DFPZ treatments reduced ladder fuels and stand densities, while retaining large trees (>30" DBH). Most trees removed were between 3"-20" DBH, consistent with the thin from below prescription.

Evaluating the effects of Defensible Fuel Profile Zone (DFPZ) treatments on forest structure and composition

The purpose of this monitoring project was to evaluate whether DFPZ treatments met project-specific desired conditions and objectives. We monitored 33 field plots in DFPZ units in the North 49 Project that received a Thin from Below treatment (Shooter Timber Sale, 767 acres). Data were collected following a Common Stand Exam protocol before and after treatment. Treatments that included commercial and precommercial thinning were implemented between 2015-2016.

Fir-dominated stand within the Shooter Timber Sale before (left) and after (right) thinning treatments were completed in 2016.

The Need for the North 49 Project

Prior to Euro-American settlement, conifer stands in the southern Cascade Mountains were characterized by fewer trees and lower fuels than observed today. Frequent, but low severity fire reduced **ladder fuels** (small trees or high shrubs growing beneath larger trees that allow fire to climb from the forest floor into the canopy). Frequent fire additionally prevented **surface fuels** (fallen trees or branches, litter, duff) from accumulating. Fire suppression throughout the 20th century has resulted in forest densification as well as fuels accumulations and increased frequency of large, high-severity wildfires.

The North 49 Forest Health Recovery Project responded to the need to reduce fuels and created **DFPZs** (Defensible Fuel Profile Zones), areas characterized by widely spaced trees, fire-resilient tree species, and reduced surface and ladder fuels where periodic low-intensity surface fires can be safely reintroduced and where wildfires can be safely fought.

North 49 Project

Project Location

The North 49 Project is within the Burney-Hat Creek Collaborative Forest Landscape Restoration Program (CFLRP) area, a 364,250 acre planning area established in 2012 that spans public, private and tribal lands. The CFLRP seeks to encourage the collaborative, science-based ecosystem restoration of priority forest landscapes. The North 49 Project was developed to improve fire-resiliency, forest health and diversity on 42,400 acres within the Hat Creek Ranger District of the Lassen National Forest. The Shooter Timber Sale implemented DFPZ treatments on 767 acres north of Highway 89 and west of Manzanita Chute.
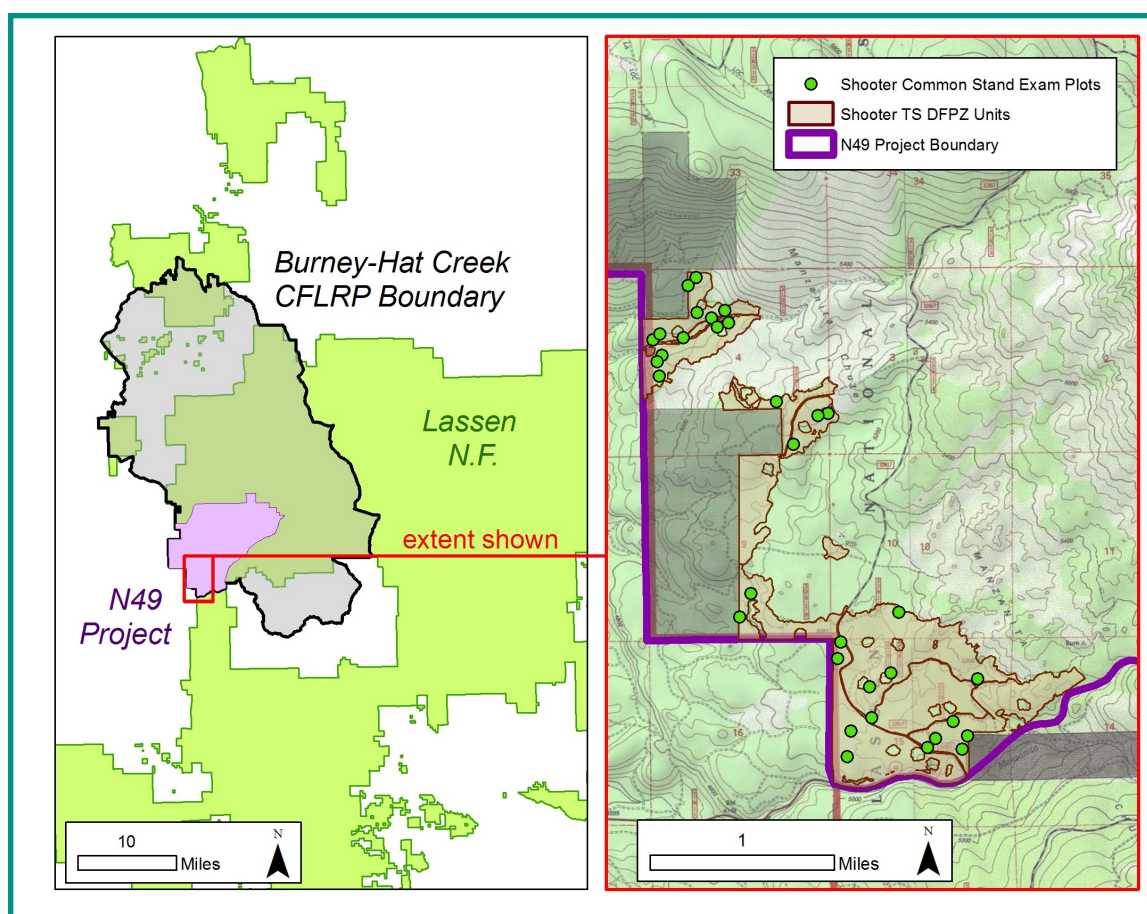
Location of the North 49 Project and Burney-Hat Creek CFLRP within the Lassen NF (left). Shooter DFPZ units and the location of Common Stand Exam (CSE) plots are shown in the map on the right.

Project Objectives

The North 49 project set specific objectives for stands within DFPZ Thin from Below treatments to improve resiliency to fire. The primary objectives were to:

- reduce ladder fuels between 3" and 30" until desired basal area levels (160-200 ft^2/acre) were attained.

- reduce stand density to within 41% and 53% of the maximum stand density for mixed conifer stands, to reduce density-related mortality for a time period of 20 years.

Monitoring Results

Monitoring Summary

Common stand exam plots were established within Shooter DFPZ treatment units in 2009 and 2010, prior to the implementation of treatments in 2015 and 2016. Thirty-three plots were re-measured post-treatment, in Fall 2016. These repeated measures allowed us to assess changes in tree density, basal area, and size class using pre– and post-treatment data, and to assess whether post-treatment conditions met project objectives and/or moved stand conditions closer to **NRV**.

What is the Natural Range of Variation (NRV)?

NRV refers to the range of conditions that would have occurred in these conifer forests under the natural fire regime. NRV can be expressed for numerous metrics of stand structure and composition, including trees per acre, relative stand density, and species composition.

Were ladder fuels reduced?
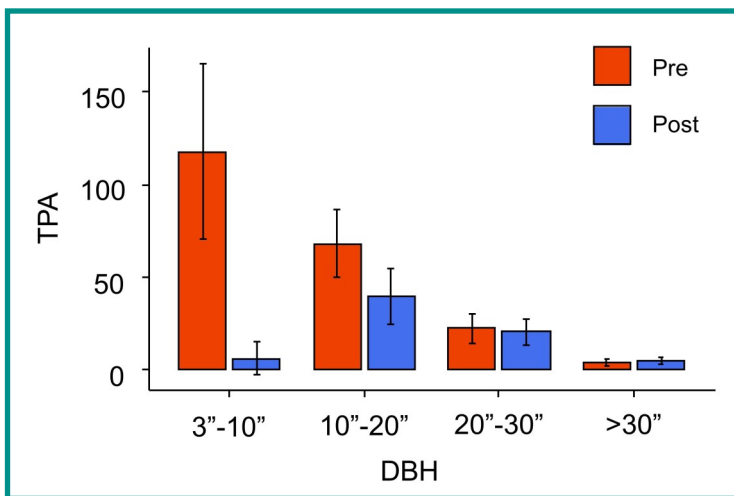
Trees per Acre by Size Class

Treatments resulted in a significant reduction of trees between 3" and 20" DBH, with no significant reduction in larger trees. Prior to treatment, the number of trees in the smallest size class (3"-10" trees per acre) averaged 118 trees/acre; this was reduced to an average of 6 trees/acre after treatment. Treatments shifted the distribution of size classes from a reverse J-shape distribution (i.e., a dominance of trees in smaller size classes) to a more even or hump-shaped distribution that is closer to what would be expected under NRV. Error bars display the 95% confidence interval.

Total Trees per Acre

Under presettlement conditions, the total number of trees per acre has been estimated at between 32 and 130 trees per acre. Treatments reduced the total number of trees greater than 3" DBH from an average of 213 trees per acre, to an average of 72 trees per acre. This brought most plots within the range that would be expected under NRV. Error bars display the 95% confidence interval.
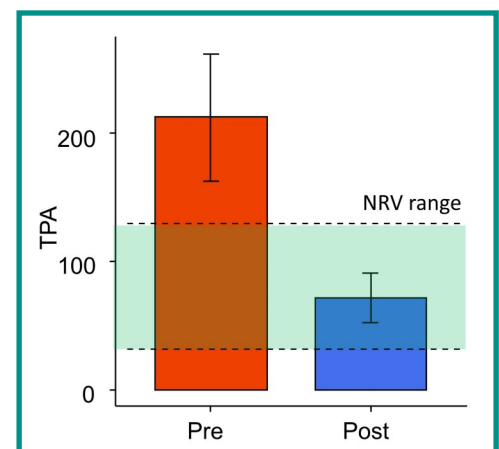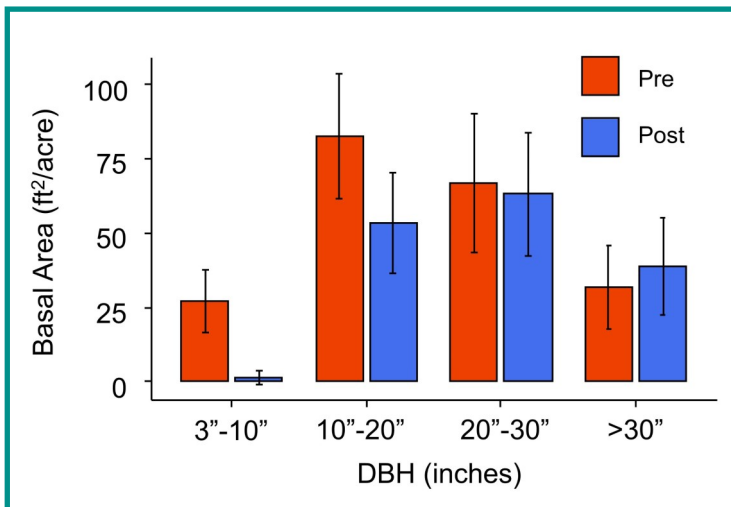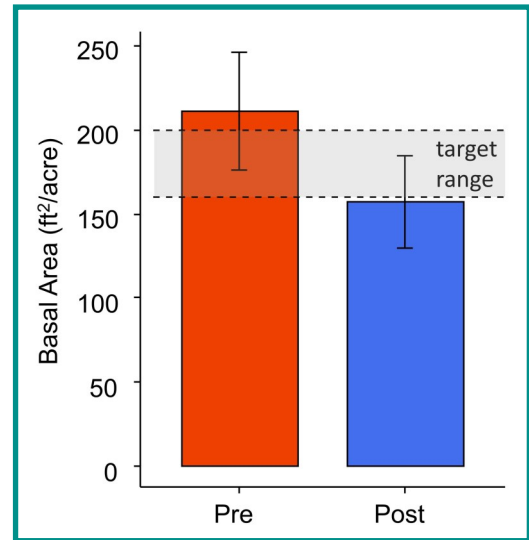
Were basal area targets achieved?

Overall Basal Area

Stands averaged 210 ft^2/acre of basal area prior to treatment, which exceeded the treatment target range. Post-treatment, basal area averaged 157 ft^2/acre, which was just under the target range of 160-200 ft^2/acre. Error bars display the 95% confidence interval.


Basal area by Size Class

Treatments resulted in a significant reduction of basal area in trees between 3" and 10" DBH. Treatments also decreased basal area of trees in the 10-20" DBH size class, with little change in trees between 20-30" DBH, and no reduction in trees >30" DBH. Error bars display the 95% confidence interval.

# Were stand density targets achieved?

Relative Stand Density Index (rSDI)

Relative stand density takes into account basal area and the average size of trees in the stand to identify density thresholds where stands may experience inter-tree competition and diminished growth. Prior to treatment, stands averaged 58% of the maximum stand density for mixed conifer forest. Post-treatment, relative stand density was reduced to 38%, just under the desired range of 41%-53%. Under NRV, stand densities averaged less than 35% relative SDI.
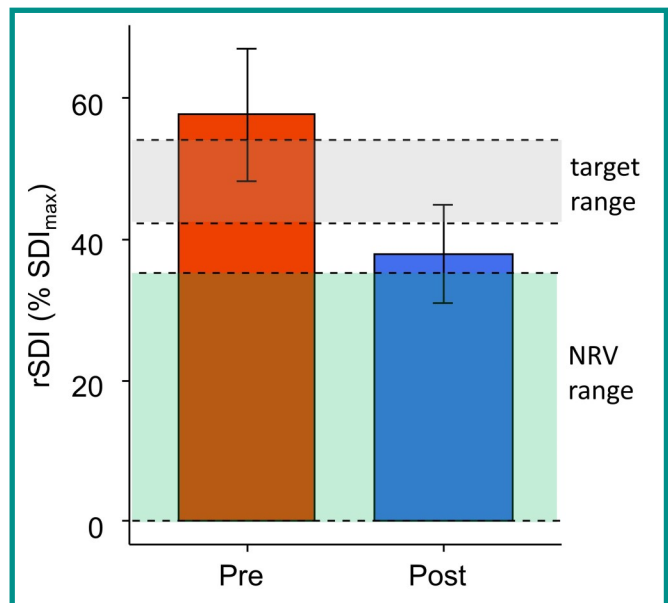
# Were there other changes to stand structure and composition?
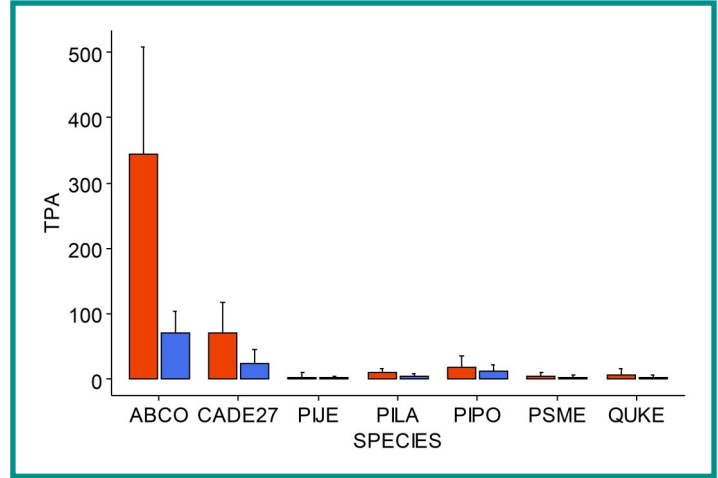
Mean tree diameter

Removal of trees in the smallest size classes increased the mean diameter of trees from an average of 8" DBH (pre-treatment) to 17" DBH (post-treatment). The project objective was between 9"-22" DBH.

Species composition

Treatments reduced the density of white fir; however it remains dominant in post-treatment stands. The mean proportion of white fir (ABCO) decreased from 76% (pre-treatment) to 59% (post-treatment) in plots. Under NRV, shade-intolerant pine (PIJE, POLA, PIPO) would have comprised a greater fraction of trees relative to shade-tolerant fir.
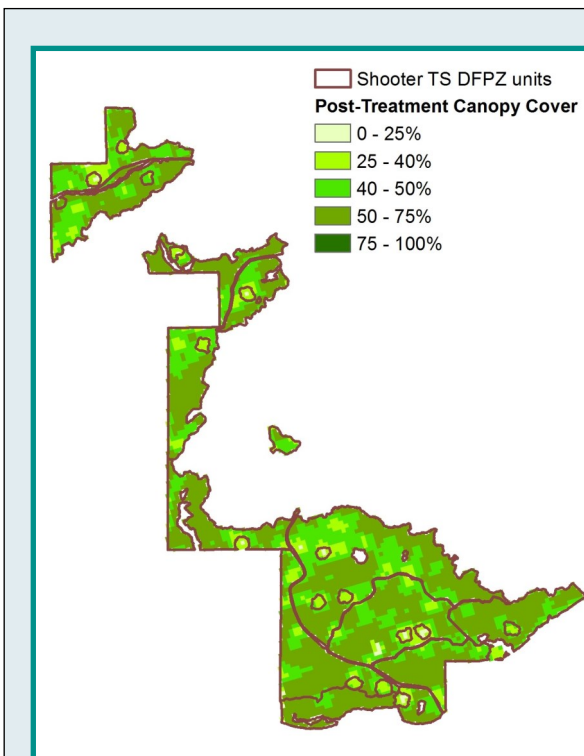
Canopy Cover

F3 modelling (USDA FS 2021) interpolates forest metrics from Forest Inventory and Analysis data across the landscape within 30m x 30m pixels. While we lack pre-treatment data from F3, post-treatment canopy cover is modelled at 51% across DFPZ treatment units, a value at the higher end of the target range of 40% - 50%. The map to the left shows the horizontal heterogeneity across treatment units, and includes 2-acre group selections scattered within the DFPZ units that introduce further breaks in the canopy. These group selections were replanted in 2019.

Summary of key findings

This project addressed the following monitoring questions from the Burney Hat Creek CFLRP Ecological Monitoring Strategy:

FOR.1.3. What are the effects of thinning and prescribed fire treatments on tree survival, mortality, and regeneration?

IMP.1.Were the project-specific objectives, design features, and mitigation measures identified during the planning

- Treatment objectives were largely met in the Shooter Defensible Fuel Profile Zone (DFPZ) unit. The DFPZ treatment reduced tree density and basal area, increased mean tree diameter, and maintained canopy cover at approximately 51%.

- Trees greater than 30" DBH were retained, with most reductions in density and basal area occurring in the smallest (3"-10" DBH) size class; this is consistent with the Thin from Below prescription.

- Treatments reduced tree density to within the range expected under the Natural Range of Variation (NRV). Relative stand density after treatment exceeded 35% in most plots, however treatments moved stands substantially closer to NRV for this metric.

- We were unable to compare pre- and post-treatment fuel loads because post-treatment data were collected before surface fuel treatments (i.e., machine piling, pile burning) were completed.

This stand was reduced from a pre-treatment basal area of 320 ft^2/acre to 160 ft^2 per acre.

Summary of metrics, project-specific objectives, and pre– and post-treatment values

Metric	Objective	Pre-Treatment	Post-Treatment
Basal Area	160-200 ft^2/acre	211	157
Stand Density	41%-53% of SDI$_{max}$	58%	38%
Mean DBH	9" - 22"	8"	17"
Canopy Cover	40% - 50%		51%