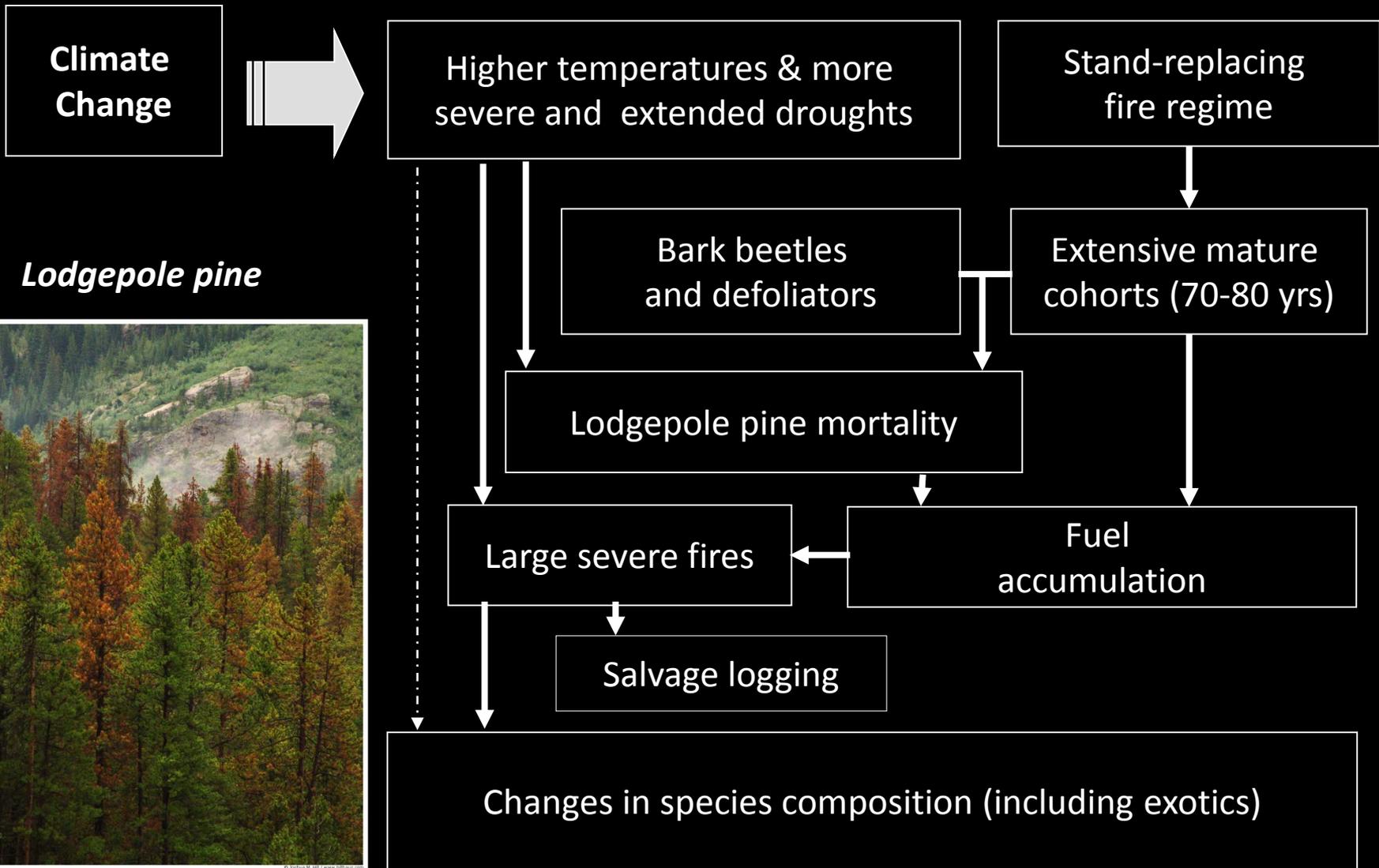


Riparian Forests

- Species more tolerant of seasonal drought will dominate.
- Hardwood regeneration could become less common.
- Riparian forests associated with small or transient water sources (e.g., springs) will be more susceptible than forests near large water sources (e.g., rivers).

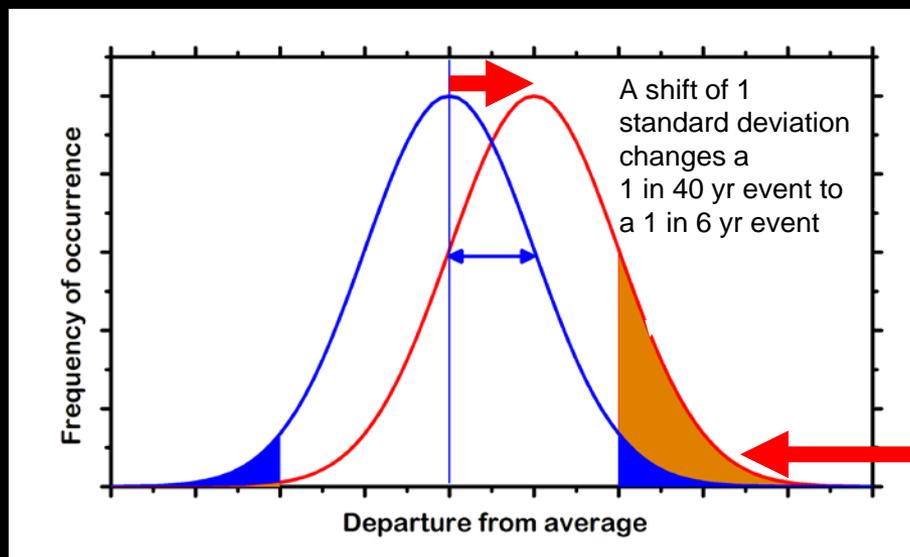


Warming affects stress complexes



Extremes matter

Frequency, extent, and severity of disturbances may be affected by climate change, altering the mean and *variability* of disturbance properties.



A shift in *distribution* of disturbance properties has a larger relative effect at the *extremes* than near the mean.

It's all about the tail!

