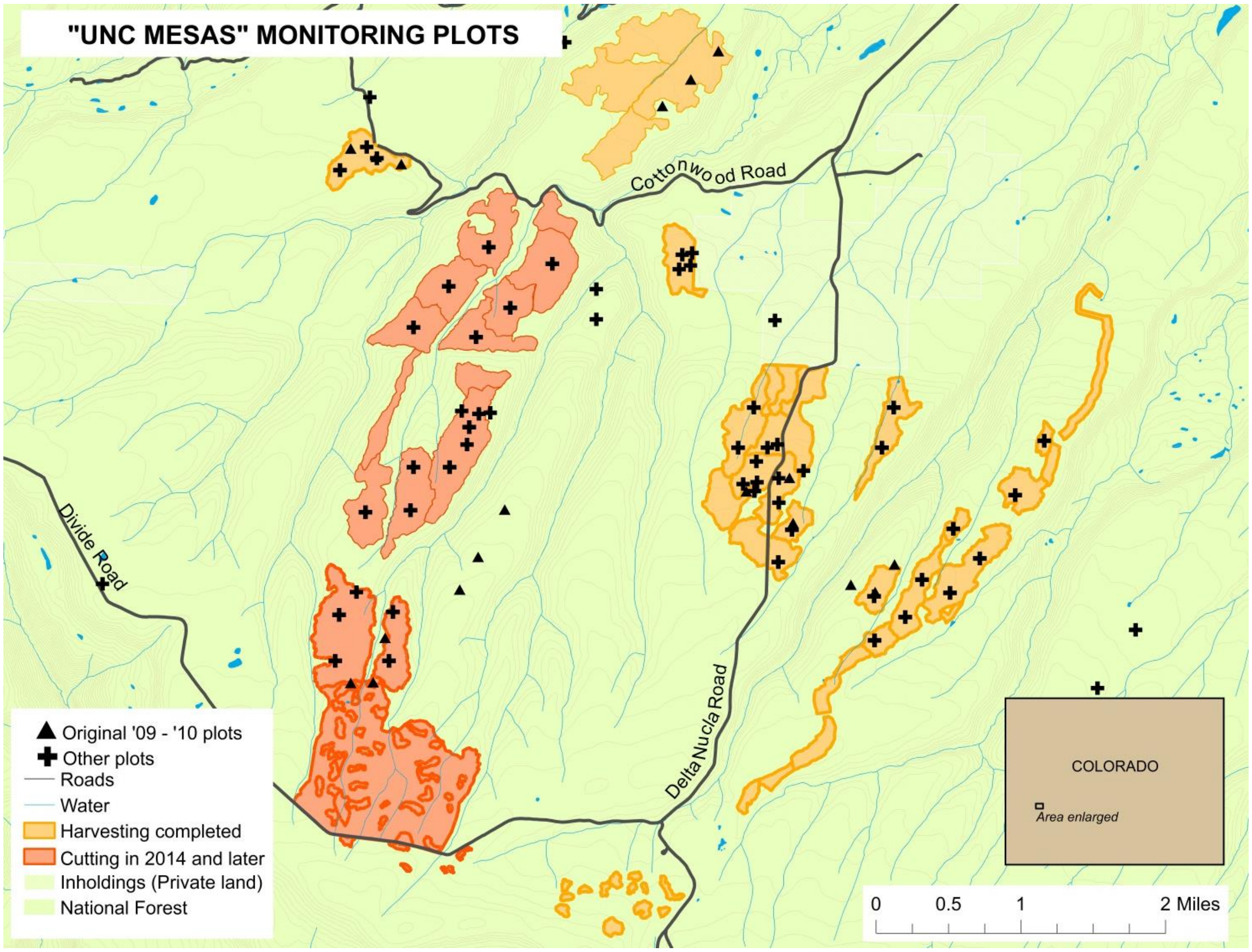
Uncompahgre Mesas Project Area 2015 Monitoring Report

This report presents a summary of data from the Uncompahgre Mesas project area. Pre-harvest data were collected on 18 ½ acre plots beginning in 2009 ("Original '09 – '10 plots" on map). More plots ("other plots" on map) were established in in 2012-2013 in both pre- and post-treatment stands.

In 2015, members of the Montrose Forestry Intern Program (shown above), led by Colleen Trout, collected data on trees, surface fuels, and/or understory cover (depending on what data were already collected) throughout the area where cutting had been completed. They also collected pre-treatment surface fuels and understory cover data to supplement already collected pre-treatment forest structure data ("Other plots" in dark orange units on map).



Changes in basal area and species composition

As expected, treatments have **reduced the basal area and trees per acre**, and have **increased the quadratic mean diameter** slightly (Figure 1).

Stands also met the objective of **retaining ponderosa pine** and **aspen**, while **removing non-pine conifer** basal area (Figure 2, below).

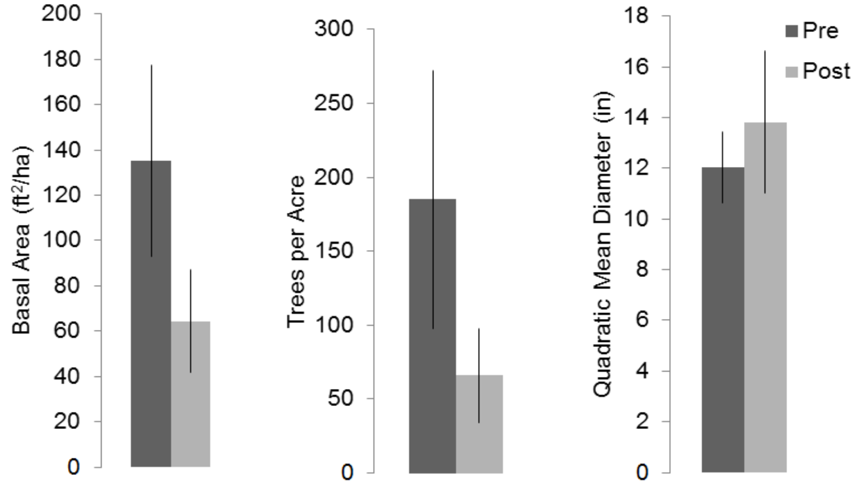


Figure 1. Mean (± standard deviation) basal area, trees per acre, and quadratic mean diameter before and after treatment.

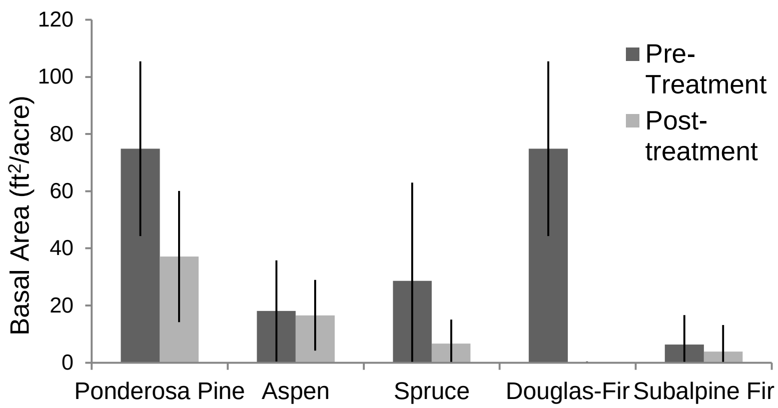
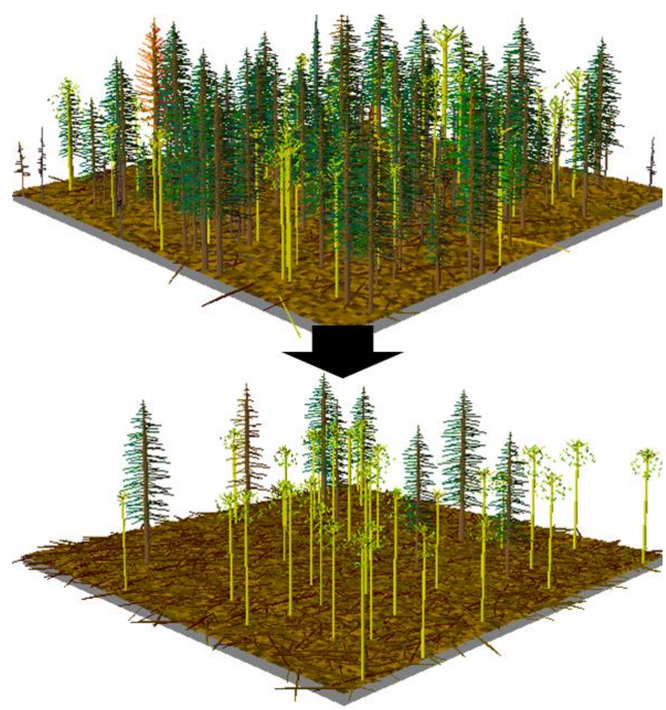


Figure 2. Mean (± standard deviation) of basal area by species before and after mechanical treatment.

The reduction in basal area and removal of the more shade-tolerant conifers has led to **more open stand conditions,** which will provide more **light for understory plants and shade-intolerant tree regeneration** (see page 4 for data on understory conditions). The picture at right shows the stand condition before (top) and after (bottom) mechanical treatment. The picture was created by Forest Vegetation Simulator based on monitoring data.



Changes in fuels and expected fire behavior

Canopy fire hazard has been reduced in treated stands. Ladder and canopy fuels were reduced and surface fire is predicted to burn in all monitored stands (under 90th percentile weather conditions). Torching, and particularly Crowning, Indices increased and suggesting active crown fire is much less likely in these stands now than before treatment (Figure 3). (Torching and Crowning indices are the wind speeds needed to sustain canopy fire; the higher the wind speed, the less likely crown fire is to occur. "Torching" is used to describe fire that moves from the surface into the crown of a single tree. Fire that moves from tree crown to tree crown is called "crowning" fire.)

Despite the reduction in canopy fire hazard, woody surface fuels doubled following treatment (Figure 4). Prescribed fires are planned to help reduce surface fuel loads.

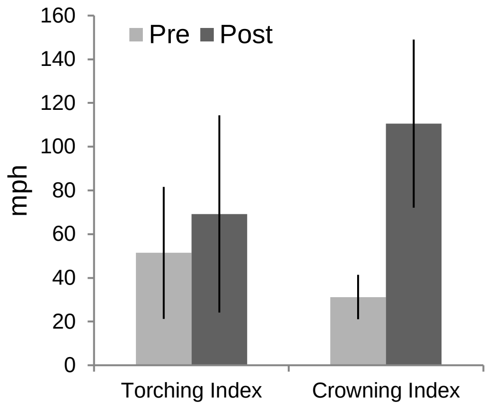


Figure 3. Mean (± standard deviation) Torching and Crowning Indices before and after treatment.

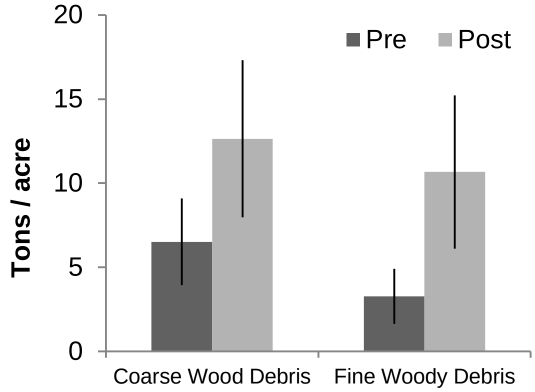
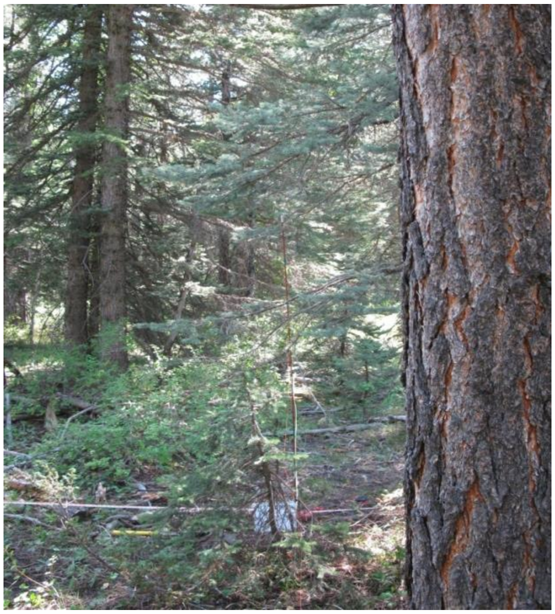


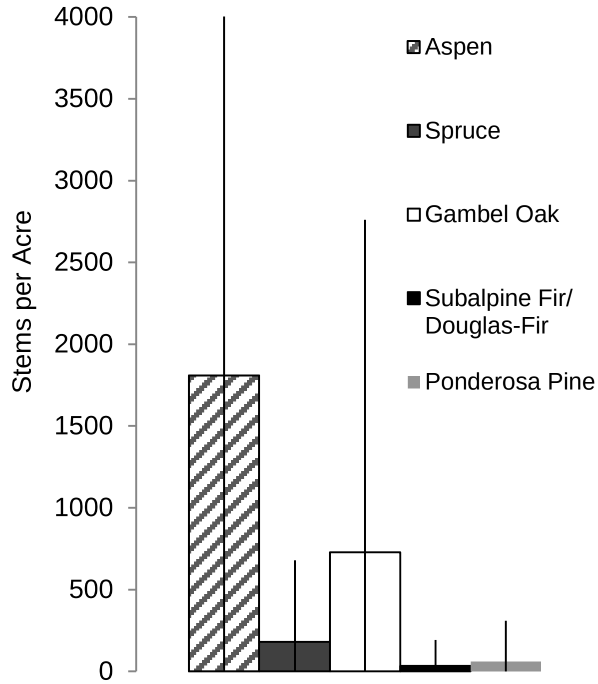
Figure 4. Mean (± standard deviation) coarse and fine woody debris in stands before and after treatment. Coarse woody debris is > 3 inches in diameter. Fine woody debris all smaller dead woody material.

Below, photos of the **Pre- (at left)** and **post-treatment (at right)** conditions of a monitored stand. The stand is much more open than previously, with reduced ladder fuels and light at the forest floor.

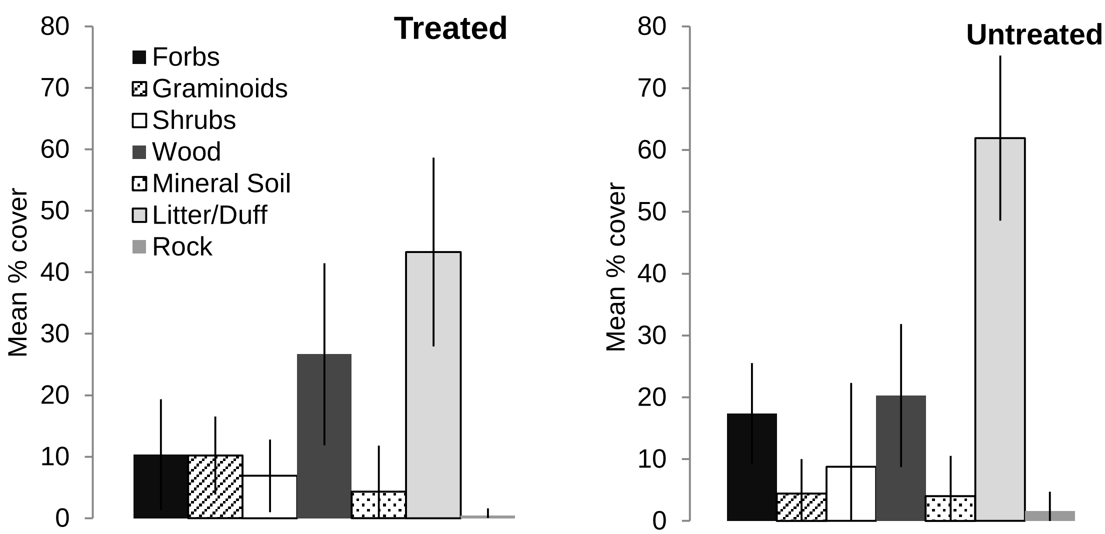


Post-mechanical treatment tree regeneration

Tree regeneration is occurring and is dominated by aspen and oak, both species that can reproduce through re-sprouting. Conifer seedlings were present at low densities (< 500 stems / acre), some of which may have been present prior to mechanical harvesting. Figure at right shows mean (± standard deviation) stems densities. Below, aspen regenerating in a cut stand.



Forbs, grasses, shrubs and forest floor cover



Mean cover (± standard deviation) of forest floor in treated and untreated areas measured in 2015. Litter, duff, and woody material are the dominant substrate following harvest. There was concern that treatments would lead to too much soil disturbance; however, mineral soil is about 5% cover in both treated and untreated units. Forbs, graminoids (grasses and sedges), and shrubs cover less area in treated than untreated stands, but plant cover will likely increase with time since treatment. Figure at left shows mean (± standard deviation) cover percent.

Canopy cover analysis

Dry, frequent-fire forest restoration often aims to increase spatial heterogeneity in forest stands and increase the number and complexity of openings. Therefore, monitoring that quantifies tree spatial pattern is necessary to ensure post-treatment forest condition goals are met. Traditional methods of quantifying spatial pattern require labor-intensive stem mapping and other demanding measurements that are not feasible given labor and budgetary constraints.

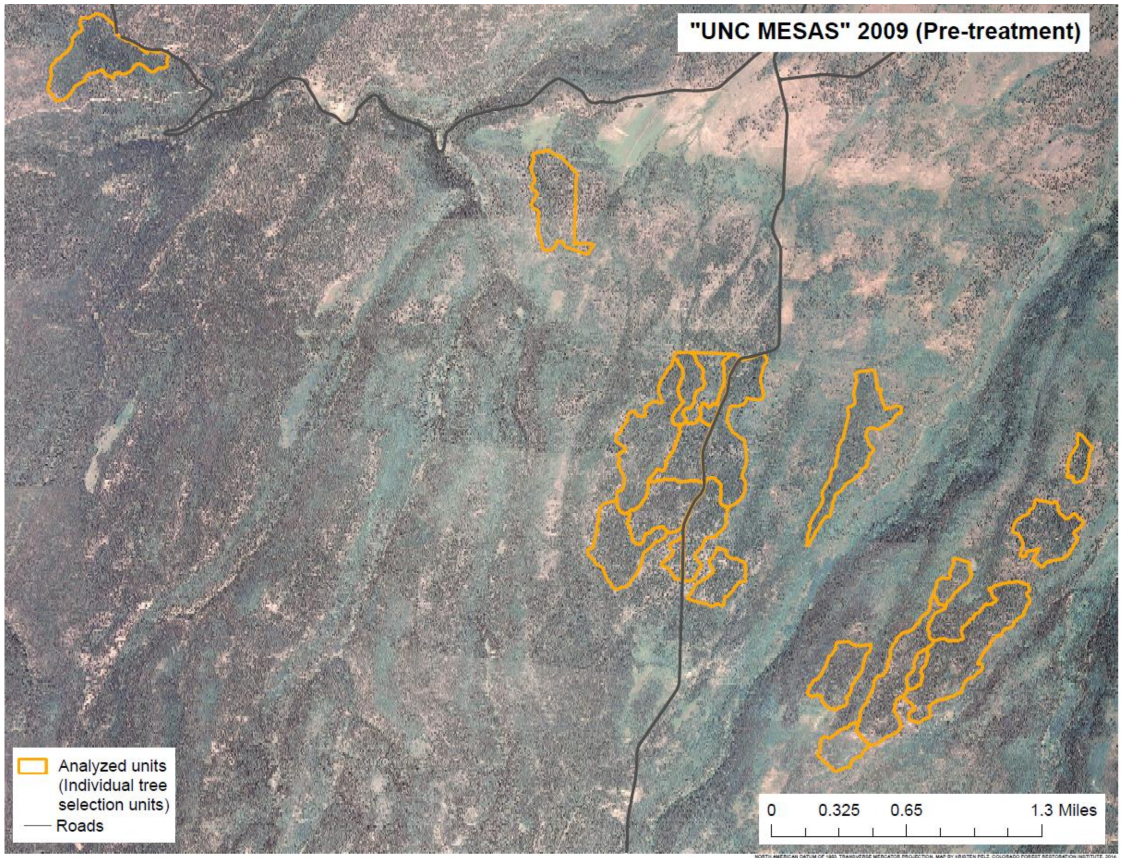
We used National Aerial Imagery Program (NAIP) imagery to quantify spatial pattern of forest cover. This imagery is collected every four years, is publically-available. We use the ENVI software package (Exelis Visual Information Solutions) to delineate areas of coniferous canopy, shadow, herbaceous ground cover and bare soil (e.g. unpaved roads) from the imagery. The reflected wavelengths of these cover types are relatively unique and allow for the mapping of forest cover.

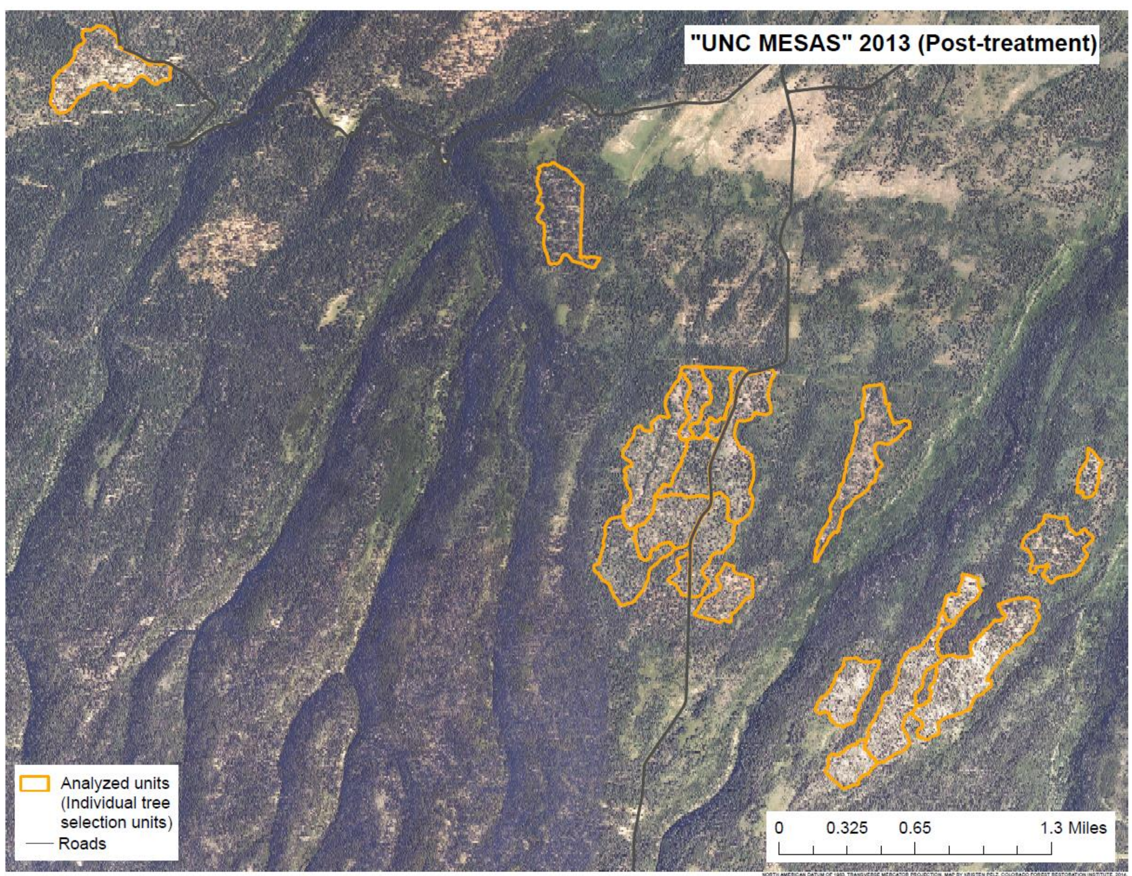
After mapping, the spatial distribution of coniferous forest canopy patches (groups of trees with continuous canopy) in a matrix of bare-ground and herbaceous groundcover (gaps between trees) can be quantified using FRAGSTATS (McGarigal et al. 2012), a program developed to analyze spatial patterns of landscape. Metrics such as the percent cover, largest patch index, edge density, patch size, patch density, patch perimeter-to-area ratio, and Euclidean nearest-neighbor distance can quantify forest cover patterns to make comparisons among different forests and monitor treatment effect through time.

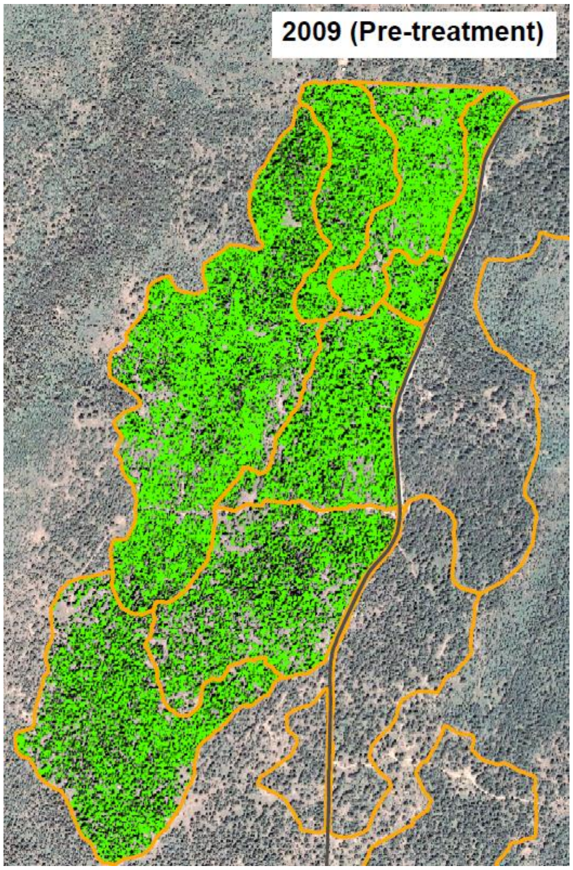
Table 1. Description of selected FRAGSTATS metrics.

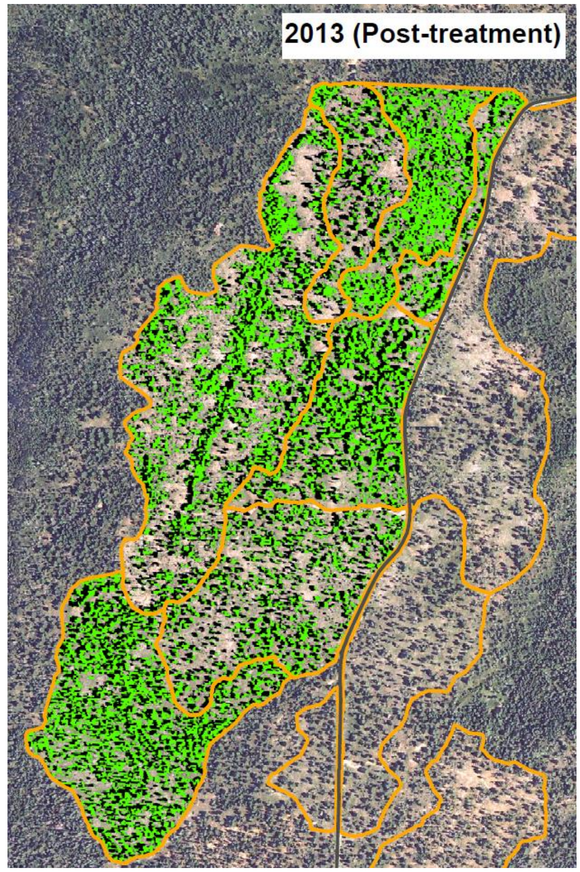
Metric	Definition, interpretation and units	Expected trend
Percentage of Landscape (PLAND)	Area of each patch type as a percent of total landscape area (%).	Decrease
Largest Patch Index (LPI)	The percentage of total landscape area comprised by the largest patch (%). It is a measure of the dominance of the largest patch of each patch type.	Decrease
Edge Density (ED)	The length of patch edge per unit area (m/ha) for each patch type. Edges are where adjacent patches influence each other are an important driver of ecological processes in complex landscapes.	Increase
Patch Area (PA)	The size of a patch by type (ha). Mean, range, standard deviation reported. Frequency distribution graphs of patch area may also be plotted using patch-level metrics.	Decrease of mean, decrease in range is expected (although lack of variation is undesirable)
Patch Density (PD)	Simple measure of the density of patches per 100 hectares. Patch density is an indication of the prevalence of patch types (i.e. canopy or opening) and is strongly influenced by the size of patches.	Increase
Euclidean Nearest Neighbor Distance (ENN)	The shortest straight-line distance between the focal patch (m) and its nearest neighbor of the same type. This simple measure of patch context is used to quantify patch isolation. Mean, range and standard deviation reported. Frequency distribution graphs may also be plotted using patch-level metrics.	Increase in mean distance and range

Pre- (top) and post-treatment (bottom) aerial imagery of Unc Mesas project area. We analyzed canopy cover in all units outlined in orange here.









Pictures above show classified canopy (bright green) in a subset of stands along the Delta-Nucla Road. Our analysis of pre- and post-treatment canopy cover showed desirable trends (see table below). The coverage of coniferous canopy has been reduced, and the number of distinct canopy patches has increased. The complexity of forest canopy cover has increased in some ways: the number of patches, distance between patches, and range of distances between patches have increased. However, the range of patch sizes decreased and the edge density did not change significantly. In the table, asterisks represent significant differences between pre and post treatment metrics. Underlines show where the change was in the desired direction.

Metric		***Time***	**Mean**	**Std Dev**	**Max**	**Min**
***Canopy cover as % of unit**	PLAND	*Pre*	**52**	12	76	35
		Post	**25**	11	52	11
***Patch density (patches / 100 hectares)**	PD	*Pre*	**1,305**	954	3,464	102
		Post	**3,244**	2,872	15,707	850
***Largest Patch Index (Largest canopy patch as % of unit)**	LPI	*Pre*	**36.8**	23.5	75.5	2.5
		Post	**3.8**	4.9	21.1	0.1
Edge density (meters / ha)	ED	*Pre*	675	241	1,136	335
		Post	700	133	929	435
***Mean patch area (ha)**	AREA	*Pre*	**0.12**	0.17	0.74	0.01
		Post	**0.01**	0.01	0.06	0.00
***Range of patch areas (ha)**	AREA_RA	*Pre*	**7.7**	11.2	52.0	0.5
		Post	**0.6**	0.7	2.1	0.0
***Euclidian nearest neighbor distances (m)**	ENN	*Pre*	**5.3**	0.7	5.0	5.9
		Post	**6.4**	0.2	5.4	7.5
***Range of Euclidian nearest neighbor distances (m)**	ENN_RA	*Pre*	**6.8**	3.2	12.2	2.0
		Post	**16.4**	7.9	38.5	7.2

Do you have questions or want more details? Contact Kristen Pelz at kristen.pelz@colostate.edu.
Report prepared by Claire Griebenow and Kristen Pelz.