COLORADO FOREST RESTORATION INSTITUTE
COLORADO STATE UNIVERSITY

Kawland Monitoring Summary

Goals and Objectives

Kawland was a fuels reduction project near Winter Park that focused on reducing fire hazard in lodgepole pine-dominated stands with high tree mortality from mountain pine beetle. Management action to accomplish this objective in monitored units consisted of harvest and removal of designated live and dead lodgepole pine. Colorado Forest Restoration Institute (CFRI) installed monitoring plots in Unit 88 to track changes in stand structure, woody fuel loading, and predicted fire before and one year following treatment.

Table 1. Project Information Table

Implementation Agency	USFS, Sulphur RD
Ownership	USFS
Year Completed	2019
Acres Monitored	50 (Unit 88)
Years Monitored	2018, 2021
Forest Type	Lodgepole pine
Implementation Method	Non-sawtimber harvest and removal
Slash Treatment	Whole tree yarding, lop and scatter, piles by landings

Highlights

The treatment substantially reduced tree density and removed nearly all dead trees. Predicted fire behavior decreased following treatment. However, fine woody fuel loading doubled despite whole tree yarding and slash piles at landings. Mean coarse woody fuels also increased, but the distribution of these fuels was so variable across the unit that the change was not statistically significant. While there was a significant decrease in shrub cover after treatment, most shrubs in this project were low-growing species such as kinnikinnick (*Arctostaphylos uva-ursi*) that do not have a large impact on fire behavior. Interestingly, tree seedling species and densities were not significantly impacted by the treatment. Logging operations took place in late fall and early winter when the ground was frozen with some snow, which may have protected small seedlings from ground disturbance. This finding may be helpful for planning future work if post-treatment stand regeneration is an objective.

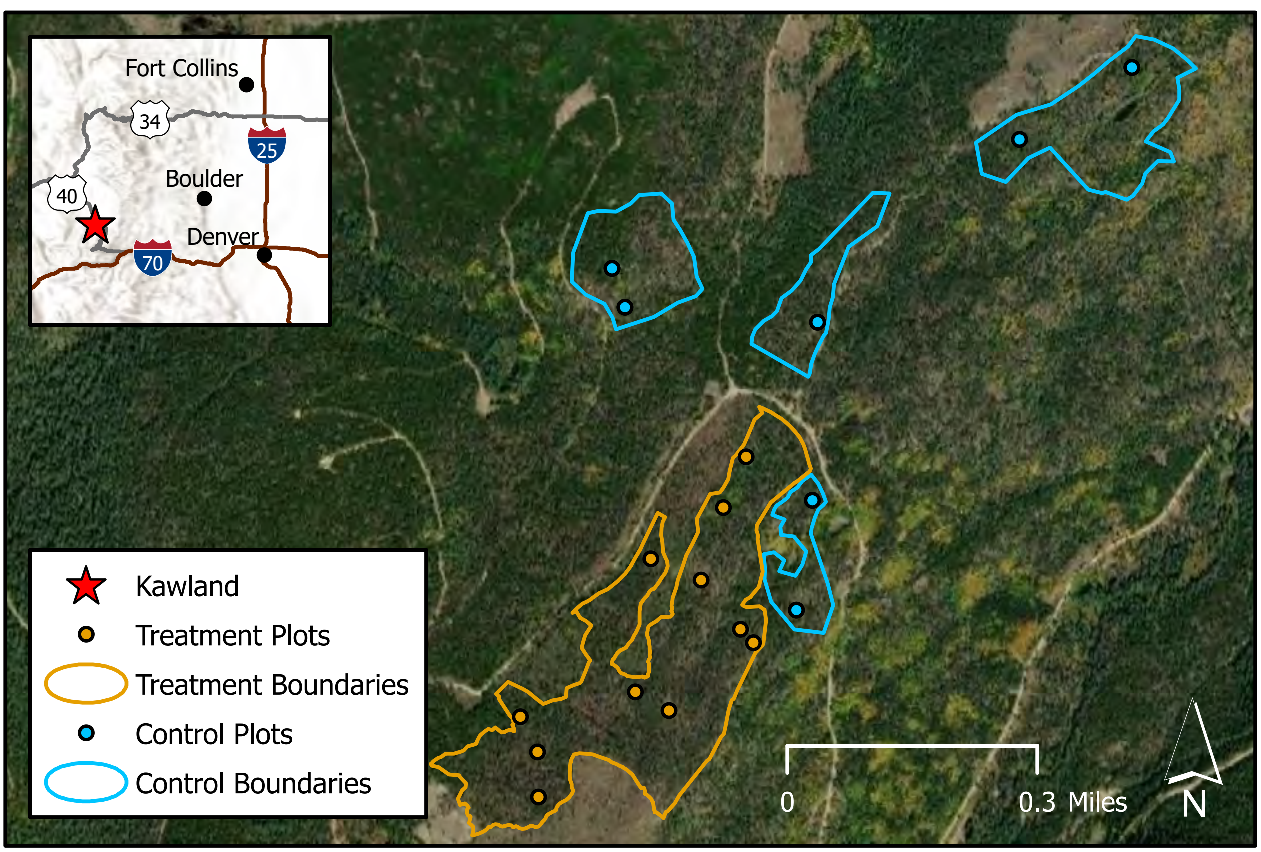


Figure 1. Map of project location, unit boundaries, and monitoring plots.

Pre-treatment **Post-treatment**

Figure 2. Pre- and post-treatment photos. Examples of forest conditions before and after treatment. Large openings were created and woody surface fuels increased in some areas.

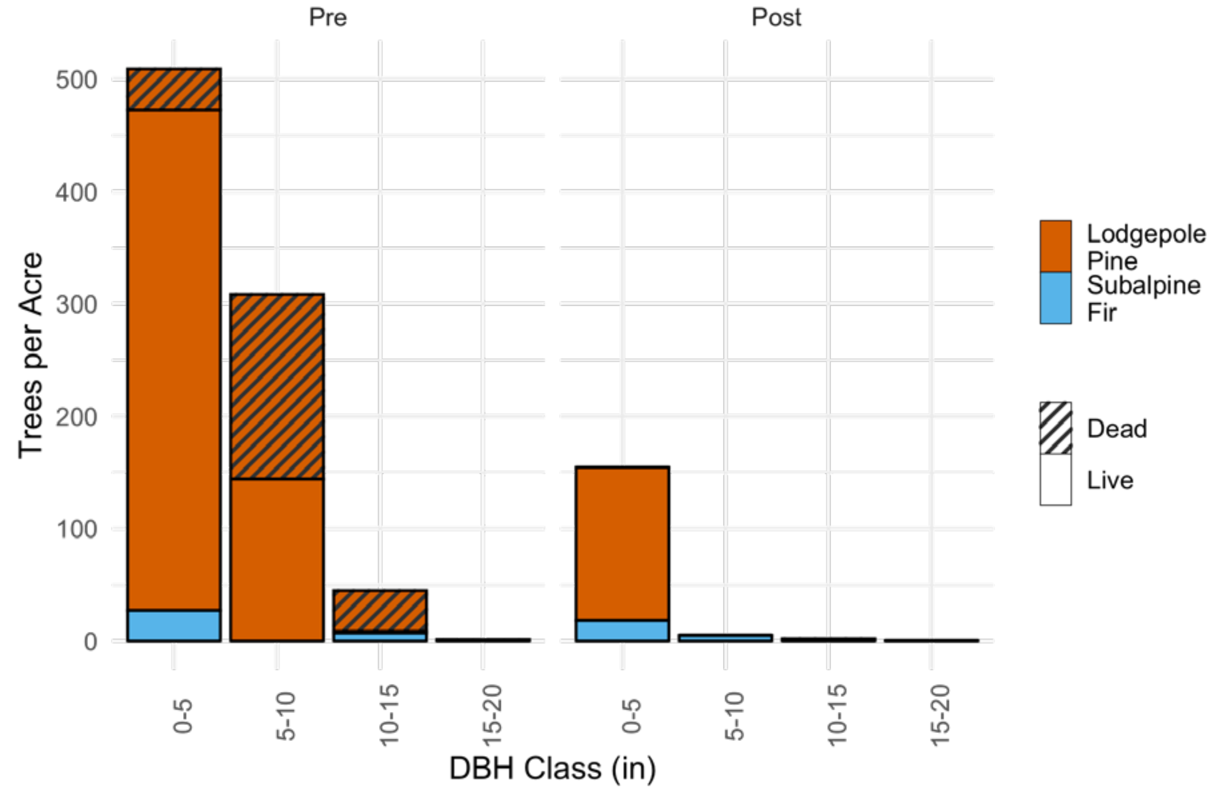
Stand structure and composition

The project removed nearly all the dead trees and reduced density overall. Subalpine fir increased in prevalence from 4% to 15% of the stand. Seedling densities were not significantly affected, potentially because they were protected from damage during logging operations by frozen ground and some snow.

Table 2. Stand characteristics (mean ± standard deviation) before and after treatment. Asterisks (*) denote a statistically significant difference at an α=0.05 level.

Phase	Live Trees per Acre	Live Basal Area	Canopy Cover	Seedlings per Acre
Pre	* 626 (405)	* 57 (32)	* 45 (23)	1,145 (985)
Post	* 161 (222)	* 8 (13)	* 7 (7)	1,009 (1,518)

PANEL A



PANEL B

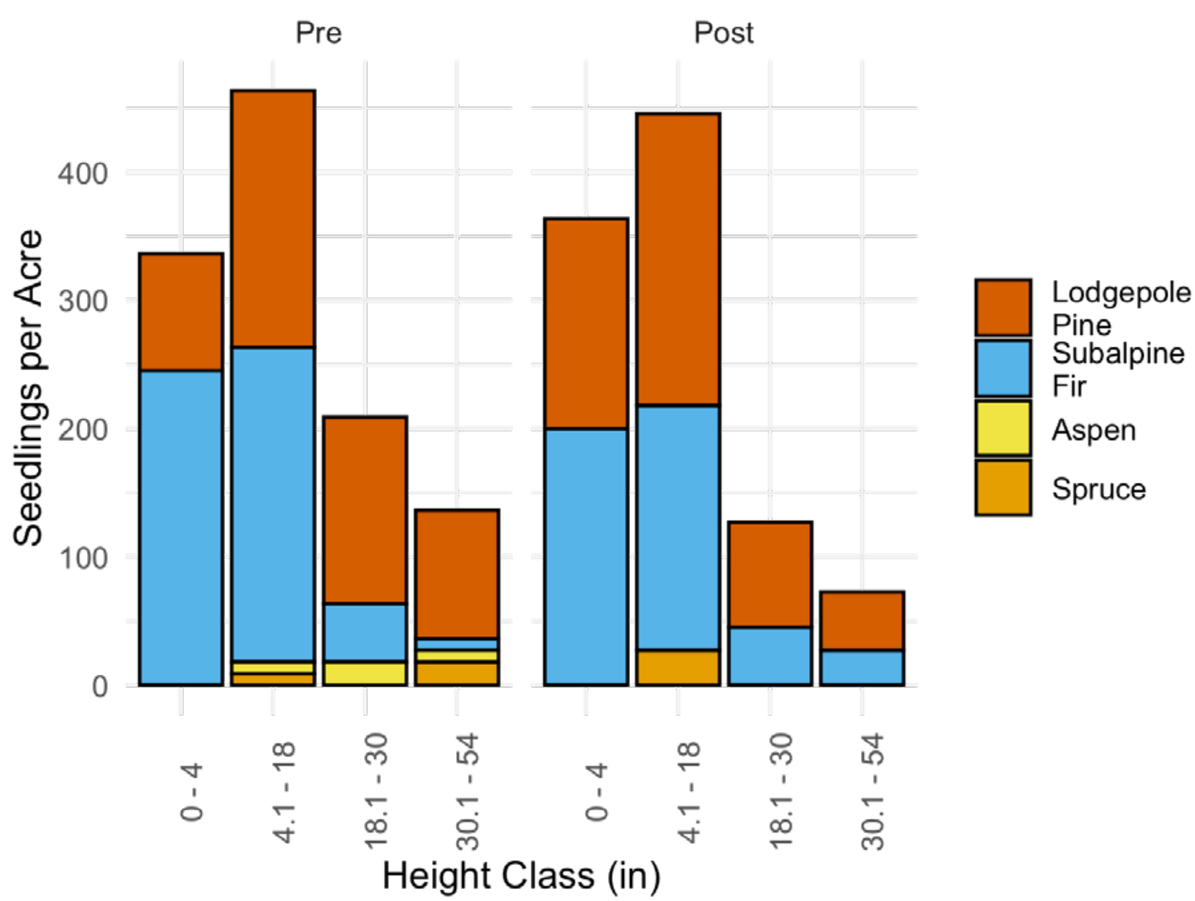


Figure 3. Panel A. Overstory trees and saplings per acre pre- and post-treatment by diameter class, species, and status.

Panel B. Number of seedlings per acre by species and height class.

Fuels and Fire Behavior

Fine woody fuel loading doubled following the treatment. Coarse woody fuel loading also increased, but this change was not statistically significant due to high variability across the unit. Shrub cover was significantly reduced; however, most shrubs were low-growing species such as kinnikinnick (*Arctostaphylos uva-ursi*) that do not have a large impact on fire behavior. Predicted tree survival under moderate fire weather conditions decreased, likely because the treatment favored smaller trees and subalpine fire which have lower crowns. Modeled flame length under severe fire conditions decreased following treatment. The windspeed needed to carry an active crown fire greatly increased as a result of the space created between residual trees. Overall, predicted fire behavior was moderated by the treatment.

Table 3. Surface fuel conditions (mean ± standard deviation) before and after treatment. Asterisks (*) denote a statistically significant difference at an α=0.05 level.

Phase	Fine Woody Fuel Loading (tons/acre)	Coarse Woody Fuel Loading (tons/acre)	Litter Depth (in)	Duff Depth (in)	Shrub Cover (%)
Pre	* 1.8 (1.7)	13.9 (14.8)	0.7 (0.4)	0.6 (0.3)	* 33.4 (14.9)
Post	* 3.6 (4.2)	18.4 (9.5)	1.0 (0.9)	0.9 (0.6)	* 9.9 (6.6)

Table 4. To model the potential fire behavior before and after treatment, CFRI used field data with the Forest and Vegetation Simulator Fire and Fuels Extension (FFE-FVS). Surviving tree basal area under moderate fire weather conditions decreased following treatment because smaller trees and species with lower crowns remained on the site. Flame length decreased under severe fire conditions.

Phase	Pre		Post	
Fire Weather Conditions	Moderate	Severe	Moderate	Severe
Total Flame Length (feet)	2	24	3	13
Surviving Tree Basal Area (%)	23	1	15	1

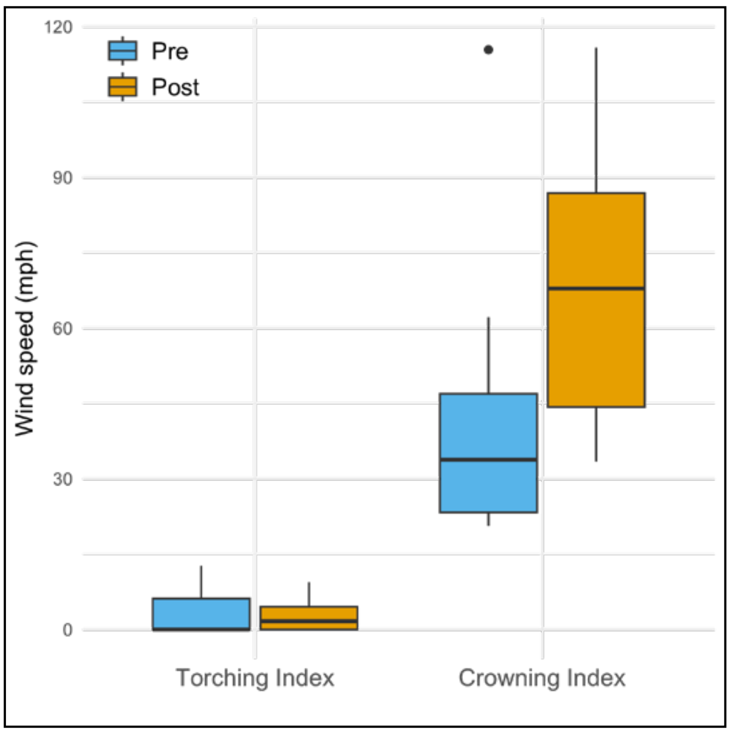


Figure 4. The figure shows the range of predicted windspeeds needed to initiate crown fire activity or torching (Torching Index), and to carry an active crown fire (Crowning Index). There was a large increase in Crowning Index following treatment due to the space between remaining trees. The lack of change in Torching Index indicates that many remaining trees have low crowns.

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