



Kawland Monitoring Summary: 3 years post-treatment

Goals and Objectives

Kawland was a fuels reduction project near Winter Park, CO that focused on reducing fire hazard in lodgepole pine-dominated stands with high tree mortality from mountain pine beetle. This project 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 understory plants before treatment and at 1- and 3-years following treatment.

Highlights

Overall, the treatment decreased tree density, greatly increased woody surface fuels, and increased understory plant cover and diversity. The majority of beetle-killed trees were removed by the treatment and live tree density was substantially reduced. Three years following treatment, lodgepole pine seedling density increased, as expected due to the creation of large openings. Woody surface fuel loading increased after the treatment, especially in masticated areas, and remained high three years later. While the overstory removal diminished crown fire hazard, high woody surface fuel loading could present challenges to fire containment. Understory plant cover initially decreased following treatment, but has since increased significantly by the three-year post measurement. Species richness and diversity also increased in the treated area over time. Openings in the canopy promoted conditions that facilitate growth and expansion of understory plant species.

Table 1. Project Information Table

Implementation Agency	USFS, Sulphur RD
Ownership	USFS
Year Completed	2020
Acres Monitored	50 (Unit 88)
Years Monitored	2018, 2021, 2023
Forest Type	Lodgepole pine
Implementation Method	Non-sawtimber harvest and removal
Slash Treatment	Whole tree yarding, lop and scatter, piles and mastication by landings

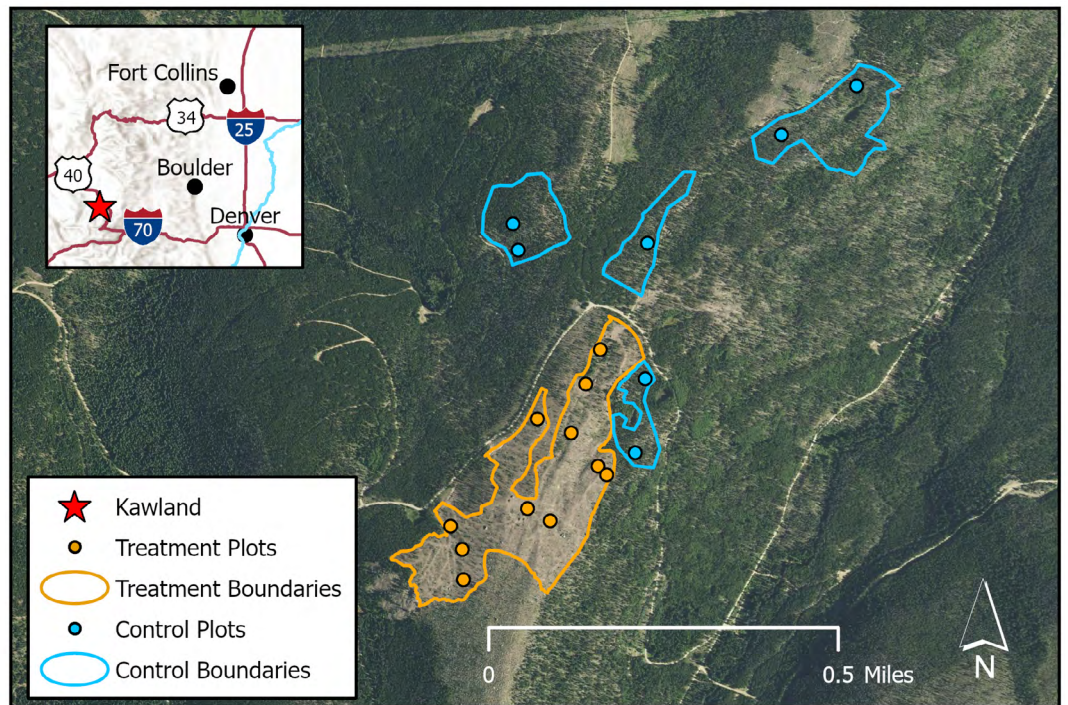


Figure 1. Map of the treatment and control units. Eleven plots were installed at random locations within the treatment unit. Seven plots were installed in neighboring control units.

Pre



1 year Post



3 year Post



Figure 2: Photo time series of two CFRI monitoring plots showing forest conditions pre-treatment (2018), large openings created 1 year post-treatment (2021), and understory vegetation regrowth 3 years post-treatment (2023).

Stand structure and composition

Methods: Trees were measured in 11 plots across the treatment area. Variable radius plots were used to capture trees with DBH equal to or greater than 5 inches, while seedlings and saplings were measured in a 1/100th acre subplot.

Results: Tree density and canopy cover were significantly reduced (Table 2, Figure 3). The number of seedlings per acre did not change from before treatment to one year following treatment. However, lodgepole seedling density increased by 50% three years following treatment (Figure 4). The increase in seedlings was expected after large openings were created but it was not statistically significant due to high variability (Table 2).

Table 2. Stand characteristics (mean ± standard deviation) before, 1 year post-treatment, and 3 years post-treatment. Asterisks (*) denote a statistically significant difference from pre-treatment values at an $\alpha=0.05$ level.

Phase	Canopy Cover (%)	Seedlings per Acre
Pre	45 (23)	1,145 (985)
1 year Post	* 7 (7)	1,009 (1,518)
3 year Post	*6 (12)	1,555 (2,349)

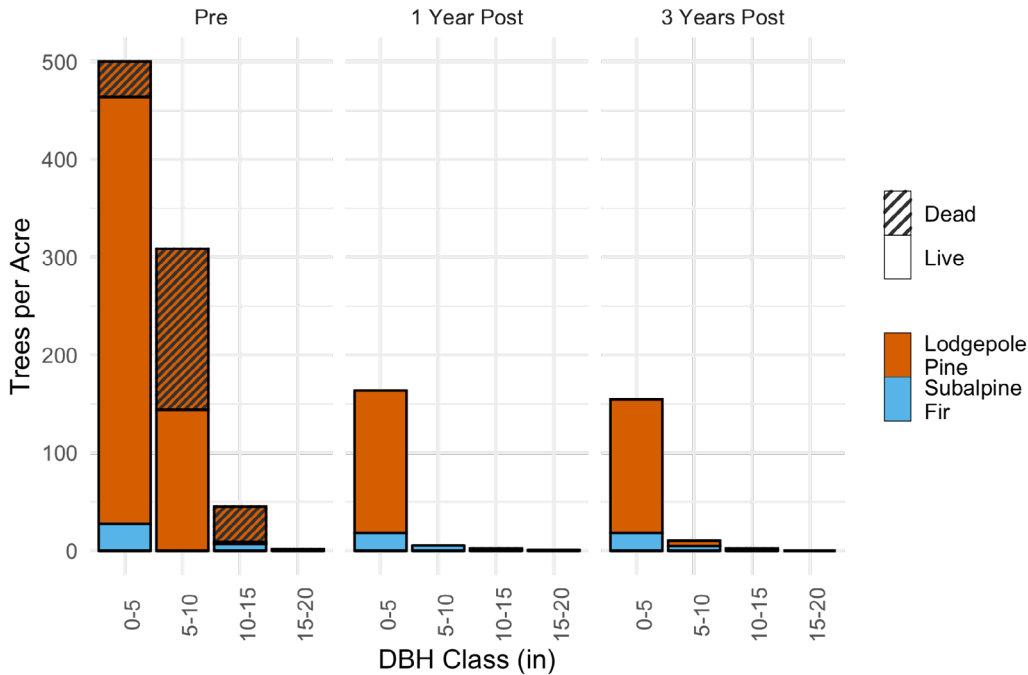


Figure 3: Tree density by species and diameter class in the treatment unit before, 1 year post-treatment, and 3 years post-treatment.

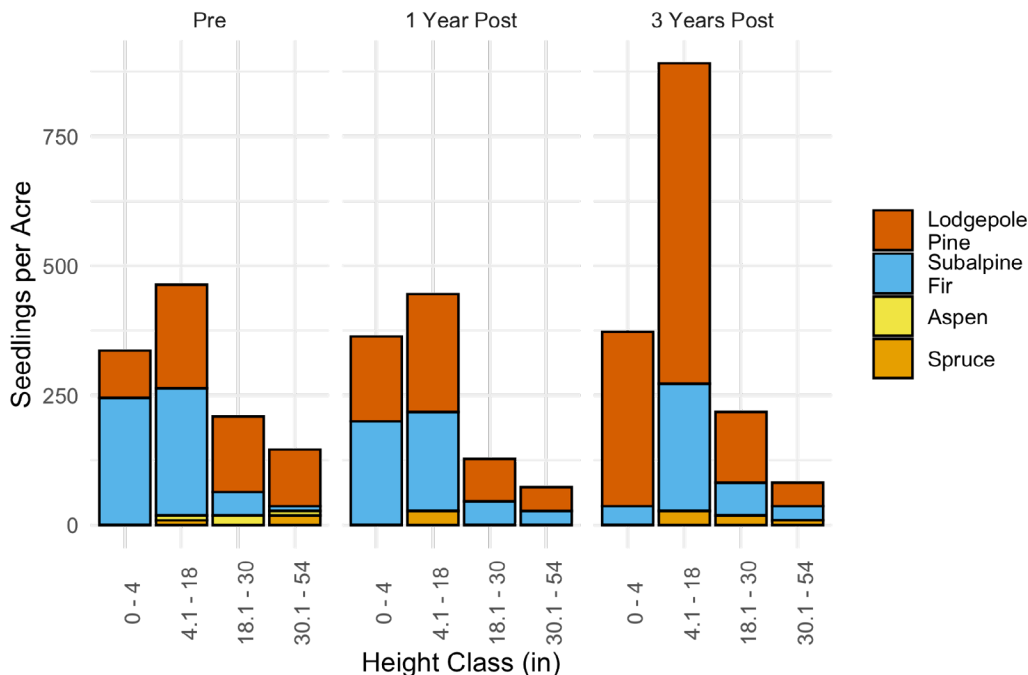


Figure 4: Seedling density by species and height class in the treatment unit before, 1 year post-treatment, and 3 years post-treatment.

Fuels

Methods: Fine woody fuel loading was estimated using the photoload method in 3 quadrats per plot. When masticated wood was too deep to estimate using the photoload method alone, depth of the masticated fuelbed was recorded within each quadrat. Coarse woody fuel diameters and lengths were measured within a 1/100th acre subplot.

Results: Fine woody fuels increased considerably following the treatment (Table 3). About 10% of the sampled area was masticated; average fine woody fuel loading across masticated subplots ranged from 14 tons/acre to 165 tons/acre. Masticated fuelbed depth decreased over the three years following treatment, but remained high in localized areas. Coarse woody fuels experienced a steady increase over the three years following treatment (Table 3).

Table 3. Surface fuel conditions (mean \pm standard deviation) before, 1 year post-treatment, and 3 years post-treatment. Asterisks (*) denote a statistically significant difference from pre-treatment values at an $\alpha=0.05$ level. Due to small sample sizes, no statistics were conducted on mastication depth.

Phase	Mastication Depth (inches)	Fine Woody Fuel Loading (ton/acre) Excluding Masticated Area	Coarse Woody Fuel Loading (tons/acre)
Pre	0	1.8 (1.7)	13.9 (14.8)
1 Year Post	10.5	3.6 (4.2)	18.4 (9.5)
3 Year Post	7.8	2.8 (2.0)	* 22.2 (8.2)

Understory

Methods: Data was collected at 11 treatment plots and 7 control plots to assess the changes in understory species cover, richness, diversity, and native vs introduced status. At each plot, the line point intercept method was used along 8 transects for a total of 200 points. In addition, all species within a 1/10th acre plot were recorded to calculate species richness.

Results: The percent cover of understory vegetation in the treated area decreased in the first-year post treatment, mainly due to a reduction in shrubs (Figure 5). However, 3 years post treatment the overall percent cover increased due to increases in all growth forms. In the same time span, understory percent cover fluctuated in the control areas, with an overall decrease 1 year post, and an increase 3 years post, but still a smaller percent coverage than the initial 2018 measurement. Species richness, or average number of species identified within a 1/10th acre plot, increased slightly in the treatment area one year post, and continued to trend upward three years post-treatment (Figure 6). This trend was largely driven by an increase in native species. The control areas did not have large changes in species richness over the measurement period. Species diversity in the control plots remained unchanged one year post, with a small increase three years post (Figure 7). The treated area steadily increased in diversity both 1 and 3 years after the treatment.

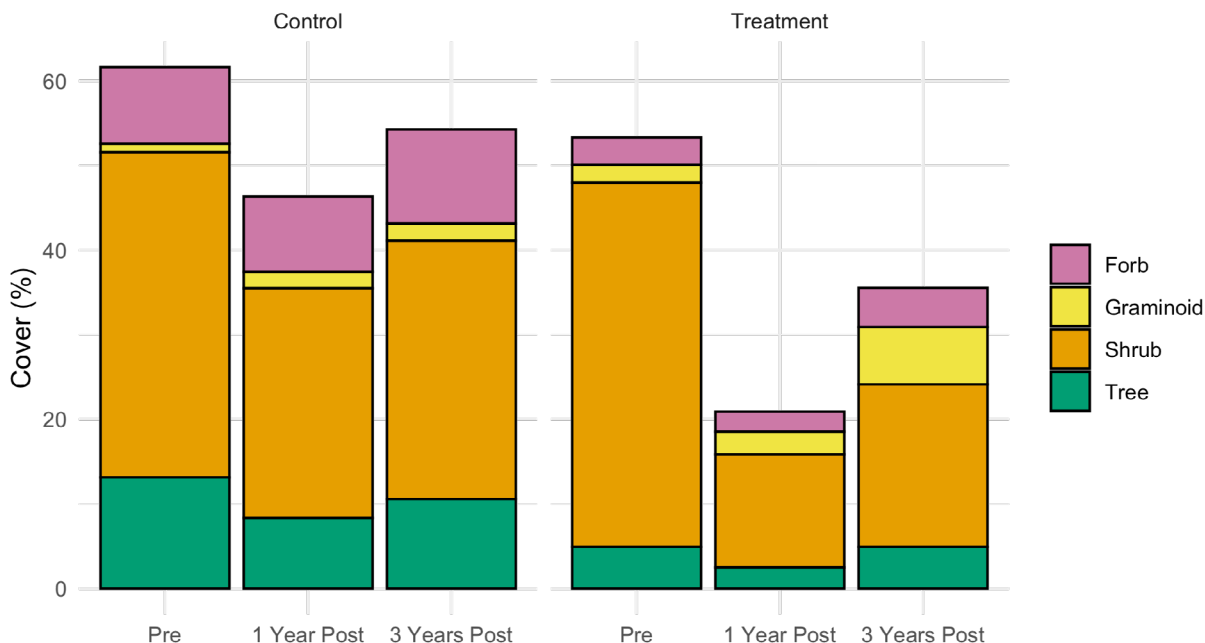


Figure 5. Percent total cover by growth form within the control and treatment units over time.

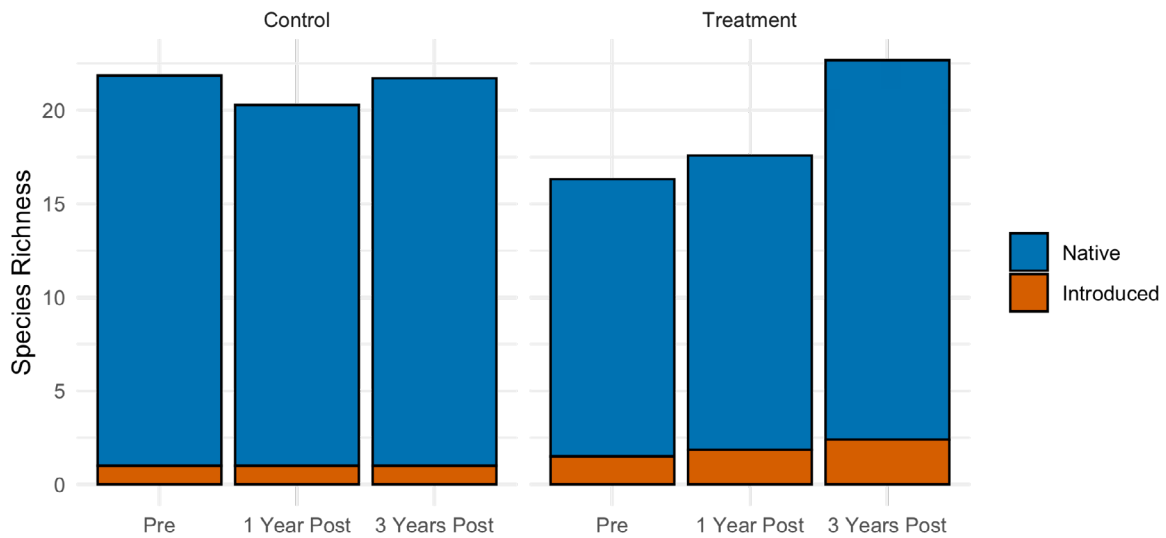


Figure 6. Plot average species richness by native status within the control and treatment units over time.

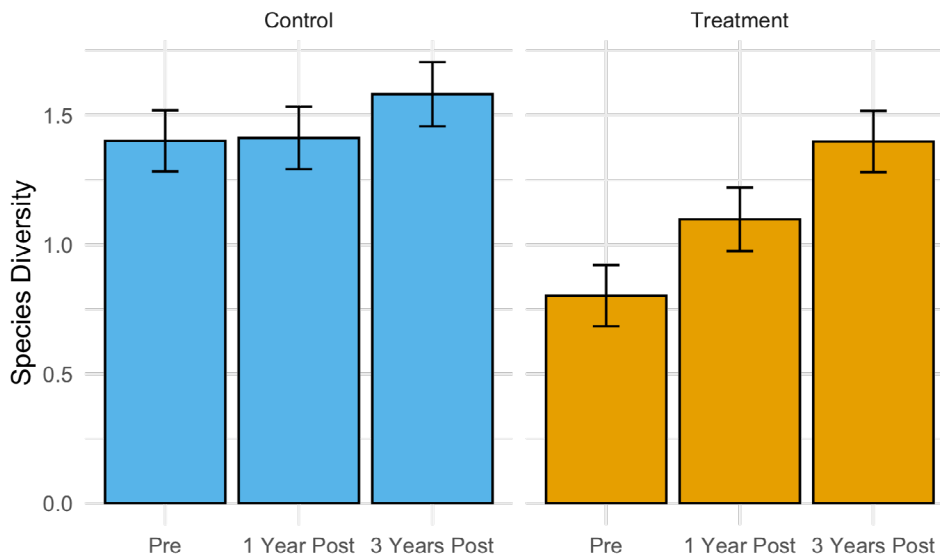


Figure 7. Plot average Shannon's diversity index in the control and treatment units over time.

Funding for this study was generously provided by CFRI through the Southwest Forest Health and Wildfire Prevention Act and by Denver Water and the US Forest Service through the Forest to Faucets Partnership.