Western Water Assessment

A conceptual model of water quantity impacts from insect-induced tree death in snow-dominated coniferous forests

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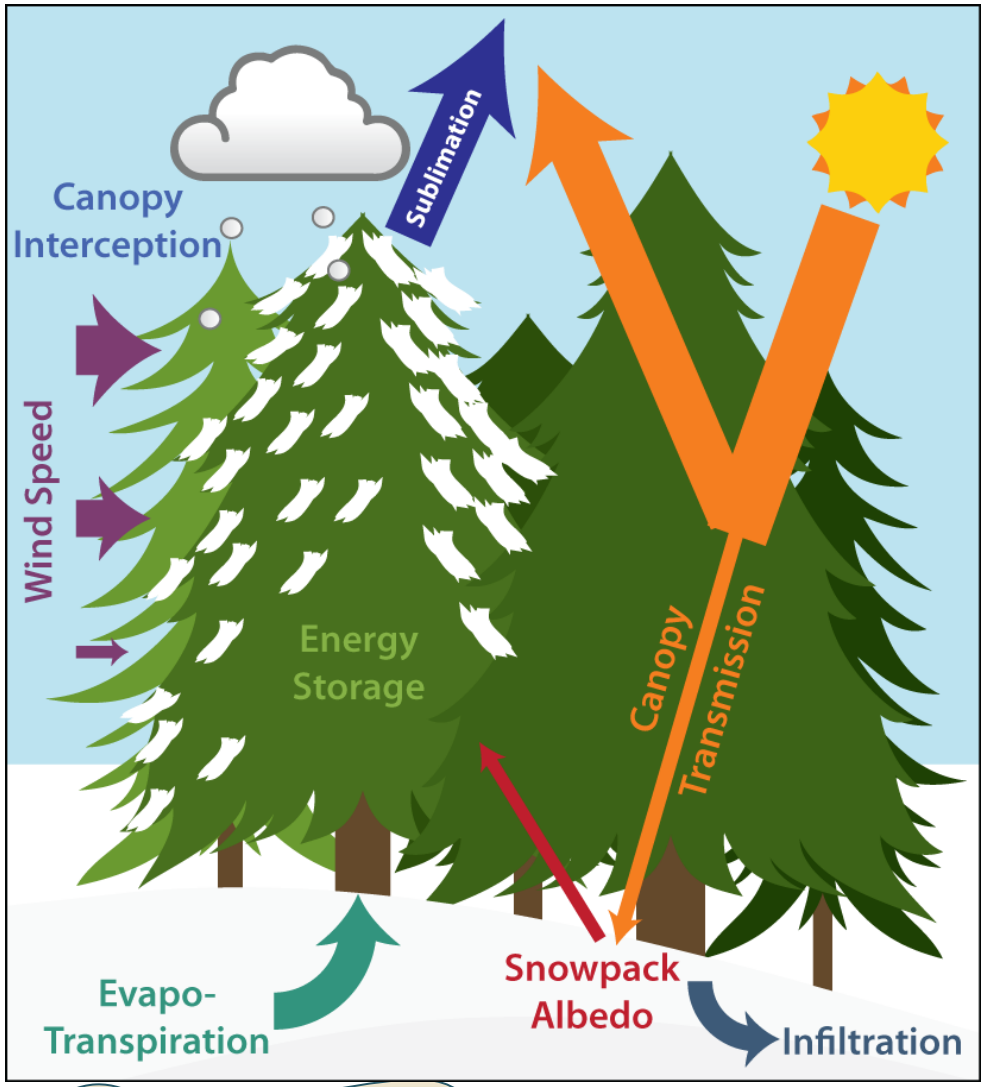
Research Objectives

- Review literature on bark beetle impacts to hydrologic processes and literature on potential analogs: fire, clearcutting, girdling

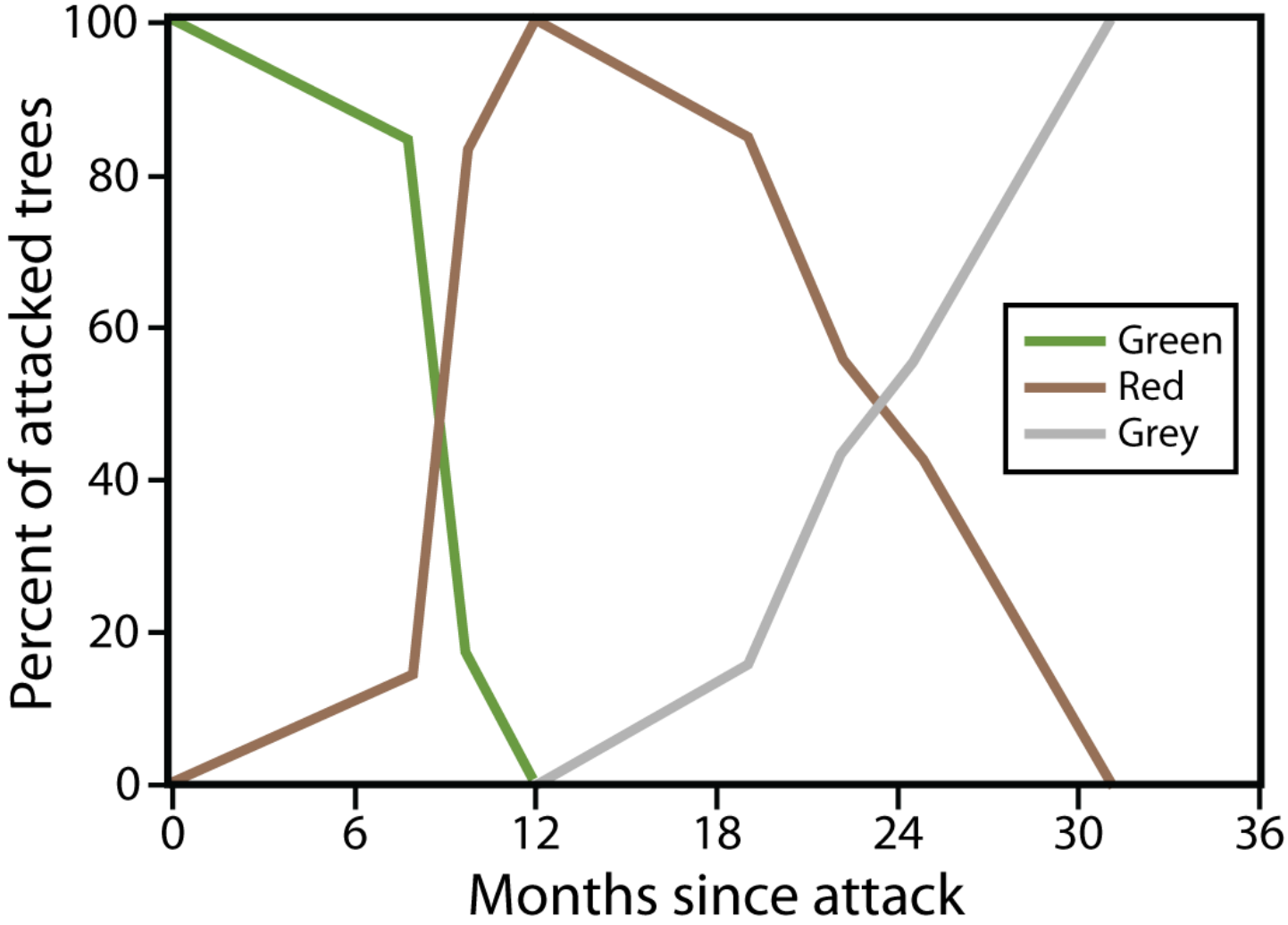
- Develop conceptual model of expected changes in processes and net effects over time in idealized stand

- Focus future research efforts based on areas of greatest uncertainty

What we know

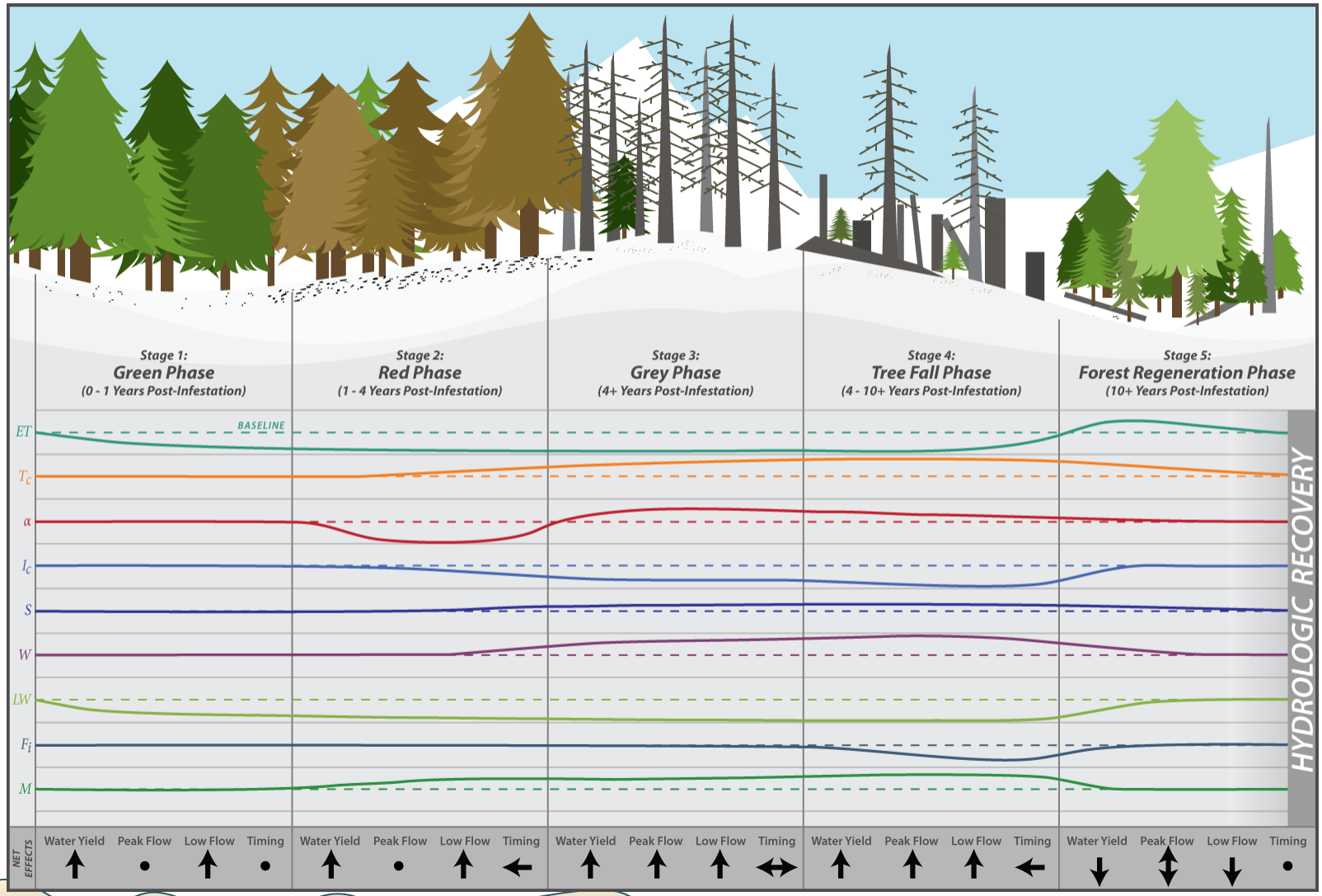

Sublimation
Canopy Interception
Wind Speed
Energy Storage
Canopy Transmission
Evapo-Transpiration
Snowpack Albedo
Infiltration

Timeline of Tree Death

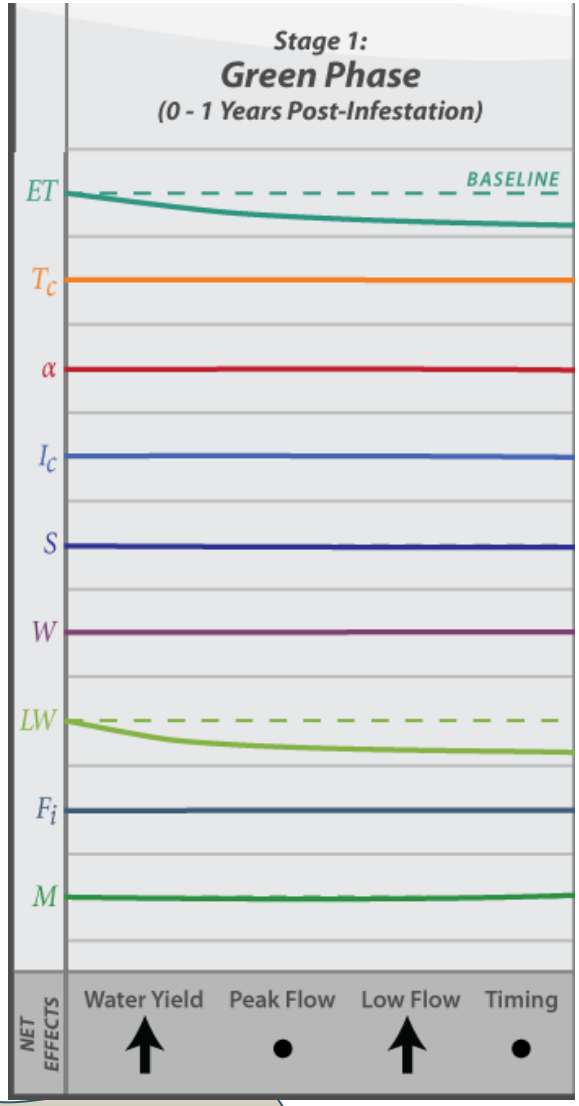


Adapted from Wulder et al. 2006

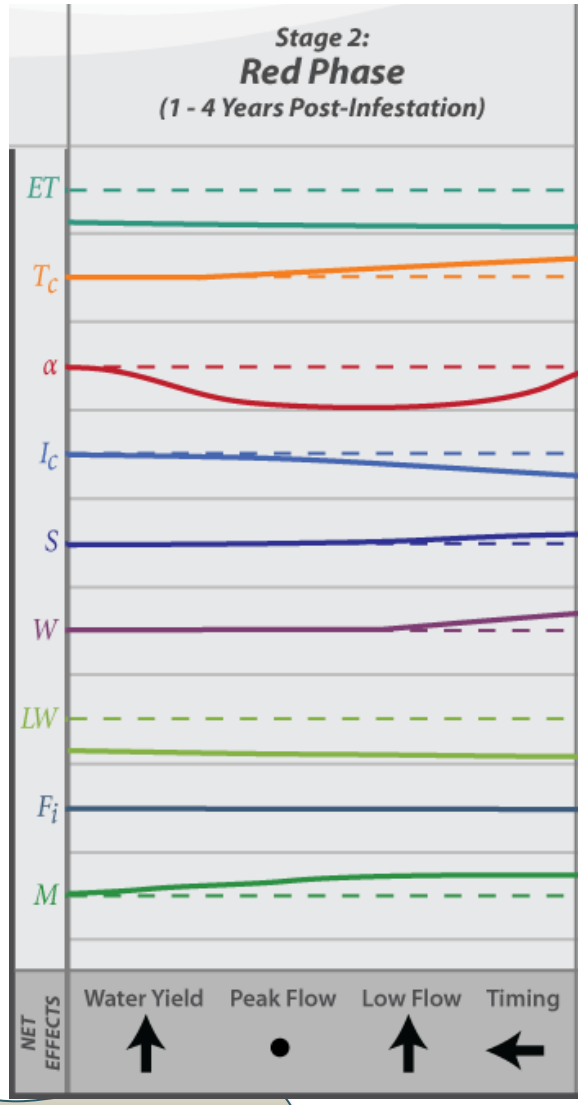
The Conceptual Model



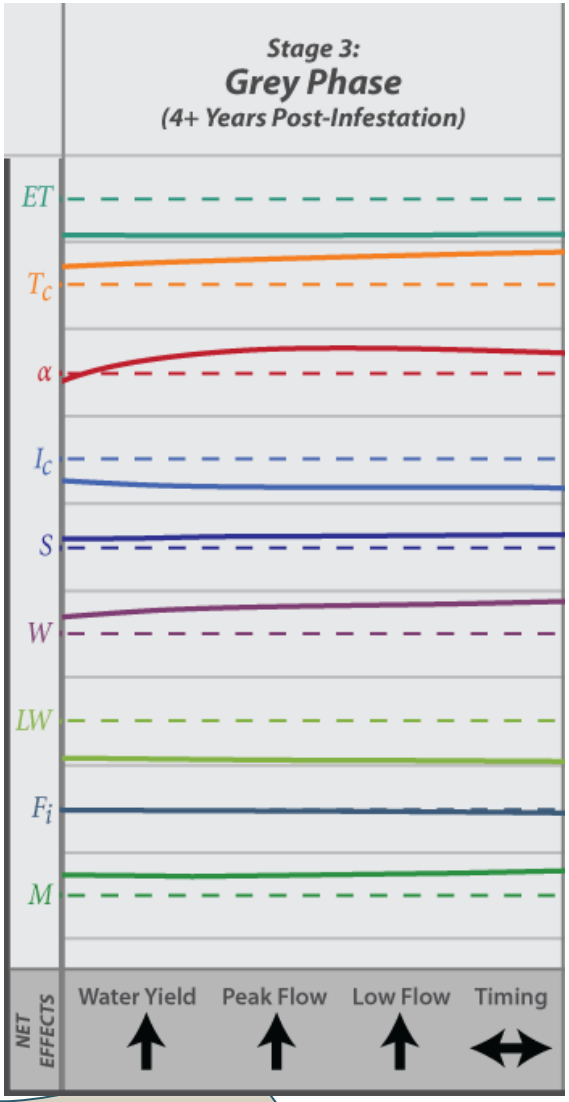
Stage 1: Green Phase



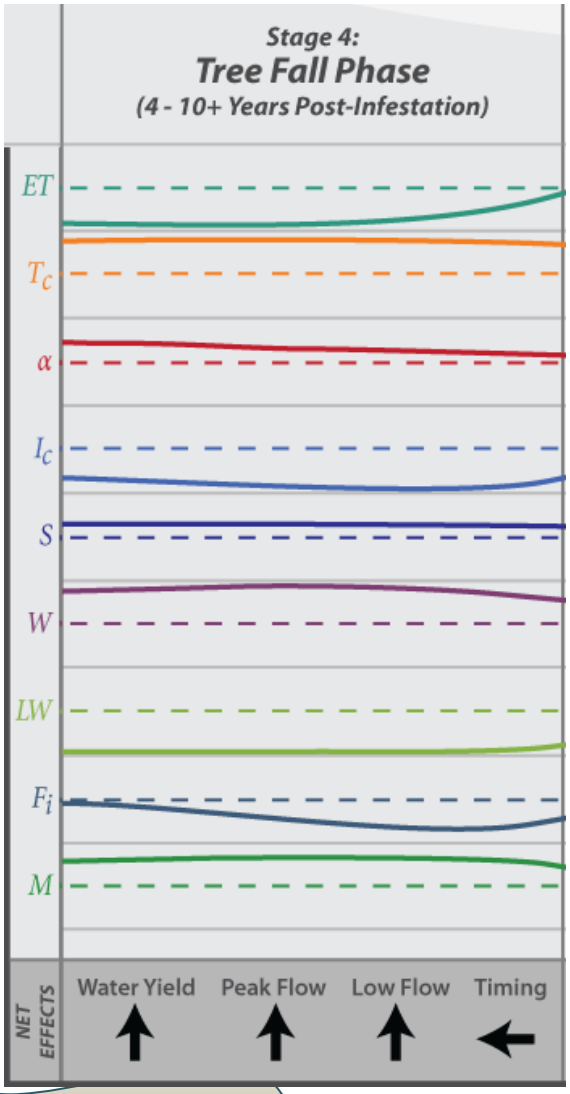
Stage 2: Red Phase



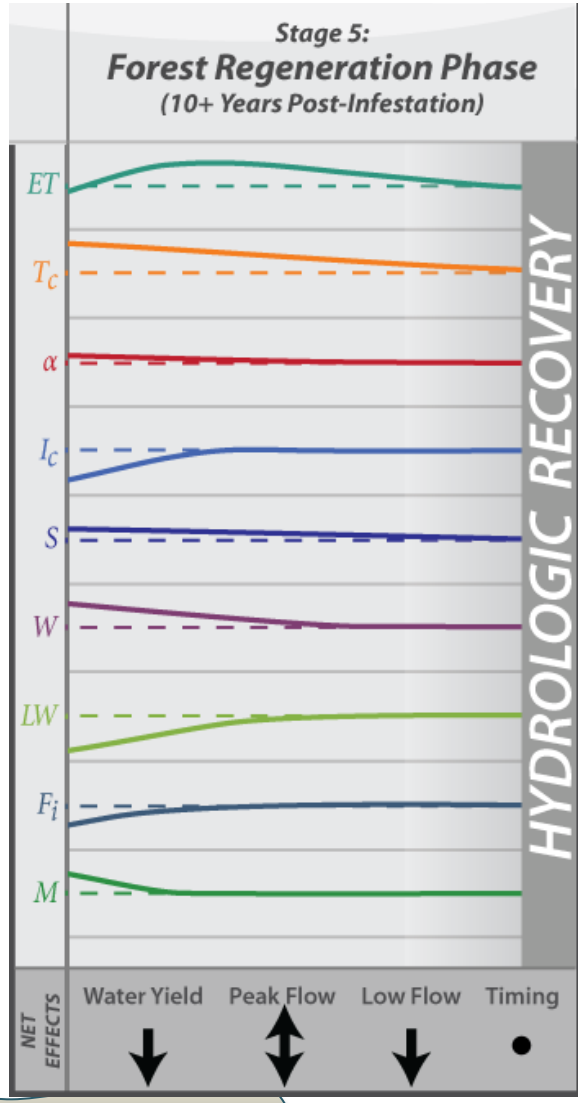
Stage 3: Grey Phase



Stage 4: Tree Falls



Stage 5: Regeneration



Confounding Factors

Forest Characteristics	Watershed	Climate/Weather	Mortality
Species Composition	Elevation	Temperature	Rate of Change
Stem Density	Slope	Precipitation	Total Extent of Mortality
Canopy Leaf Area	Aspect	Humidity	Extent of Each Mortality Phase
Canopy Geometry	Basin Area	Wind Speed	
Tree Height	Forested Area	Cloudiness	

Take-Home Message

- Stands die slowly and pass through multiple stages, often at the same time; makes prediction difficult
- Remaining live, smaller trees and stand structure makes beetle-killed forests different from clearcuts or fire
- Effects can be highly dependent on site-specific factors
- Need better understanding of processes and larger-scale modeling in order to understand impacts