

Mountain Pine Beetle and Lodgepole Pine in south-central Oregon: Fuel for Fire???



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This project is funded by the Joint Fire Science Program to investigate temporal dynamics of fuels and fire behavior following mountain pine beetle (MPB) epidemics in south-central Oregon lodgepole pine forests. Data collection began summer of 2010 and will continue through 2011. The study addresses 2 main questions:

1. How do fuel profiles in lodgepole pine forests change over time in response to mountain pine beetle epidemics?
2. What are the effects of mountain pine beetle epidemics and changes in fuels on fire behavior over time?

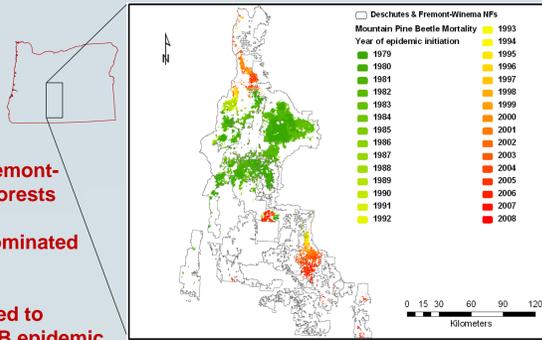
Study Area and Sampling Design

Chronosequence Approach

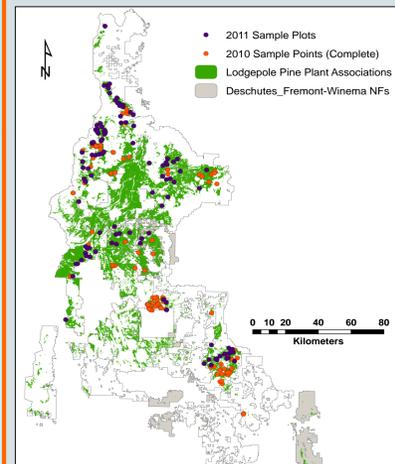
Study Area:

- Deschutes and Fremont-Winema National Forests
- Lodgepole pine dominated plant associations

• Aerial survey data used to identify time since MPB epidemic across study area



Chronosequence of mountain pine beetle epidemic initiation across the Deschutes and Fremont-Winema National Forests, OR. Developed from aerial survey cumulative mortality data.



Plot Selection

• Spatially balanced sampling methods (Stevens & Olsen 2004)

• Using aerial survey polygons of differing time since MPB initiation, plot selection was stratified along a lodgepole pine plant association productivity gradient (high, moderate, and low productivity).

• 29 year chronosequence (1979-2008)

• 4 replicates of each productivity level

• 228 total plots

8.92m radius central plot

- Trees and snags >5 cm DBH
- Height
- Height to Crown base
- Dwarf Mistletoe Rating
- Canopy Cover
- Convex Densiometer

3.2 m radius subplots

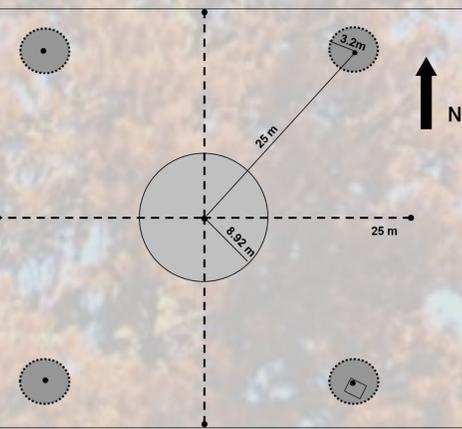
- Shrubs, seedlings, & saplings
- Height and basal diameter
- Convex Densiometer

2x2 m Quadrat

- Understory plant and shrub cover (%)
- Ground cover

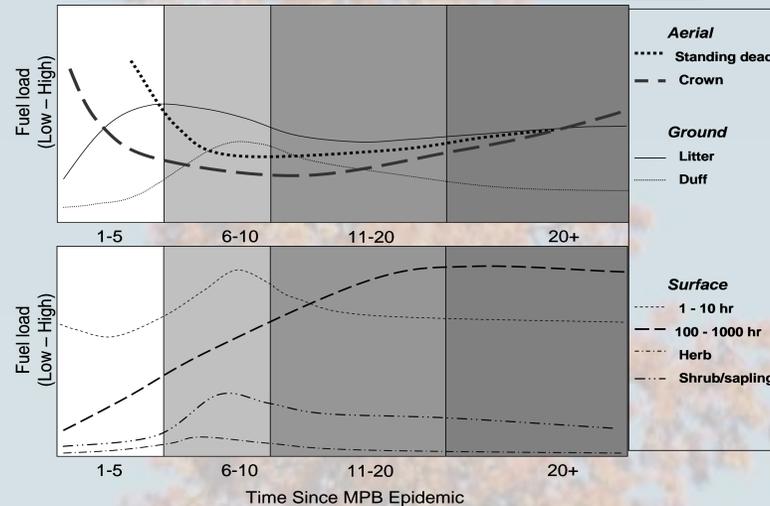
25 m transect

- Fuels- 1hr, 10hr, 100hr, 1000hr
- Litter, duff, and fuel height
- Canopy cover (line intercept)
- Fuel photos



Sample plot schematic indicating spatial layout of subplot and transect measurement points.

Hypothetical fuel profiles over time



• **1-5 years post-epidemic** - Crown fuels such as needles and fine branches may be transferred to the forest floor increasing litter and 1 hr and 10 hr fuels. Remaining aerial fuels will be comprised of standing dead trees from MPB induced mortality. Herbaceous vegetation and shrubs will begin to increase due to canopy openings.

• **6-10 years post-epidemic** - Ground fuels will peak and begin to decrease due to decomposition. Surface fuels, specifically shrubs and herbaceous vegetation, will reach a peak and dramatically increase ladder fuels. 1 and 10 hr fuels will increase through loss of fine branches from standing dead material. Standing dead material may begin to fall and add slightly to 1,000 hr surface fuels.

• **11-20 years post-epidemic** - 1,000 hour fuels will begin to monotonically increase as standing dead trees fall and decrease aerial fuel loads. However crown fuel loads in the canopy may begin to increase as remaining live trees expand crowns. Shrub and sapling fuel loads are still relatively high as saplings now reach or exceed previous crown base heights.

• **20-30 years post-epidemic** - Litter, duff, shrub/sapling, and 1 and 10 hour fuels may begin to reach pre-epidemic levels, while 100 and 1,000 hour fuels may continue to increase on the surface. Saplings may be approaching substantial heights and increasing ladder and crown fuels.

~2 yrs. Post-MPB



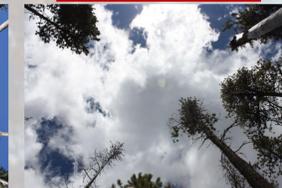
~4 yrs. Post-MPB



~19 yrs. Post-MPB



~27 yrs. Post-MPB



Time since MPB

Potential Fire Behavior

• **1-5 years post-epidemic** - Rate of surface fire spread may be elevated due to increases in fine surface fuels. Potential for active crown fires will be high due to decreased foliar moisture content.

• **6-10 years post-epidemic** - Rate of surface fire spread may remain high due to remaining fine fuels and increases in understory vegetation. Total heat release should increase from a slight increase in 100 and 1,000 hr fuels. Potential for active crown fire should substantially decrease from reduction in crown bulk density.

• **11-20 years post-epidemic** - Rate of surface fire spread may begin to decrease with lower fine fuel loads. Ladder fuels may increase with increased shrub and sapling fuel loads, and may begin to increase crown fire potential if some live crown remains. Heat release may begin to increase due to standing dead trees falling and adding to 1,000 hr fuel loads.

• **20-30 years post-epidemic** - The large flux of 1,000 hr fuels will increase total heat release, but rate of spread and fire-line intensity should continue to be low. As regeneration and continued dominance of shrubs occurs, crown fire initiation and possible crown fire risk increases as crown fuels begin to reestablish in the upper canopy.

	Pre beetle	1 year	2+ years	Needles on	Needles off	Treefall	Regeneration
Relative fire risk and severity							
Fuel Model				Change	Change	Change	Change
Canopy Cover				Decrease		Increase	Increase
Canopy Base Height				Increase		Decrease	Decrease
Canopy Bulk Density				Decrease		Increase	Increase
Foliar Moisture Content		Decrease					



Fire Behavior Modeling

• **BehavePlus v. 4.0.0** - Surface and crown fire behavior at a single point in space and time for one weather condition.

• **FamMap v. ?/FARSITE** - Spatial and temporal variation of potential fire behavior across a landscape for specific weather scenario(s).

• **FCCS v. 2.1** - Classify complex fuelbed characteristics over time following MPB.

