

Climate Accelerated Growth of Vegetation, Pests & Fire: The Perfect Storm

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Whether it is Weather or Climate?

- ▶ **Weather** is the mix of events that happen *each day* in our atmosphere, including temperature, rainfall and humidity. Very short term phenomena.
- ▶ **Climate** is the *average* weather pattern in a place over many years (i.e., 20 to 30 yrs).
- ▶ **Hence**, 1 or 2 yrs of 'weather' does not make a 'climate'.
- ▶ **Therefore**, this is good as it gets me off the hook for trying to explain this year's cool spring.
 - **Key Point:** Climate trends are more global phenomena than local/ regional ones. Oceans spread the climate 'love'



Reality

- ▶ Regardless of its cause, we can all agree that most of the West has warmed and become drier during summer over the last 30 yrs. Complexity!!

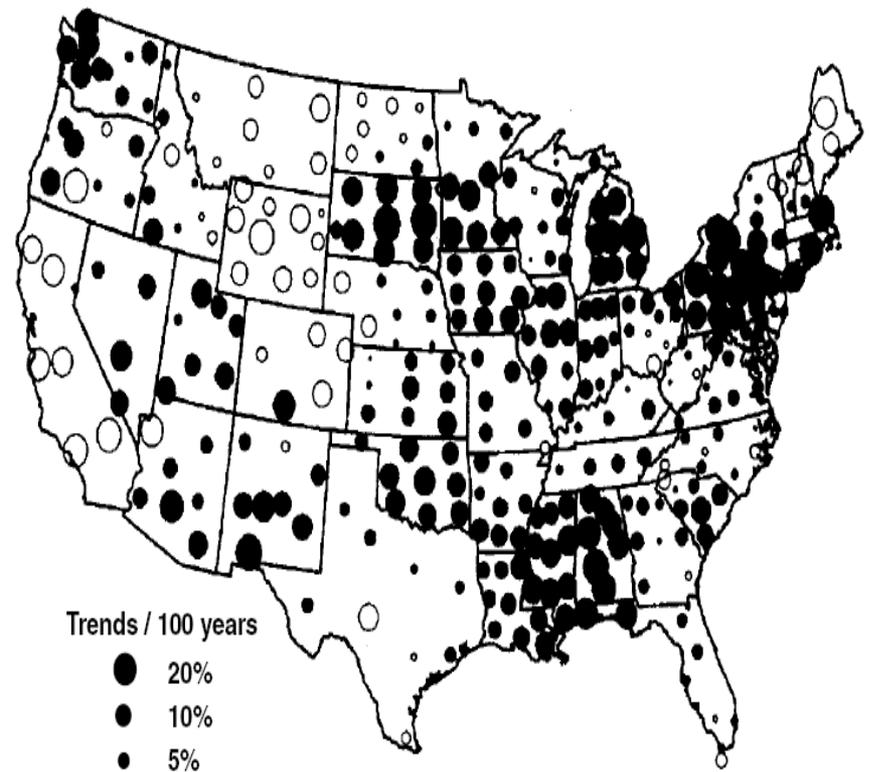
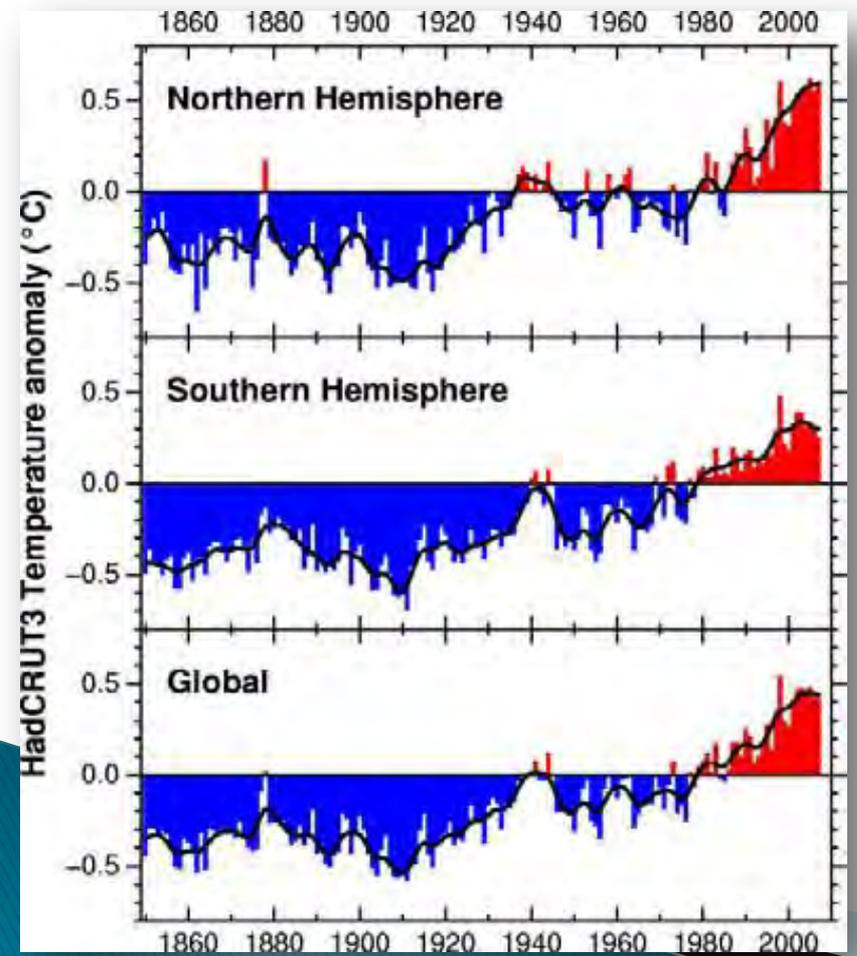
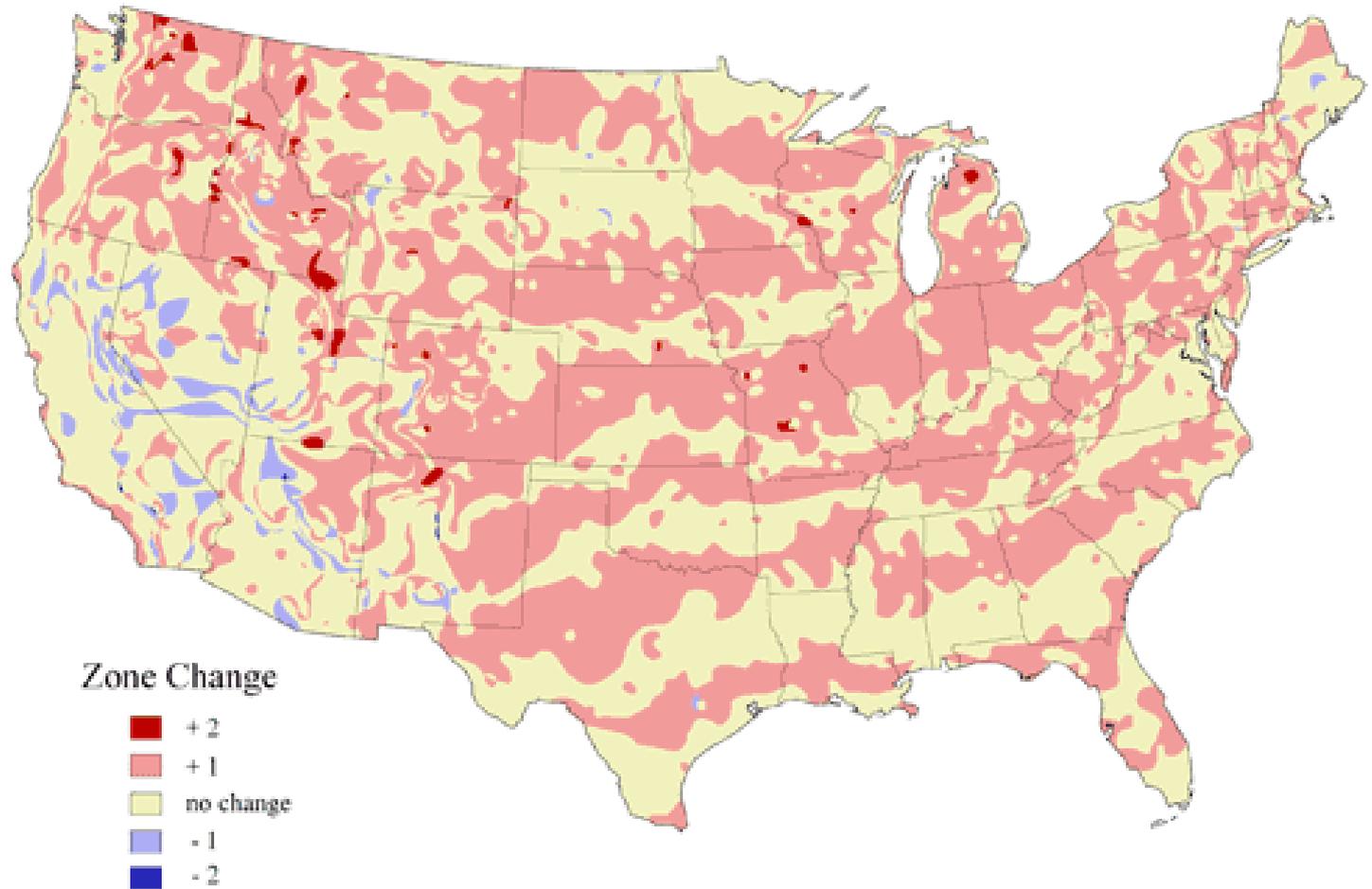


Figure 1.5—Precipitation trends (1900-94 converted to percent per century) centered within state climatic divisions are reflected by the diameter of the circle centered within each climatic division. Solid circles represent increases and open circles, decreases (from Karl et al. 1996).



Differences between 1990 USDA hardiness zones and 2006 arborday.org hardiness zones reflect warmer climate



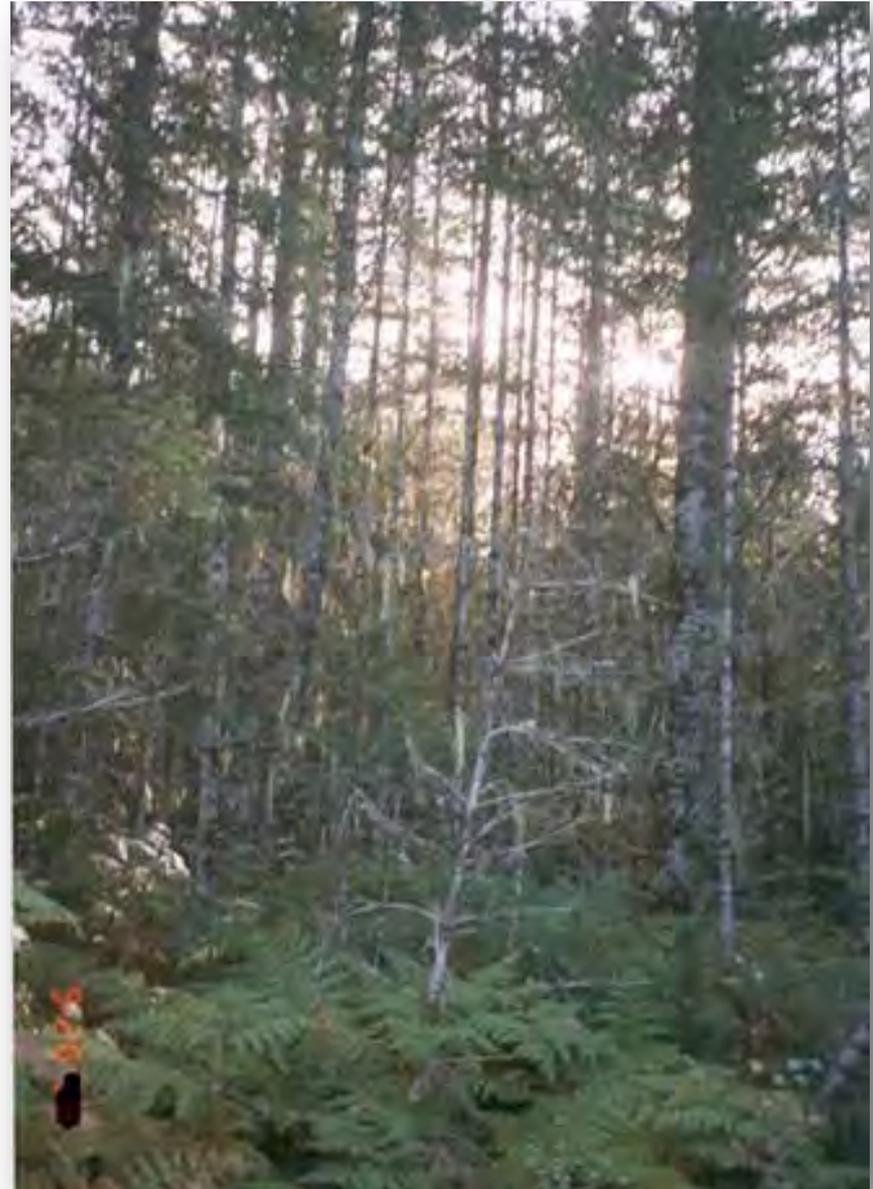
Key Objectives

- ▶ To outline how climate change will affect the growth, senescence & succession of forests
- ▶ To outline strategies we can employ to minimize forest impacts due to climate change



Climate Change & Plant Growth

- ▶ Vegetation grows quickly, **initially**, in response to higher temperatures & CO₂, despite more frequent & longer lasting droughts. Fire suppression also facilitates this growth.
 - THIS IS CALLED THE **GREEN UP**



Climate Change & Senescence

- ▶ Increasing temperatures & summer droughts increase competition among the plants occupying the site, leading to poor plant health. Insects & diseases begin to take over...
 - THIS IS CALLED THE **BROWN DOWN**
 - Forest gradually becomes more susceptible to catastrophic wildfire; and invasion of exotic plants



Let's Assume Trends Continue Over Next 80 yrs

- ▶ Temperature: **↑ 7 F**
- ▶ CO₂: **↑ 2X** present (=720 ppm)
- ▶ Precipitation: **↑ 30%**, mostly wintertime rains



What is the Role of Forest Insects & Diseases? With Climate Change?

- ▶ Act as synergists to the decline by taking advantage of stressed trees (stocking/ age)
- ▶ Warming will further synergize the impact of I's and D's
 - Better survival + More generations = More bugs
 - Warmer winters = More fungal spores and growth



• Boreal Wildfires • Ecological Speciation

BioScience

Organisms from Molecules to the Environment

June 2008

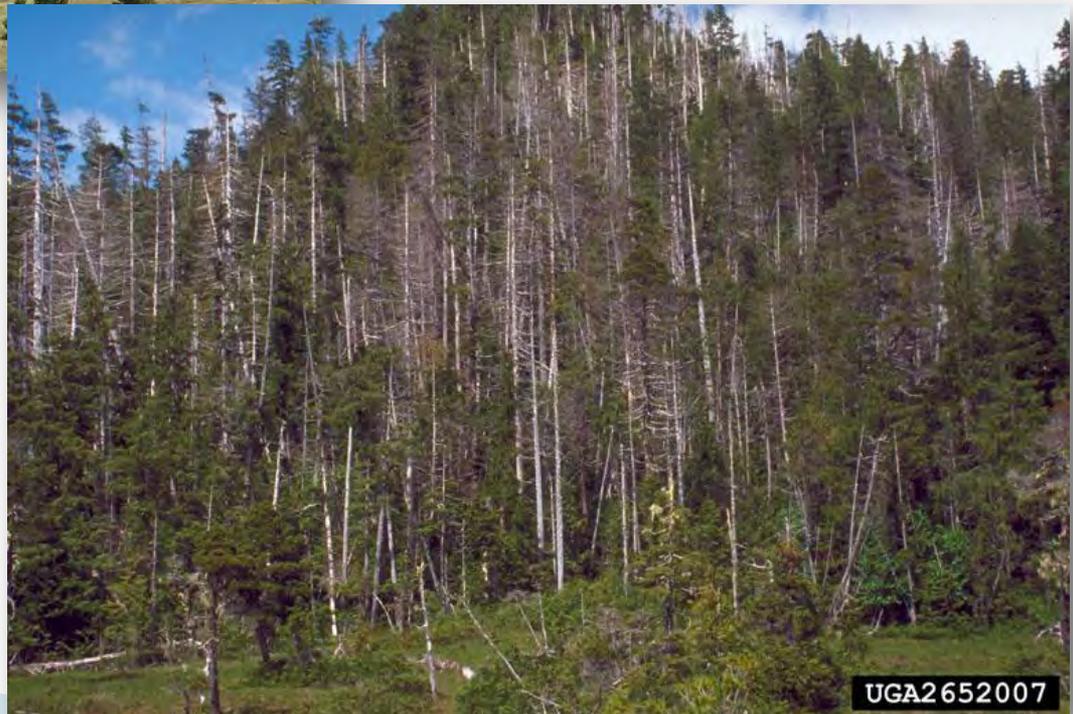
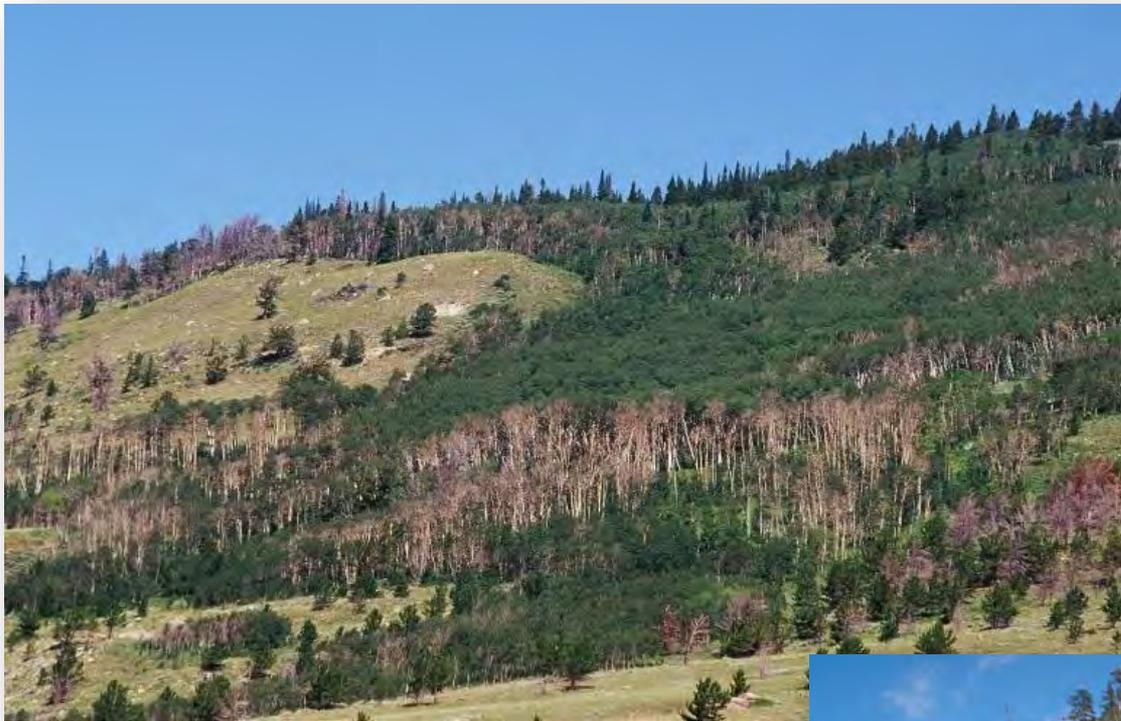
American Institute of Biological Sciences

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**21st Century Directions in Biology:
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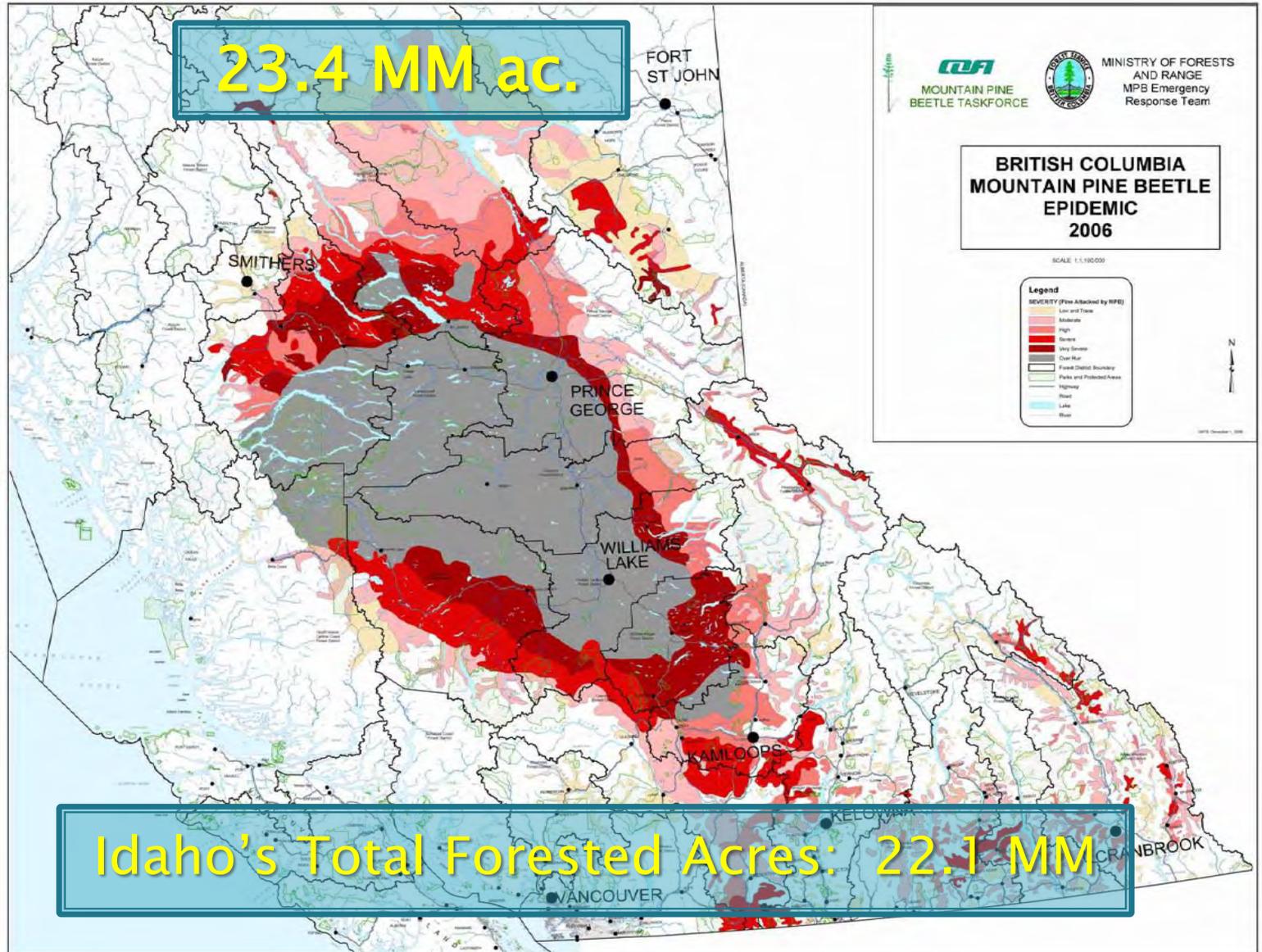
Bark Beetle Eruptions





UGA2652007

MPB Epidemic in British Columbia



MPB Epidemic in British Columbia



UGA2108081



Climate Change & Forest Succession

- ▶ Contemporary forest will shift upslope 1,650 to 2,400 ft and northward with 7 F warming
 - We will likely 'lose' alpine forests, and have species adapted (sage) to hotter/ drier climates encroaching the lower elevations
- ▶ Area of traditional forest may decrease up to 30%
 - This area will be under a novel climate and hence novel association of plant species. BUT, total forested area should change little.
 - Source: Rehfeldt, Crookston, Warwell and Evans. 2006. Empirical analysis of plant-climate relationships for the western United States. I.J.P.L. 167:1123–1150.



Strategies for Environmental Management

- ▶ **Nothing** [let nature take its course & be willing to accept what you'll get]
- ▶ **React** to change [monitor change & practice adaptive forms of management]
- ▶ **Anticipate** change [apply technology & learning to get ahead of change]
- ▶ A combination of these approaches will most likely be needed



Tactics for Environmental Mgmt

- ▶ Make existing forests healthier so they can withstand climate change, pests & fire (re-allocate biomass) by:
 - Thinning
 - Removing competing vegetation (mastication/ prescribed burning/ chipping/ mowing)
 - Plant more drought tolerant varieties of native stock
 - Build up seed banks of these varieties
 - Promote species diversity
 - Fuel breaks
- ▶ Work hard to maintain critical forest types, such as those that are endangered or where endangered species depend on their presence. Short-term strategy, hope climate does not continue to warm.



Tactics for Environmental Mgmt

- ▶ Get ahead of climate change, be proactive!
 - Help native species get to their preferred range
 - Plant proven novel species in behind of shrinking natural forest. Take advantage of vegetation suitability models to plan 'future' forest.
 - Example: look to select tree species 1 to 2 climate zones warmer.
 - Afforest: Use trees to mitigate climate change impacts
 - Aggressively manage **invasive** species
 - Develop methods to handle biomass generated from resiliency tactic
 - Example: Green energy, Wood construction, Carbon pumping
 - Experiment with new species & forests

▪ **Source: Connie Millar, Climate Change Re-Thinking Forest Management in the West**

