

Overview

Recent mountain pine beetle (*Dendroctonus ponderosae* Hopkins) outbreaks in western North America have set millions of hectares of forests on to new development trajectories. In Colorado more than 1.2 million hectares of pine forests were affected by bark beetle infestations between 1996 and 2009. Since 2000, concerns over increased fuel loads have prompted an unprecedented amount of harvesting, focused on the removal of dead lodgepole pine.

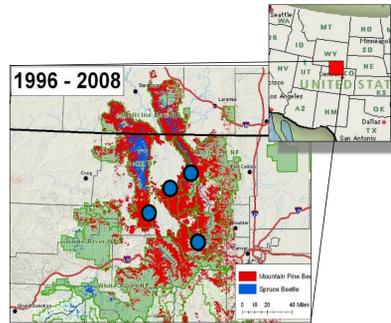
Objectives

In untreated and harvested beetle-killed stands we:

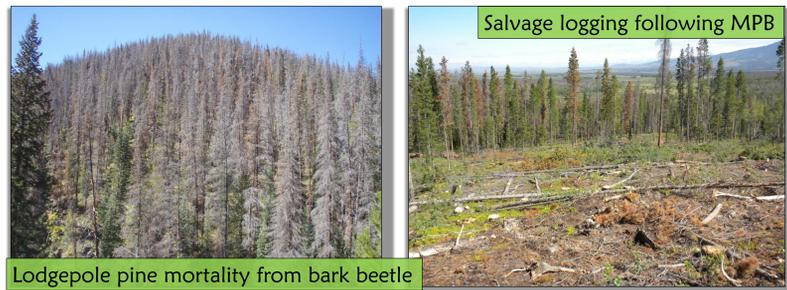
- Quantified surface and crown fuel profiles
- Measured response of seedling recruitment to overstory mortality
- Used these measurements to predict stand development and potential fire behavior over time with the Forest Vegetation Simulator (FVS-FFE)

Study Area

This study was conducted in four separate mountain pine beetle management areas located between 80 and 140 km northwest of Denver, Colorado. Study areas were located on US Forest Service land on the Medicine Bow-Routt and Arapaho-Roosevelt National Forests and on Colorado State Forest land. Site elevations ranged from 2661 – 2980 m above sea level.



Extent of beetle-caused mortality in Colorado and southern Wyoming.



Design

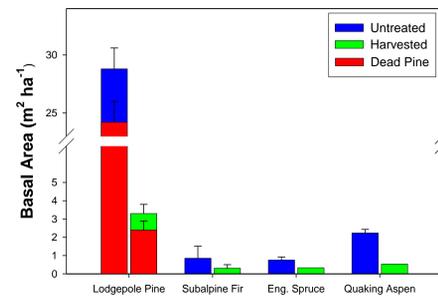
- Each study site consisted of 6 untreated and 6 harvested units (n = 24).
- Stand structure, seedling recruitment and fuel loads were measured in each unit.

Current Conditions

Stand Structure

- Lodgepole pine makes up 86% of total basal area in our study area.
- 84% of lodgepole basal area is dead, 72% of total BA.

Composition of overstory trees (> 10 cm DBH)

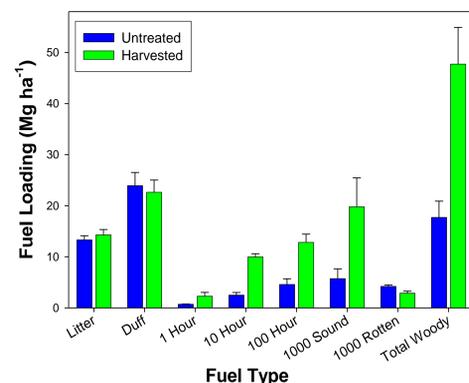


	Understory Trees (<10 cm DBH)	Advance Regeneration	Recruitment (≤ 3 years old)
Untreated			
Lodgepole Pine	362 (86)	562 (104)	305 (108)
Subalpine Fir	46 (11)	956 (193)	1114 (316)
Engelmann Spruce	37 (13)	75 (19)	79 (28)
Quaking Aspen	14 (6)	1093 (202)	114 (40)
Harvested			
Lodgepole Pine	102 (22)	669 (120)	3135 (714)
Subalpine Fir	20 (8)	272 (103)	144 (40)
Engelmann Spruce	12 (7)	21 (9)	4 (3)
Quaking Aspen	3 (1)	1269 (252)	841 (356)

*Numbers in parenthesis represent standard error based on 24 units. Advance regeneration is > 3 years old, < 10 cm DBH.

- Lodgepole pine was the most abundant species of seedling recruitment in harvested areas, 10x more than untreated areas, the opposite was true of subalpine fir which was most plentiful in untreated areas.

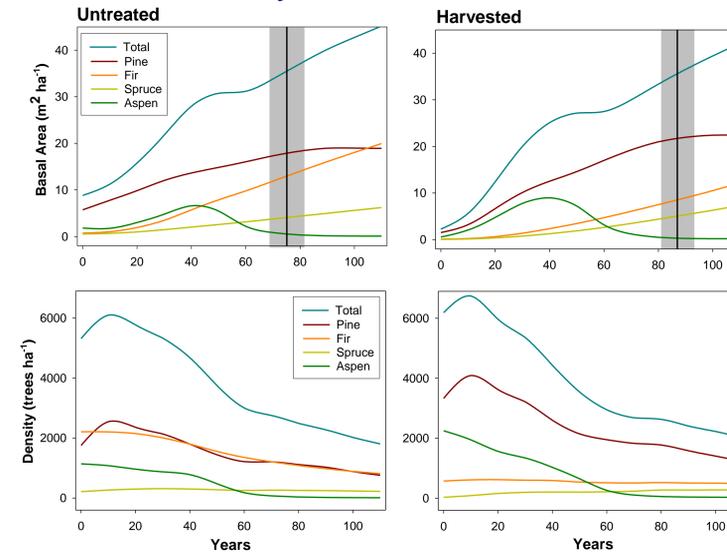
Surface Fuels



- Total woody surface fuels were 2.6x higher in harvested areas, however the larger size classes, >2.5 cm (i.e. 100, 1000 hr fuels), were the greatest contributors.

Future Conditions

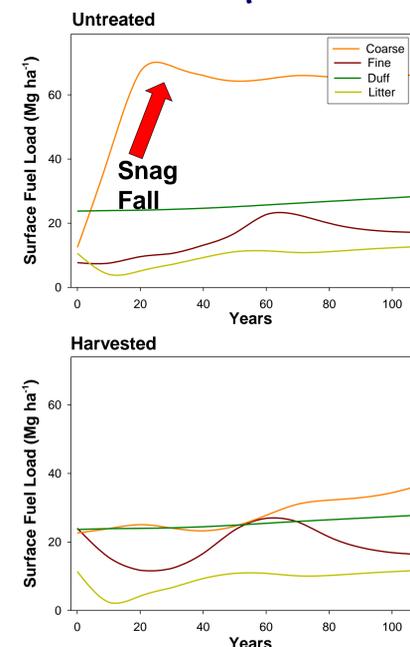
Stand Development



- Growth simulations predict stand basal area and quadratic mean diameter will return to pre-outbreak conditions (~35.5 m² ha⁻¹ and 13.5 cm, respectively, shaded area) in both harvested and untreated stands in 75 to 90 years.

- After more than a century, subalpine fir will make up the majority of stand basal area in untreated stands (44%) while lodgepole pine will be the most common species in harvested area (53%).

Fuel Development



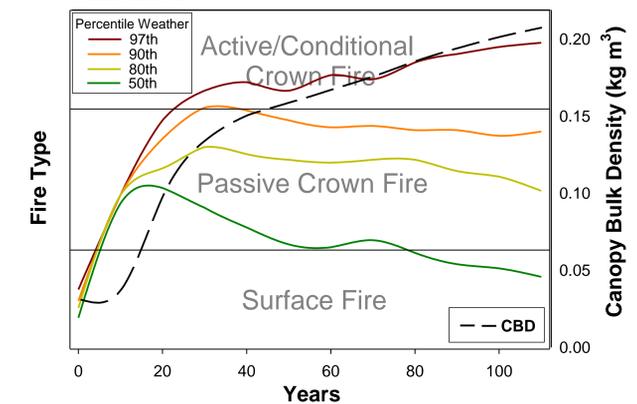
- Coarse woody fuels (> 7.6 cm diameter) are predicted to increase 2.5x in the first two decades as standing dead pine topples.

- Fine fuels (< 7.6 cm) in harvested areas are predicted to diminish to the level of untreated stands in the first 2 decades due to decomposition and a minimal input from the developing canopy.

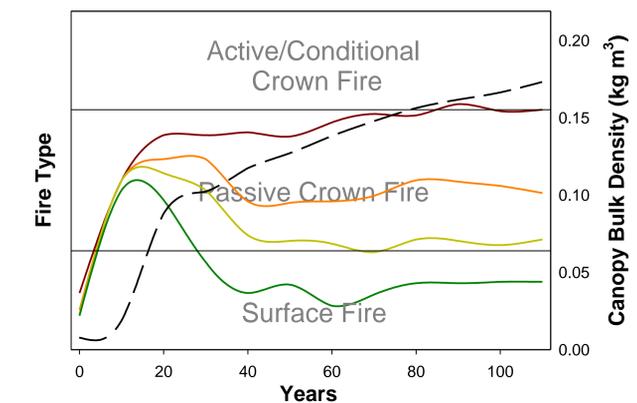


Potential Fire Behavior

Untreated



Harvested



- In the first 15 years, as the canopy develops, potential fire behavior is not predicted to differ between untreated and harvested areas.

- Differences in potential fire behavior between untreated and harvested stands after the first two decades will be driven by differences in species composition, associated canopy bulk density and weather conditions.