COLORADO FOREST RESTORATION INSTITUTE
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Green Mountain Prescribed Fire: Post-Burn Monitoring Report

Overview

The Green Mountain Prescribed Fire is a forest management project covering approximately 1,200 acres within the South Platte Ranger District on the Pike-San Isabel National Forest in Jefferson County (Figures 1 and 2). The project is located in the Buffalo Creek area, which hosts several other forest management initiatives, including the Sand Springs Prescribed Fire (Slack et al. 2023), Spring Creek, Nighthawk, Osprey, and Long Scraggy (NOS) projects (Slack et al. 2021). Green Mountain and the surrounding projects are strategically located to mitigate the impacts of wildfire on the Upper South Platte Watershed. The Green Mountain project area was mechanically thinned in 2018 as part of the Little Morrison Restoration Project (Slack et al. 2021). In June 2024, the South Platte Ranger District conducted a broadcast burn on 533 acres (Figure 1, Table 1; SPRD 2024). The combination of both mechanical thinning and prescribed fire is an effective treatment in lowering subsequent wildfire severity in the western US (Davis et al. 2024). The Colorado Forest Restoration Institute (CFRI) established monitoring plots across two of the Green Mountain burn units to track changes in forest structure, woody fuels, and understory plants.

Figure 1. Photo of the Green Mountain prescribed fire actively burning through a CFRI monitoring plot in June of 2024. Photo taken by Andrew Slack.

Goals & Objectives

CFRI used the objectives described in the Green Mountain Burn Plan to monitor outcomes for this prescribed burn (SPRD 2022). Objectives were split into ecological goals ("Resource Objectives") and operational objectives ("Prescribed Fire Objectives").

Resource Objectives

1. Reduce the overall fuel loading to lessen the risk and impacts of high-intensity wildland fire.
2. Reintroduce prescribed fire into fire adapted ecosystems to restore historical fire regimes and condition class ratings.
3. Create sustainable forest conditions that are resilient to fire, insects, and diseases, while providing for diverse wildlife habitats, recreational opportunities, and sustainable watershed conditions.

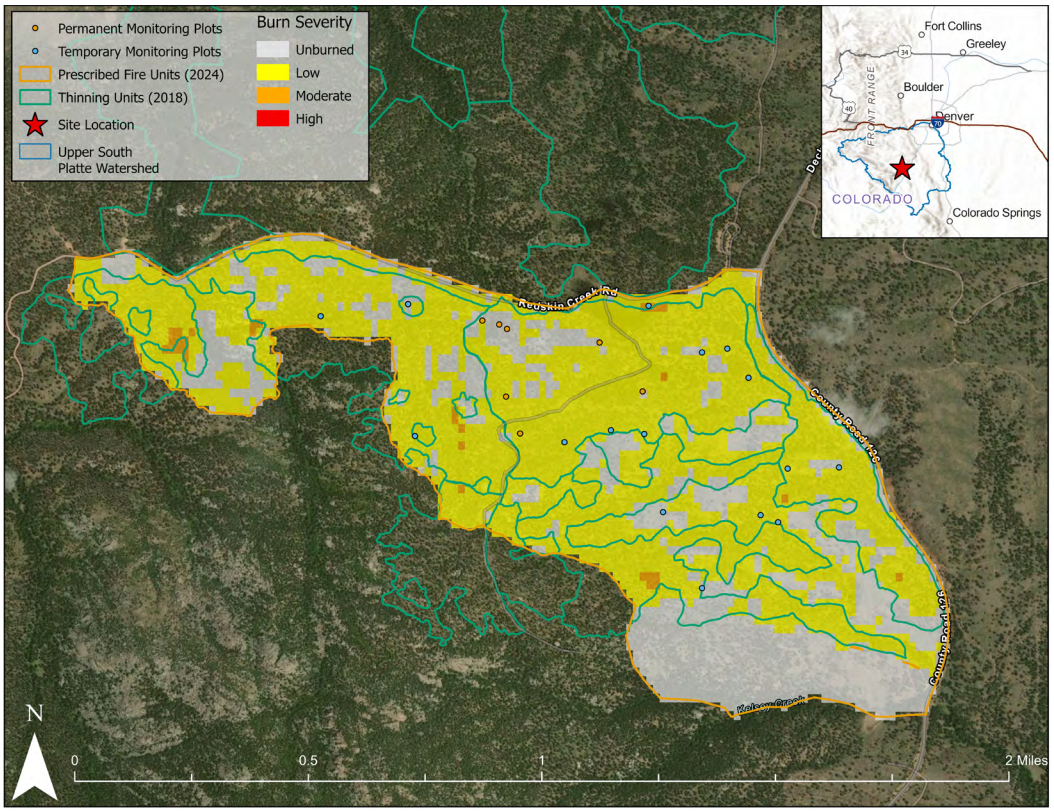

Figure 2. Map of Green Mountain prescribed fire project area, located near the town of Bailey in the Upper South Platte watershed. The burn severity map was calculated using aerial imagery to determine the difference in Normalized Burn Ratio (dNBR; Key and Benson 2006).

Prescribed Fire Objectives

1. Provide for public and firefighter safety and protect both on and off-site values.
2. Introduce fire to a minimum of 75% of the flammable grasses, litter and 1-100 hour fuels, measured by ocular estimate immediately post burn.
3. Thermally thin stands, create small openings and remove ladder fuels with no less than 6-foot scorch heights measured by ocular estimates immediately post-burn.

   Acceptable overstory mortality:

Size Class (DBH)	Douglas-fir	Ponderosa Pine
Biomass (<12”)	50-100%	50-75%
Overstory (>12”)	30%	5%

4. Achieve the following consumption objectives:

Natural and Activity Fuels	Goal	Acceptable Range
1-hour	70%	50-100%
10-hour	60%	50-90%
100-hour	50%	30-80%
Duff	50%	0-60%

Long-term monitoring at Green Mountain will be needed to fully examine the outcomes for Resource Objective 3 and components of Prescribed Fire Objective 3. Evaluation of Prescribed Fire Objective 1 is beyond CFRI’s scope of analysis.

Table 1. Project information.

Implementation Agency	Pike-San Isabel National Forest, South Platte Ranger District
Ownership	US Forest Service
Funding	Forests to Faucets
Forest Type	Dry mixed-conifer
Year Completed	2024
Implementation Method	Mechanical thinning (2018); Prescribed fire (2024)
Acres Treated	438 (Thinning); 533 (Prescribed fire)
Acres Monitored	460
Years Monitored	2017 (pre-thin), 2018 (post-thin), 2020 (pre-burn), 2024 (post-burn)

Methods

CFRI partners with the Pike-San Isabel National Forest and Denver Water through the Forests to Faucets Partnership to collect monitoring data at permanently established plots and evaluate the long-term outcomes of forest management in the Buffalo Creek area. Field data was collected pre- and post-thinning (2017, 2018), and pre- and post-prescribed fire (2020, 2024; Figure 3) to monitor changes in forest overstory, tree regeneration, surface fuels, and understory plant communities. Coarse woody fuels data is not collected in the immediate post-burn protocol, and will be included in future summaries.

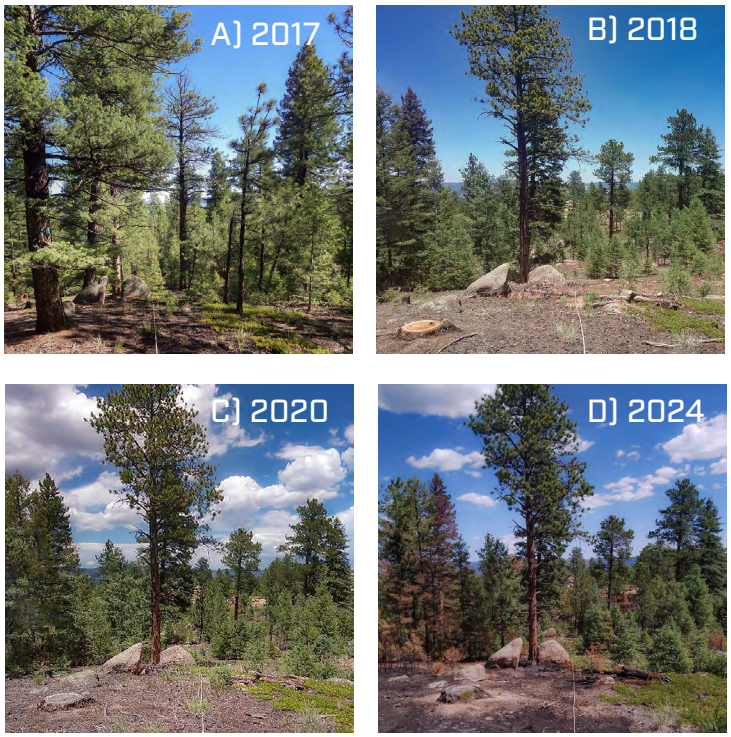

Figure 3. Photo time series of a CFRI monitoring plot in the Green Mountain prescribed fire showing conditions prior to forest thinning (A, 2017), reduced tree density after thinning (B, 2018), surface vegetation growth post-thinning and before prescribed fire (C, 2020), and surface fuel and minor vegetation consumption after prescribed fire (D, 2024).

Field data was collected at 6 plots permanently established within two of the Green Mountain burn units (Figure 3). An additional 18 plots were temporarily added for immediate post-burn data collection in order to better capture the variability in surface fuel conditions and burn severity. Since these 18 plots do not have corresponding pre-treatment data, they will not be visited again for additional monitoring. Five of the permanent plots and 15 of the temporary plots burned, establishing a sample size of 20 plots for this report. Fire effects on the forest floor were classified in 12 subplots within a 1/10th acre area at each plot (240 subplots total). A detailed description of our field data collection methods can be found in the Post-Wildfire Mothership Plot Protocol (CFRI, 2020). In the future, monitoring crews will visit plots 1- and 5-years post-burn to collect additional data.

Highlights

The Green Mountain Prescribed Fire successfully reintroduced fire into a fire adapted ecosystem and reduced the overall fuel loading of the project area (Resource Objectives 1 and 2). Overall fire severity was mixed, where differences in the normalized burn ratio (dNBR) showed widespread low severity in the burn units (Figure 2). However, the field monitoring plots captured relatively higher burn severity (Figure 4), when compared to other prescribed fire projects in the area – Payne Gulch (Slack et al. 2024) and Sand Springs (Slack et al. 2023). It is possible the dNBR underestimated actual burn severity because not enough time had elapsed between the burn and when the image was captured, and the coarse resolution of satellite imagery can miss fine-scale pockets of high severity. Although the burn severity results from dNBR indicate low severity (Figure 2), the monitoring plots captured a majority of the area burned, significant changes in fuel loading, and variable crown scorch.

Within the 20 monitoring plots that captured the burn, 64% of surface vegetation and 68% of surface substrate (fine woody fuels and inorganic matter) burned at ranging severities of lightly scorched to moderately burned (Figure 4). These metrics of burn coverage nearly meet the threshold defined in Prescribed Fire Objective 2, but are within the acceptable target range in Prescribed Fire Objective 4. Fine woody fuels demonstrated a significant decrease in fuel loading following the burn when compared to pre-burn conditions (p-value <0.02); post-burn fine woody fuel loadings were similar to pre-thin levels, stressing the critical need to utilize prescribed burns to manage the increase in surface fuel loading following thinning activities (Figure 5, Resource Objective 1). Similarly, both litter and duff loadings following the burn were significantly lower than pre-thin levels (p-value = 0.0001), showing that the combination of thinning and prescribed fire is necessary in lowering both surface and ground fuel loading (Figure 5).

Crown volume scorch, maximum scorch height, and stem char height on both overstory and sapling trees were all

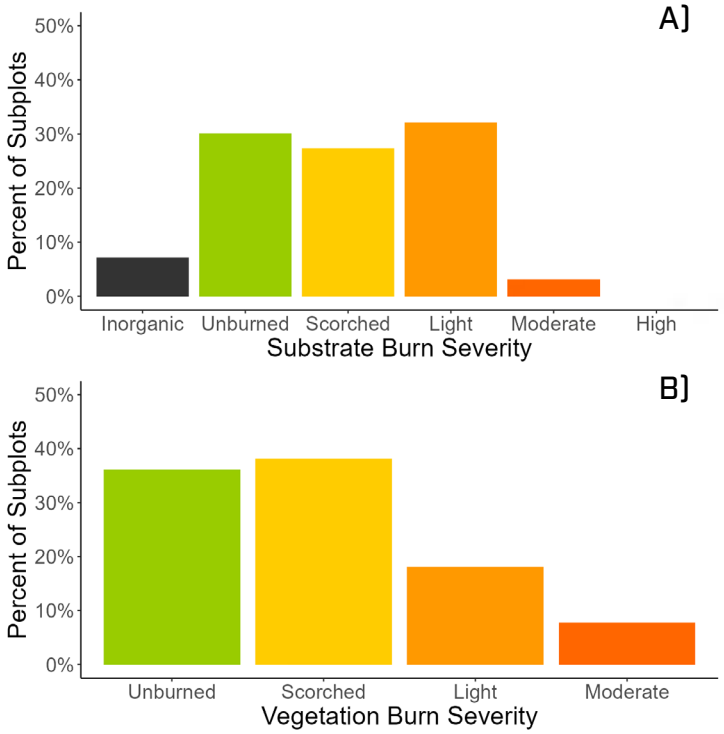

Figure 4. Forest floor burn severity for substrate (i.e. dead and inorganic material, A) and vegetation (B). Burn severity was low within monitoring plots but relatively uniform, with 68% of surface fuels burned and 64% vegetation burned following broadcast burning.

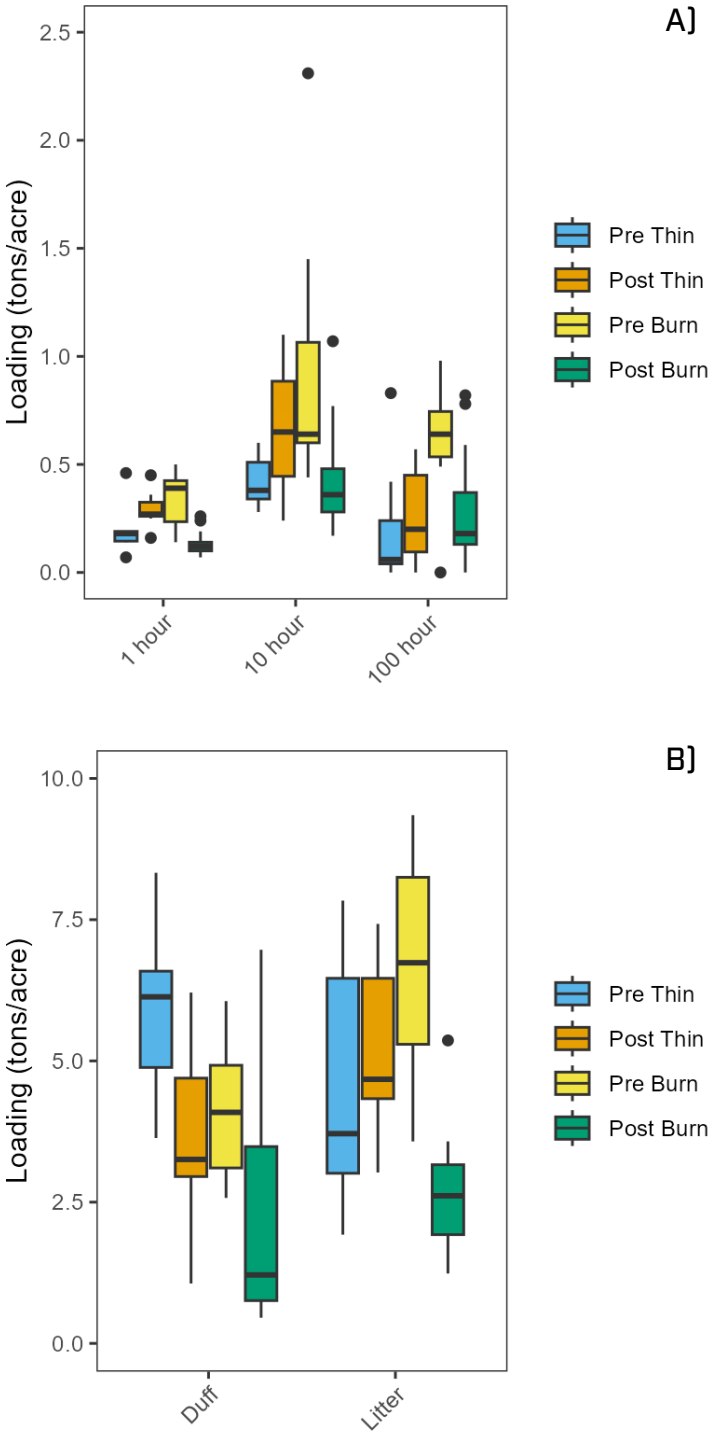

Figure 5. Changes in surface fuel loading for fine woody fuels (i.e. 1-, 10-, and 100-hour fuels, A) and litter and duff (B).

highly variable within burned plots (Table 2). For overstory trees, crown scorch ranged from 0-90% with an average scorch volume of 19%, maximum crown scorch height ranged from 0-67 feet, with an average maximum height of 27 feet, and maximum stem char height ranged from 0-38 feet, with an average maximum height of 4.3 feet. CFRI applies the term scorch with respect to tree crowns and char with respect to tree stems. "Scorch heights" in the context of Prescribed Fire Objective 3 seemingly refers to what CFRI denotes as "stem char." Under this assumption, average stem char heights fall slightly short of 6-foot scorch heights defined in Prescribed Fire Objective 3, however the 6-foot target metric was met within the range of measurements. For saplings, crown scorch ranged from 0-100% with an average crown volume of 22%, maximum scorch height ranged from 0-18 feet with an average maximum height of 3.6 feet, and maximum stem char height ranged from 0-5 feet with an average maximum height of 0.74 feet. Across all plots, there was 3% mortality of overstory trees and 11% mortality of saplings.

Table 2. Percent of crown volume scorched, maximum foliage scorch height, and maximum stem char height on overstory and sapling trees. The standard deviation is in parentheses.

	Crown Volume Scorch (%)	Max Scorch Height (ft)	Stem Char Height (ft)
Trees	19 (25)	27 (19)	4.3 (5.6)
Saplings	22 (34.4)	3.6 (5.4)	0.74 (1.3)

*Saplings are <5 inches DBH and ≤4.5 feet tall

The impacts that the Green Mountain fuel reduction projects have had on the forest ecosystem have contributed to resiliency in a fire prone environment and a baseline for managers to sustain resilient conditions. All goals and objectives for this broadcast burn were nearly or completely met. For future burns, managers may want to specify goals (see Resource Objective 3) to avoid general language and include target metrics that can be measured, as in Resource Objectives 1 and Prescribed Fire Objectives 2 and 4. In short, managers should take note that the actions taken to burn these units safely and consistently were effective in meeting their goals, and the use of prescribed fire to reduce residual fuels from thinning operations is critical to ultimately lower wildfire risk.

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