21.12 Calf Canyon Post-Wildfire Immediate Field Inventory Summary / November 2023
New Mexico Forest and Watershed Restoration Institute

Photos by NMFWRI Field Crew

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Introduction and Project Description

The Southwest Ecological Restoration Institutes (SWERI) includes three university-based restoration institutes: the New Mexico Forest and Watershed Restoration Institute (NMFWRI), the Colorado Forest Restoration Institute (CFRI), and the Ecological Restoration Institute (ERI) in Arizona. These institutes work together to develop a program of applied research and service to help create healthy forests, prevent wildfires, sustain the resiliency of water supplies to wildfires, and create jobs. NMFWRI is located at Highlands University (HU) in Las Vegas, NM. According to the Southwest Forest Health and Wildfire Prevention Act (P.L. 108-317), the authorizing legislation for the SWERI, the purpose of the institutes is to "promote the use of adaptive ecosystem management to reduce the risk of wildfires and restore the health of forest and woodland ecosystems in the Interior West." NMFWRI has partnered with the United States Forest Service (USFS) and other agencies to monitor more than 2,500 plots on Collaborative Forest Restoration Program (CFRP) and other restoration projects across the state since 2007. The NMFWRI's Ecological Monitoring Program maintains a professionally managed field crew to collect data on short and long-term ecosystem responses to restoration treatments. This data provides a critical scientific basis for adaptive management decisions and improved treatment effectiveness. The field crew also provides hands-on internship and training opportunities for students and recent graduates to help build New Mexico's forestry workforce.

During June 2014, June 2019, and June 2023, the NMFWRI inventory and monitoring crews measured 9 plots across approximately 89 acres in the Calf Canyon region of the Gallinas watershed in the Pecos-Las Vegas Ranger District of the Santa Fe National Forest. These plots were established to monitor the CFRP project 21.12 entitled *"Gallinas Watershed Implementation Project*" hereafter referred to as *"Calf Canyon CFRP."* This project is accessible on foot on forest land via Forest Road 263 and NM Highway 65 northwest of Las Vegas, in San Miguel County, New Mexico. The site is mixed-conifer, including Douglas-fir, white fir, ponderosa pine, limber pine, and blue spruce, and ranges in elevation between 8800 - 9000 feet with moderate to steep slopes (average 33% grade).

The treatment, as proposed in the 2012 CFRP application, was intended to reduce excessive stocking levels and produce wood products. Harvested material was intended to be used as lumber, vigas, latillas, and firewood, and the project description included engagement of local student groups and the public. NMFWRI monitoring photos indicate that treatments had begun implementation in 2014 but were not completed. In 2019, crews noted signs of a prescribed fire. NMFWRI does not have further details on the timeline of treatment implementation.

In spring 2022, this project area burned in the Hermit's Peak Calf Canyon (HPCC) wildfire at low to moderate composite burn severity. The Hermit's Peak fire began as an escaped prescribed burn and later merged with the Calf Canyon fire which started as a winter pile burn. The Hermit's Peak Calf Canyon fire grew to become the largest and most destructive wildfire in New Mexico history at 341,471 acres. Of this footprint, 24% was classified as high soil burn severity, 30% was classified as moderate soil burn severity, 37% was classified as low soil burn severity, and 9% was classified as unburned.

More information about the HPCC wildfire is available here:
https://storymaps.arcgis.com/stories/d48e2171175f4aa4b5613c2d11875653.

Other post-fire reports, and a map of all NMFWRI monitoring within the burn scar, is available here:
https://nmfwri.org/monitoring/post-fire-monitoring-reports/

Monitoring Methods

The NMFWRI monitoring crew followed the protocols published in the their Field Monitoring Manual, linked here: https://nmfwri.org/resources/upland-forests-monitoring-field-manual/

These protocols are based on the Department of Interior's FEAT/FIREMON Integrated (FFI) sampling protocols. They used 1/10th acre fixed plots to assess tree size (diameter and height) and density (trees/acre). A nested sub-plot of 1/100th acre was used to estimate understory and ground cover in all years. Photo points were taken at each plot. Surface fuels were measured using Brown's transects. The location of the plots was based on a stratified random sampling design.

All raw data and photo points will be provided to the managers of the project area; the goal of this report is to summarize this information in a concise manner.

Disclaimer

NMFWRI provides this report and the data collected with the disclaimer that the information contained in these data is dynamic and may change over time. The data are not better than the original sources from which they were derived. It is the responsibility of the data user to use the data appropriately and within the limitations of monitoring data in general, and these data in particular. NMFWRI gives no warranty, expressed or implied, as to the accuracy, reliability, or completeness of these data. This data and related graphics are not legal documents and are not intended to be used as such. This includes but is not limited to using these data as the primary basis for the development of thinning prescriptions or timber sales. NMFWRI shall not be held liable for improper or incorrect use of the data described and/or contained in this report.

Analysis was also done according to our standard protocols. Note that the values reported in the tables are expressed on a per acre basis, but represent only area actually sampled. We do not scale up these values to calculate volume of wood over the project area, and warn readers of this report that they are not intended for that purpose. The accompanying tables show summaries of our data, and some differences are discussed below; however, differences that seem apparent here may not stand up to rigorous statistical tests. For some estimates, the standard deviation exceeds the mean (i.e., the coefficient of variation is greater than 100 percent), and sampling errors for some estimates exceed 100 percent. Therefore, data should be used and results interpreted with appropriate caution.

Summary

Data Summary

The field crew observed a relatively high diversity of tree species in the Calf Canyon CFRP project area, with dominant species including Douglas-fir, white fir, and ponderosa pine (**Figure 6**). Following treatments and fire, ponderosa pine increased in dominance. Tree health concerns for sick trees observed included mistletoe and fire scorch/char (**Table 2**). While this area was affected by the Hermit's Peak Calf Canyon fire, the composite burn index for the project area was primarily unchanged (77%), with 23% of the project area classified as low severity and 1% classified as moderate severity (**Figure 5**).

Growing stock basal area and tree density both decreased following treatments and wildfire (**Figure 8**). 69.8% of growing stock trees survived the HPCC wildfire. While growing stock mean height increased slightly, live crown base height decreased slightly (**Figure 7**). Snag basal area increased, but snag density decreased following treatments and fire (**Figure 11**). At 27 sqft/acre, snag basal area remains below growing stock basal area of 40 sqft/acre.

Total surface fuel loads declined following both treatments and wildfire, with surface fuel loads immediately post-wildfire measuring at less than half of pre-treatment levels (**Table 9**). 1000-hr fuels shifted towards predominantly sound fuels following treatments and wildfire (**Figure 25**). Ladder fuel loads also decreased substantially following treatments, and remained low post-wildfire (**Table 8**).

While live tree seedling densities increased post-wildfire, aspen comprised almost all post-wildfire seedling regeneration, and densities of conifer seedlings decreased following wildfire (**Figure 16**;

Supplementary Figures). Following wildfire, live sapling densities decreased while dead sapling densities increased (**Figure 17**). Aspen also made up the majority of saplings recorded (**Supplementary Figures**). Live and dead shrub densities also decreased from the 5-year post-treatment measurement to the immediate post-wildfire measurement (**Figure 16**). Kinnikinnick and Fendler's ceanothus dominated the shrub class across measurements (**Supplementary Figures**).

Access required coordination with both federal land managers and private landowners in Calf Canyon, as site access required travel through private land with private gates. Access to all plots remained possible via driving and hiking for the 2023 measurement period; however, road conditions were highly dependent on weather.

Management Implications:

Due to low burn severities and low post-wildfire tree mortality, the initial fire recovery outlook for this unit is good, and the data does not suggest any immediate regeneration or post-wildfire state transition concerns. However, an increase of bare soil ground cover from 7% 5 years post-treatment to 27% immediately post-wildfire does indicate an increased risk of soil erosion post-wildfire. The field crew noted mullein and bull thistle on multiple plots immediately post-wildfire. While these are both non-native species of potential concern for outcompeting native plants, they may also be playing a role in soil stabilization during the initial post-wildfire recovery period.

The reported substantial decrease in surface fuel loads, ladder fuel loads, growing stock basal area and density, and snag density following treatments and wildfire all indicate a decreased risk of high-severity wildfire based on fuel load and stand structure. The noted increase in snag basal area following wildfire may pose a concern for increasing surface fuel loads in the future as snags fall and become surface fuels. Additional monitoring is needed to determine ongoing adaptive management strategies as the post-wildfire ecosystem develops.

Table 1. *Summary table: Calf Canyon. Species dominance is based on numeric density*

21.12 Calf Canyon CFRP			
Metric	**2014 PreTreatment**	**2019 PostTreatment5yr**	**2023 PostFireImmediate**
Dominant Growing Stock Species	PSME	ABCO	PIPO
Dominant Snag Species	PSME	PSME	PSME
Dominant Live Seedling	ABCO	POTR5	POTR5
Dominant Live Sapling		POTR5	POTR5
Dominant Live Shrub (Seedling Class)		ARUV	ARUV
Average Aspect (degrees)		171	165
Trees per Acre (growing stock)	91.1	48.9	38.8
Basal Area (growing stock, sqft/acre)	95.5	57	44.7
QMD (growing stock, inches)	15	16.2	15.6
Average Tree Height (ft)	54.5	72.7	59.4
Average Live Crown Base Height (ft)	30.1	29.7	23.8
Height of Tallest Tree (ft)	101	120	106
Live Tree Seedlings Per Acre	744	678	1190
Live Tree Saplings Per Acre		133	88.9
Live Shrub Seedlings Per Acre		6690	5360
Tree Canopy Cover (%)		38	41
Grass & Forb Cover (%)		33.1	52
Total Tons Surface Fuels per Acre	66.6	43.9	27.8

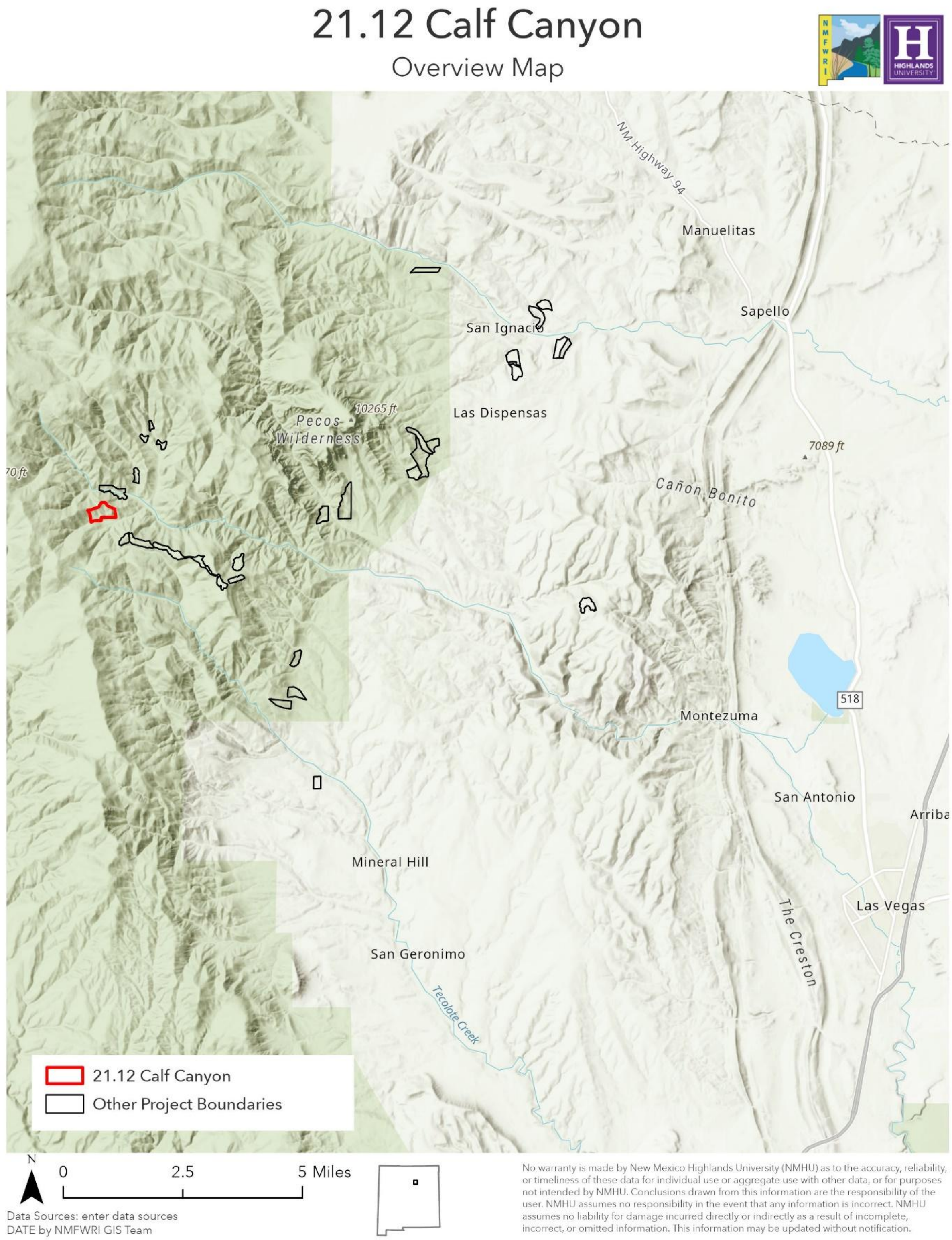


Figure 1. *Regional overview map of the 21.12 Calf Canyon CFRP project*

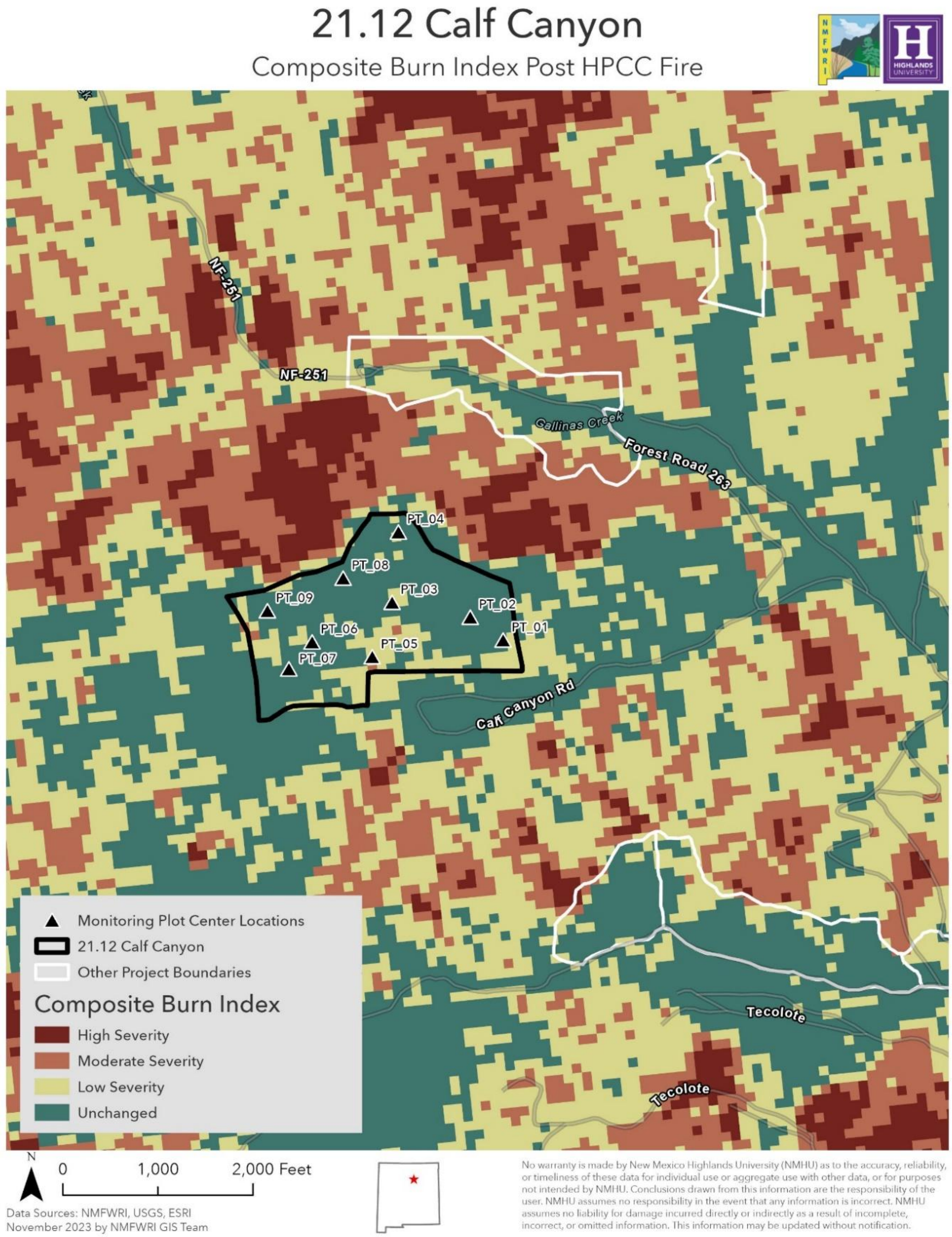


***Figure 2**. Composite Burn Index of the 21.12 Calf Canyon CFRP project following the 2022 Hermit's Peak Calf Canyon fire*

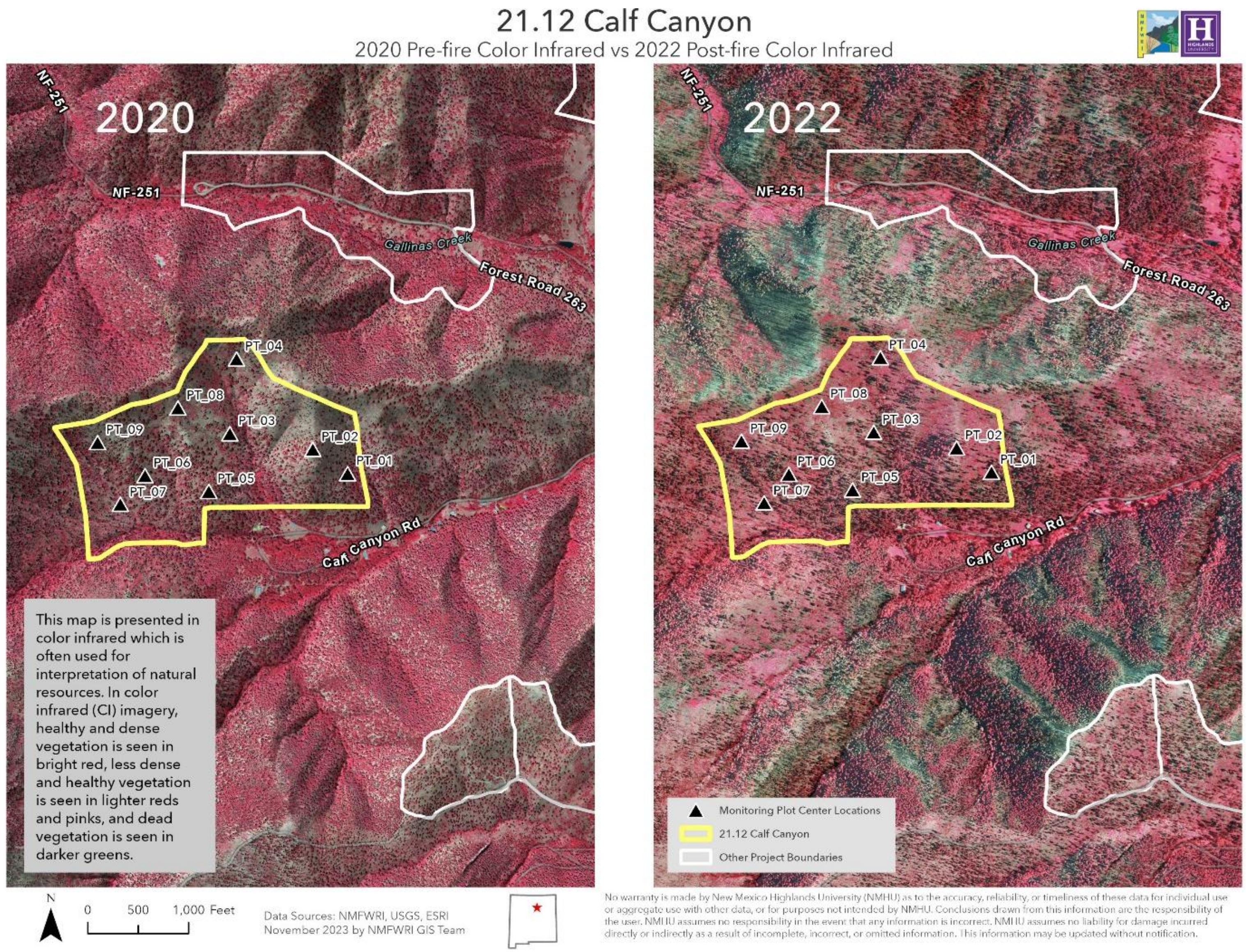


Figure 3*. Map of color infrared of 21.12 Calf Canyon CFRP project before and after the Hermit's Peak Calf Canyon fire*

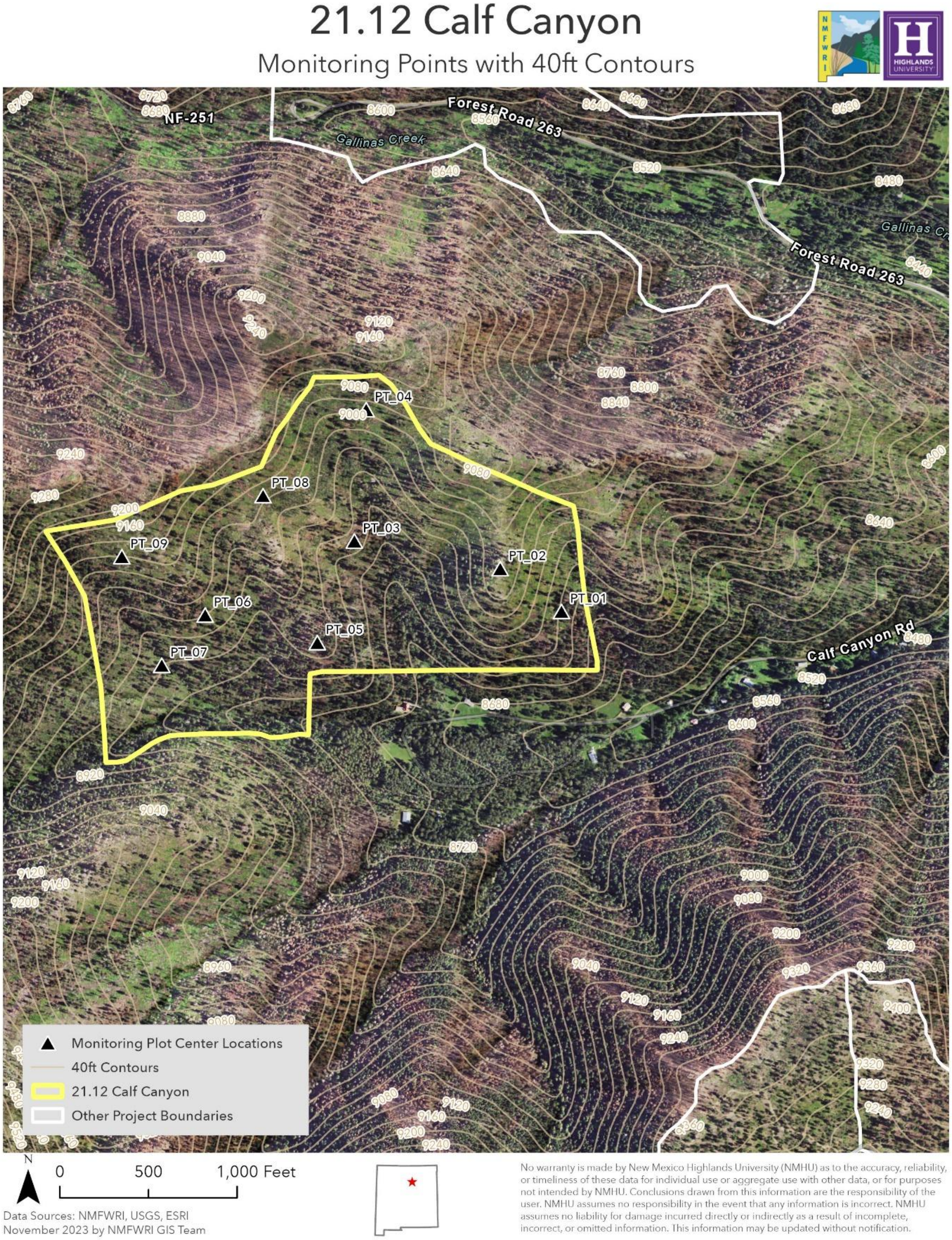


Figure 4*. 21.12 Calf Canyon CFRP project with monitoring plots and contour lines*

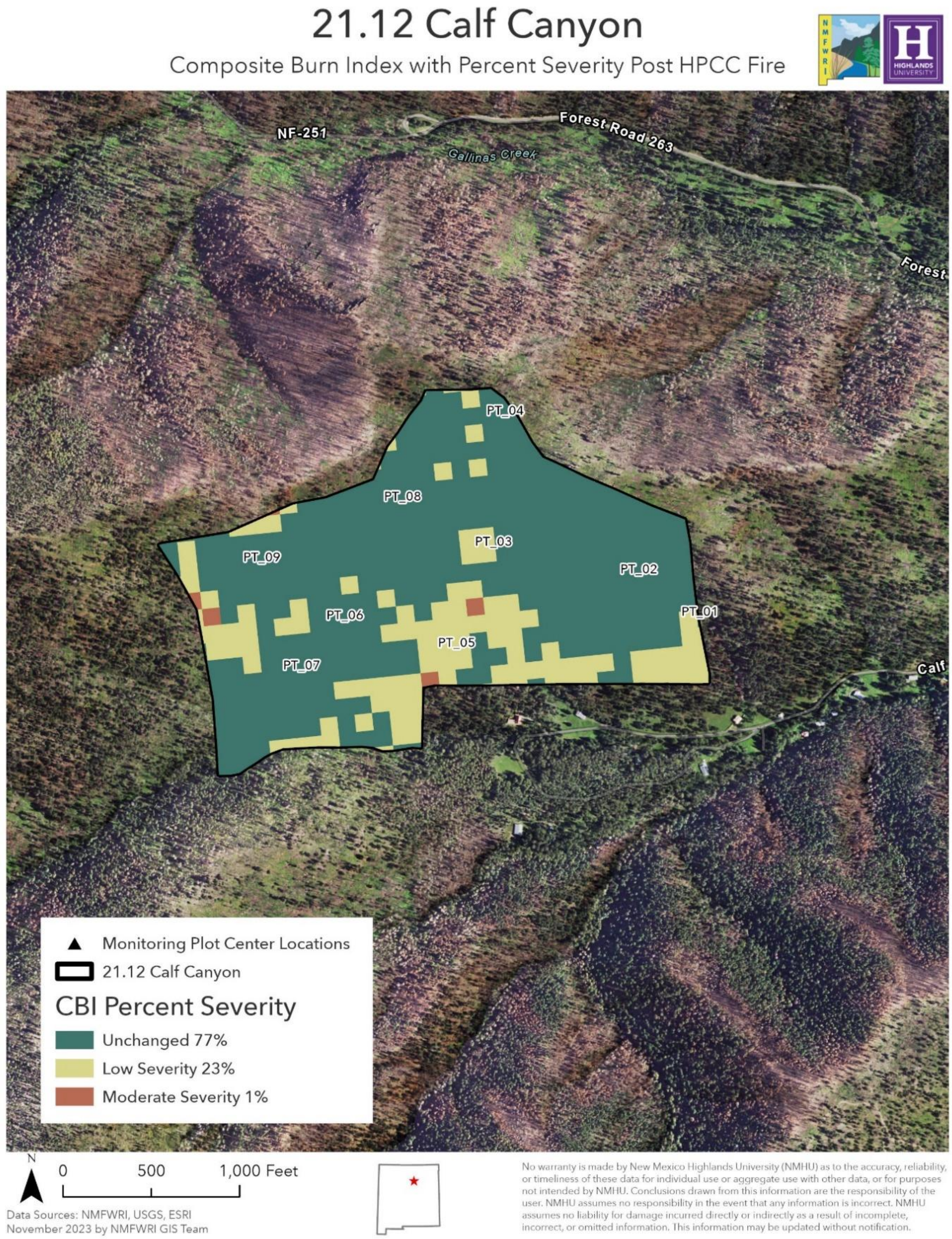


***Figure 5**. 21.12 Calf Canyon CFRP project with composite burn index. The breakdown of percent burn severity within the project area is listed in the legend*

Monitoring Detail - Tree Component

Overstory trees

The overstory (trees >5” DBH) showed high diversity with six species represented across measurement periods. While Douglas-fir was originally the dominant species in the growing stock overstory pre-treatment, ponderosa pine became dominant by the immediate post-wildfire measurement. An increase in the proportion of white fir and decrease in the proportions of limber pine and aspen were also observed across measurement periods. The snag overstory was dominated by Douglas-fir in all measurement periods, and Douglas-fir made up substantial proportions of sick trees in all measurement periods as well. Note that some subjectivity in the designation of “sick” status between crews across measurements make direct comparisons of sick tree densities and compositions challenging.

Species Symbol	Scientific Name	Common Name
ABCO	*Abies concolor*	white fir
PIFL2	*Pinus flexilis*	limber pine
PIPO	*Pinus ponderosa*	ponderosa pine
POTR5	*Populus tremuloides*	quaking aspen
PSME	*Psuedotsuga menziesii*	Douglas-fir
2TREE		unknown tree*

*Dead/burned and lacking identifying characteristics

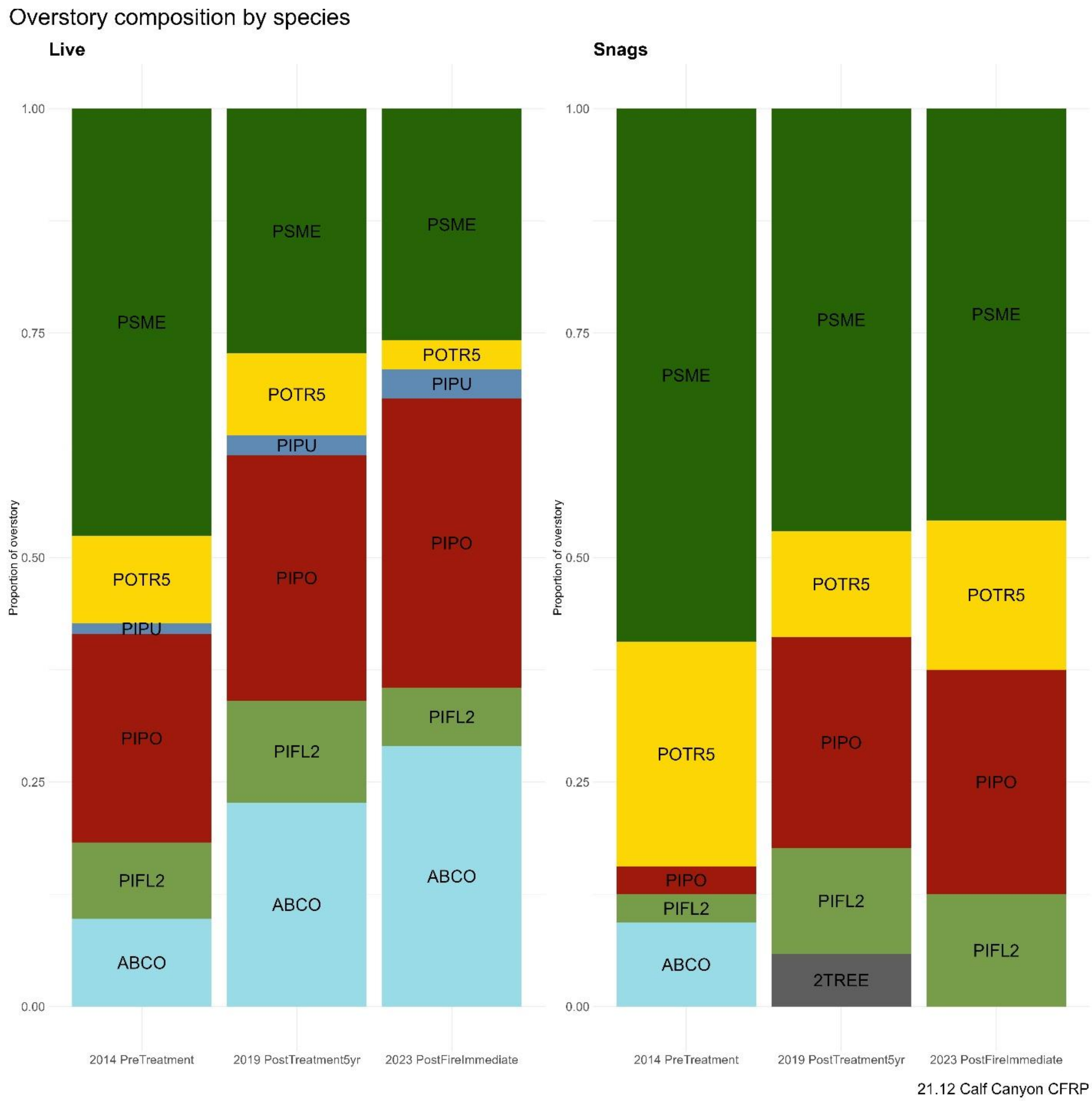


Figure 6. Species composition by status across all measurement periods for all trees (>5” DBH).

Growing Stock

Heights from 2019 data are excluded in this report; they were proven to be unreliable measurements in the data quality control process. Growing stock mean height increased from 57 ft in the pre-treatment measurement to 65 ft in the immediately post-wildfire measurement, indicating retention of taller trees. However, mean live crown base height decreased from 32 ft in the pre-treatment measurement period to 28 ft in the immediate post-wildfire measurement.

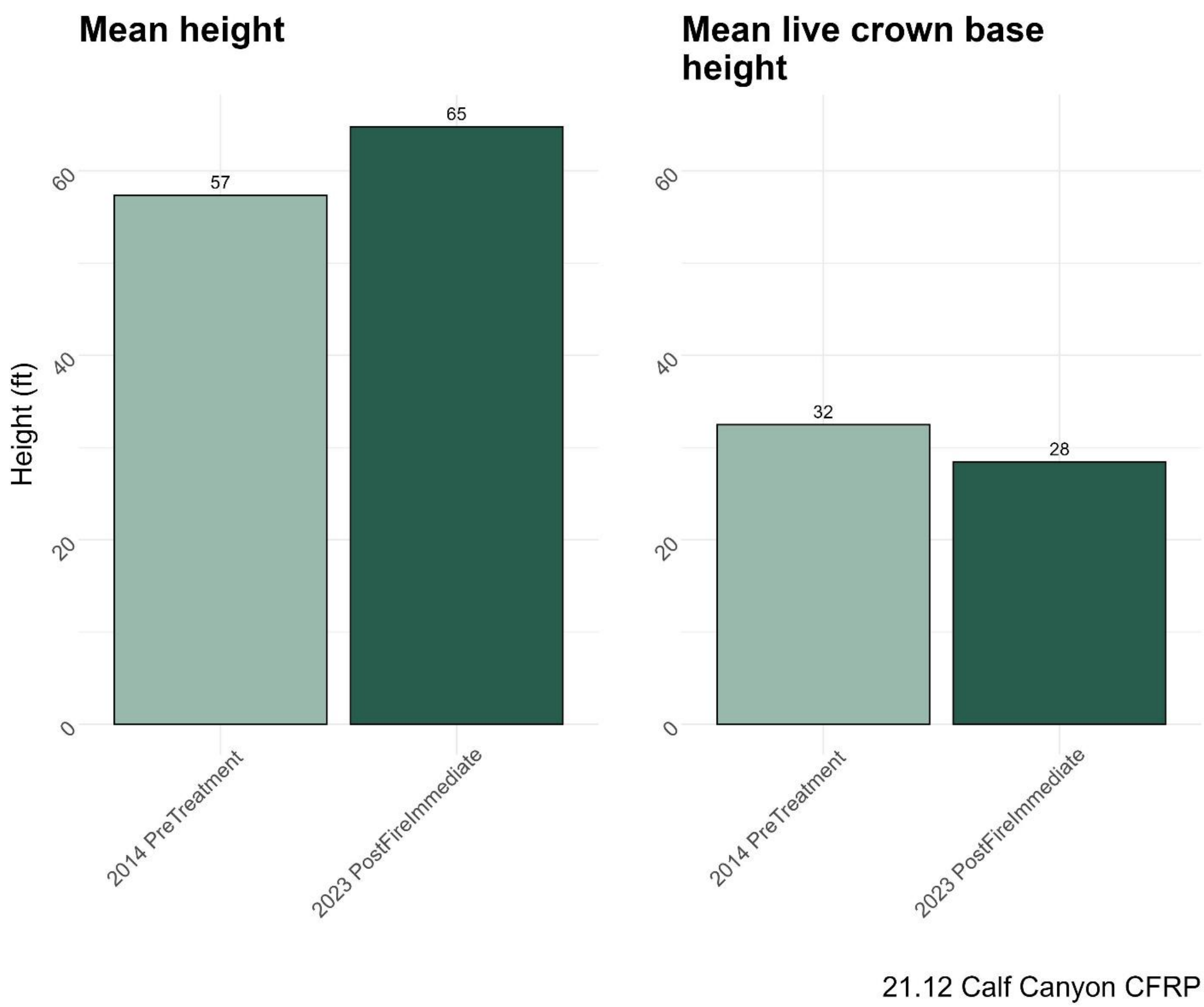


Figure 7. Mean height and live crown base height for growing stock trees (>5" DBH, live + sick status). Mean values represent averages of plot means for each monitoring status

Growing stock mean basal area decreased from 96 sqft/acre pre-treatment to 57 sqft/acre 5 years post-treatment to 40 sqft/acre immediately post-wildfire. Quadratic mean diameter remained relatively steady, increasing from 14.9 inches pre-treatment to 16.2 inches 5 years post-treatment, before decreasing to 15.6 inches immediately post-wildfire. These trends are reflective of the reduction in growing stock trees following treatments and fire, but do not indicate any major change in the mean diameter of trees remaining.

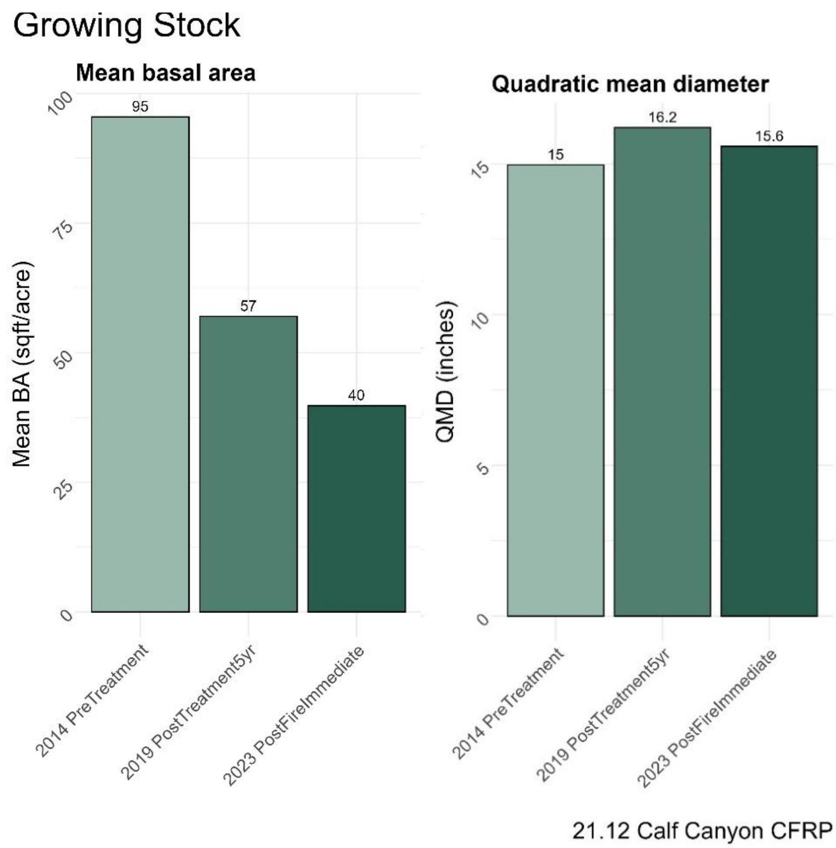


Figure 8. Mean basal area and quadratic mean diameter for growing stock trees across both measurement periods (>5” DBH, live + sick status). Mean values represent averages of plot means for each monitoring status

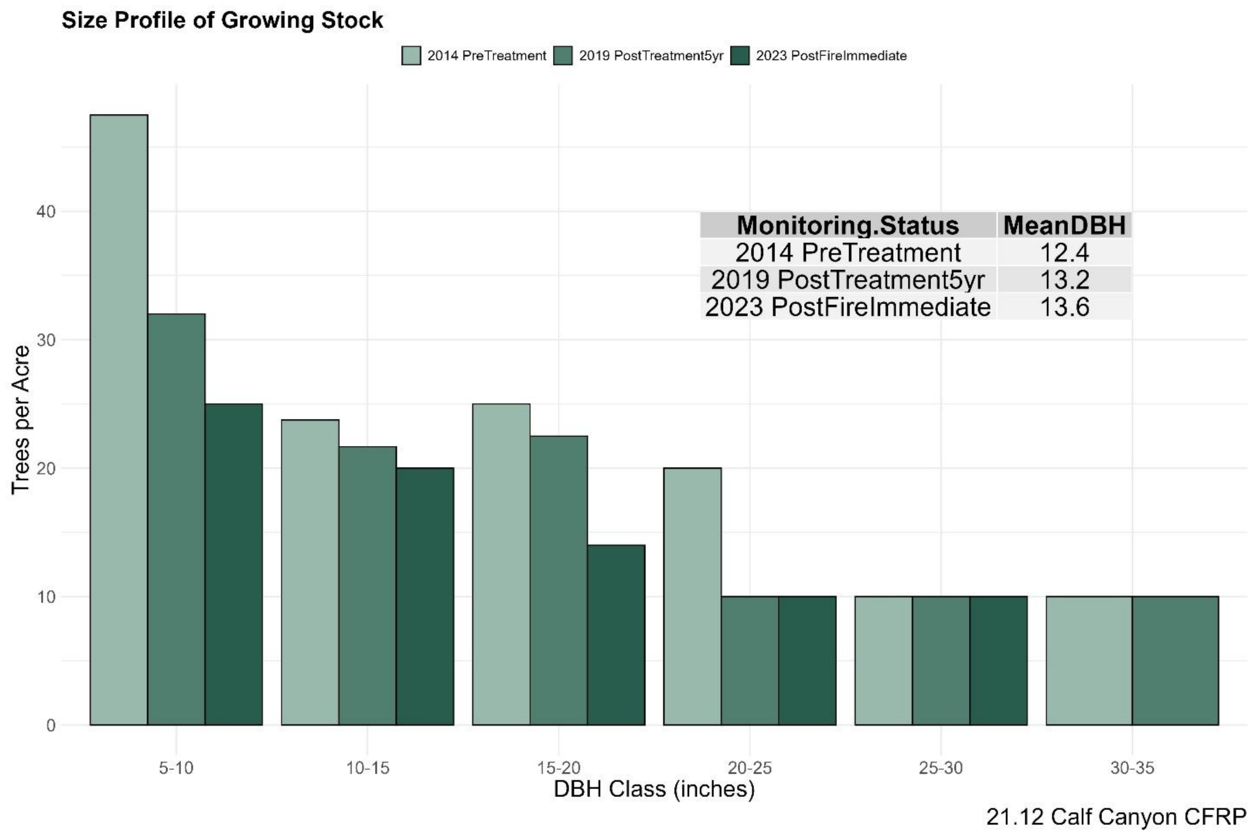
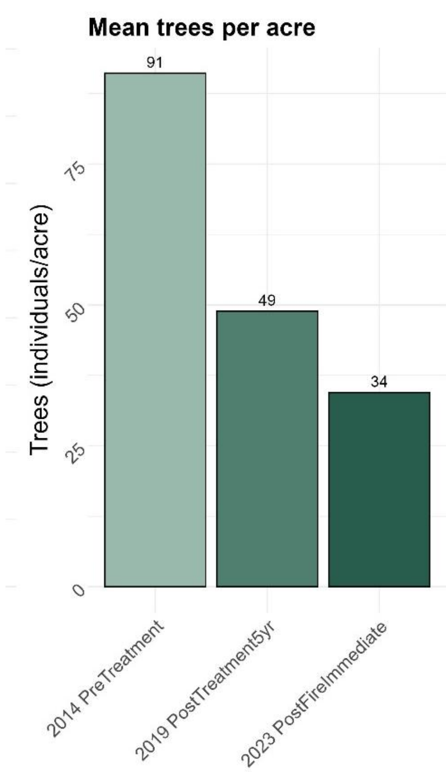


Figure 9. *Histogram of growing stock trees (> 5" DBH) per acre by diameter class. The inset table shows mean DBH across all plots in inches.*



Growing Stock Survival

The mean number of trees per acre decreased by nearly half from 2014 pretreatment to 2019 5 years post-treatment (53.8% of trees remaining), due to likely a combination of thinning, prescribed burns, and natural tree death. Post-HPCC wildfire, trees per acre decreased to 34. 30 of 43 total count of growing stock trees remained, this is a 69.8% survival rate. Treatments conducted within the Calf Canyon project area between 2014 and 2019 likely contributed significantly to the severity of the fire and therefore tree survival. Though NMFWRI does not have specific information on treatment prescriptions, our data shows treatments reduced trees per acre, retained larger trees, reduced ladder fuels, and reduced fuels on the ground surface. All these metrics can contribute to decreased fire severity risk.

Post-HPCC Survival (PostTreatment5yr to PostFireImmediate): 69.8%

Figure 10: *Number of growing stock trees across all measurement periods (>5" DBH), showing 69.8% of growing stock trees survived the HPCC wildfire. Mean values represent averages of plot means for each monitoring status*

Snags

Snag mean basal area increased from 21 sqft/acre pre-treatment, to 23 sqft/acre 5 years post-treatment, to 27 sqft/acre immediately post-wildfire. Mean snag density decreased from 37 trees per acre pre-treatment, to 19 trees per acre 5 years post-treatment, to 27 trees per acre immediately post-wildfire. Quadratic mean snag diameter increased from 10.9 inches pre-treatment to 14.5 inches 5 years post-treatment, before decreasing to 11.4 inches immediately post-wildfire.

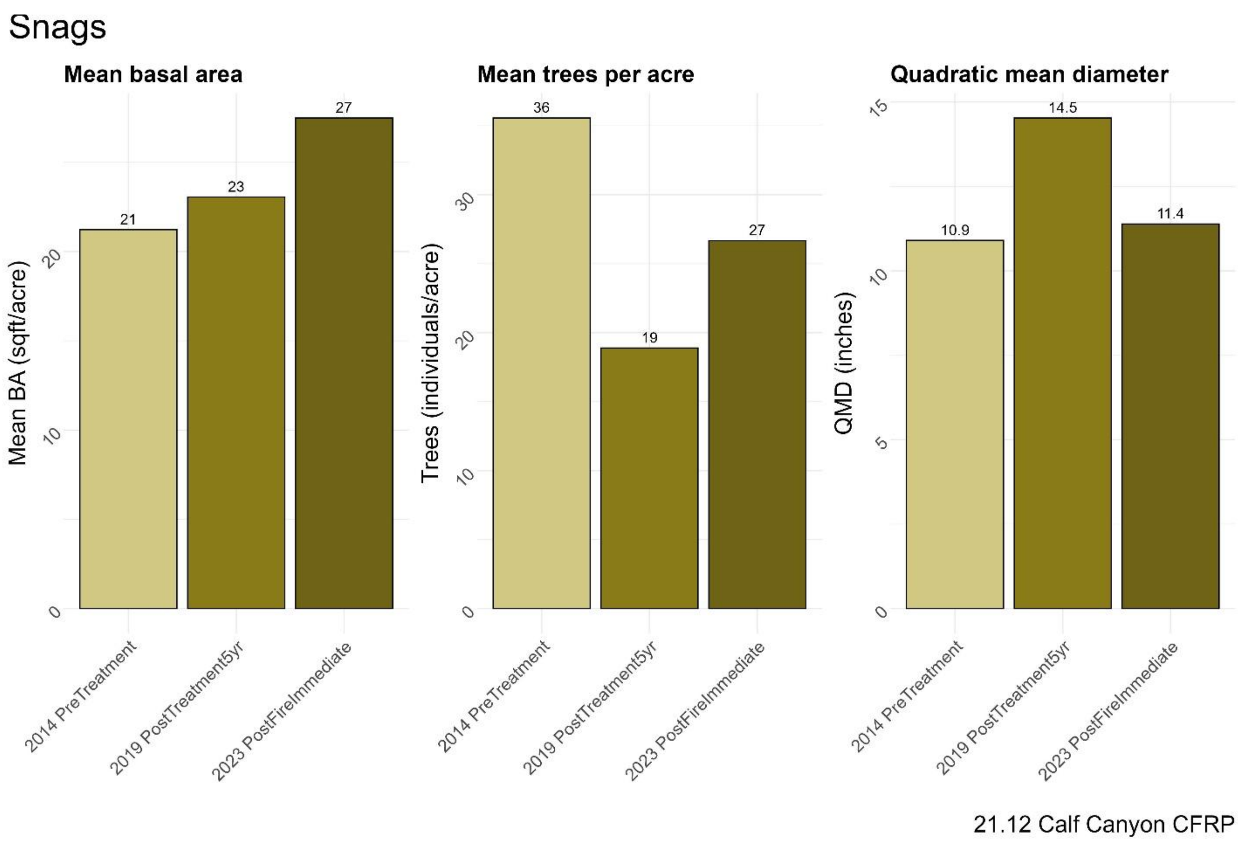


Figure 11. Mean basal area, mean trees per acre, and quadratic mean diameter for snags across all measurement periods (>5" DBH). Mean values represent averages of plot means for each monitoring status

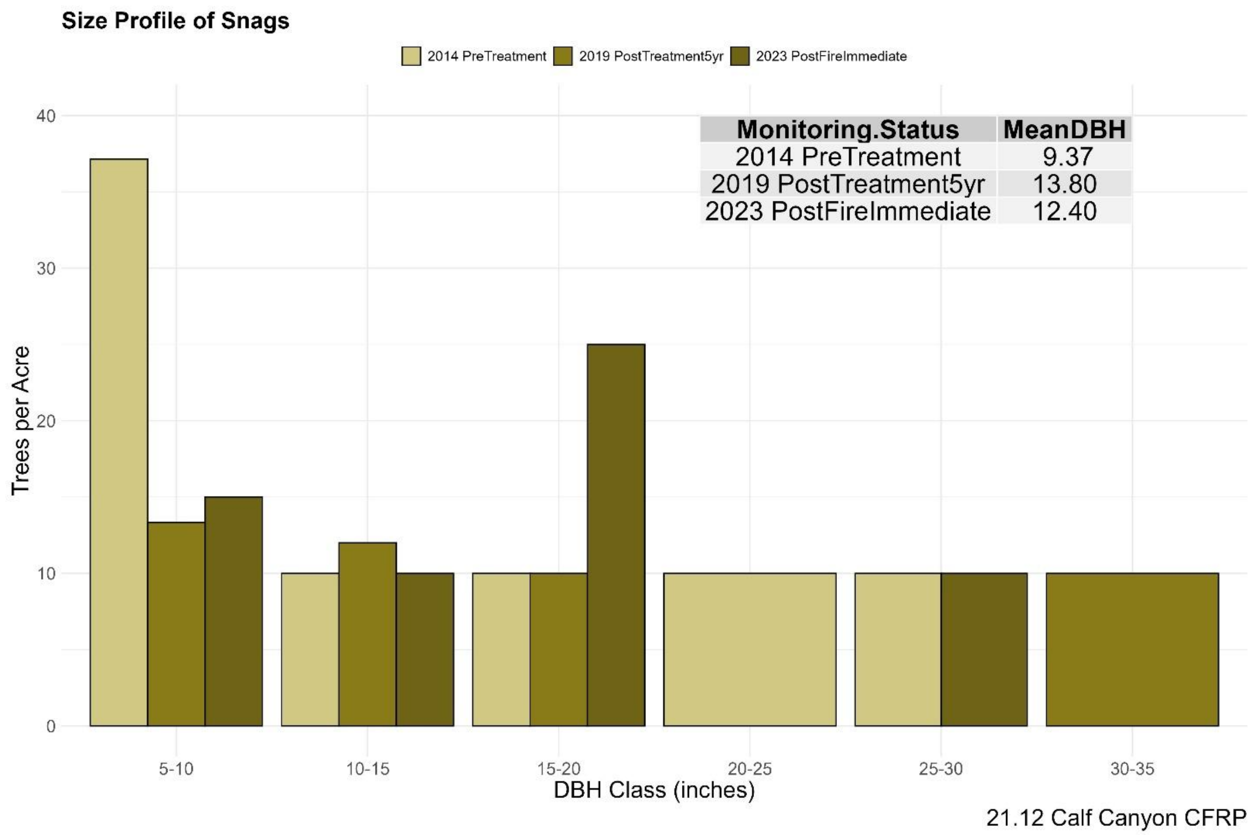


***Figure 12**. Histogram of snags (> 5" DBH) per acre by diameter class. The inset table shows mean DBH across all plots in inches.*

Damages

Damage codes were not recorded in the 2014 pre-treatment measurement. The single observation of a broken top was added through tree comments. In 2019, mistletoe was the most common damage recorded for growing stock trees with 13 observations, however only 2 observations of mistletoe were recorded for growing stock trees in 2023. This is consistent with published research results describing a reduction in mistletoe infection following fire (Conklin & Armstrong, 2005). There were 9 observations of trees with bark beetle damage in 2019, but no trees with bark beetle damage were recorded in 2023.

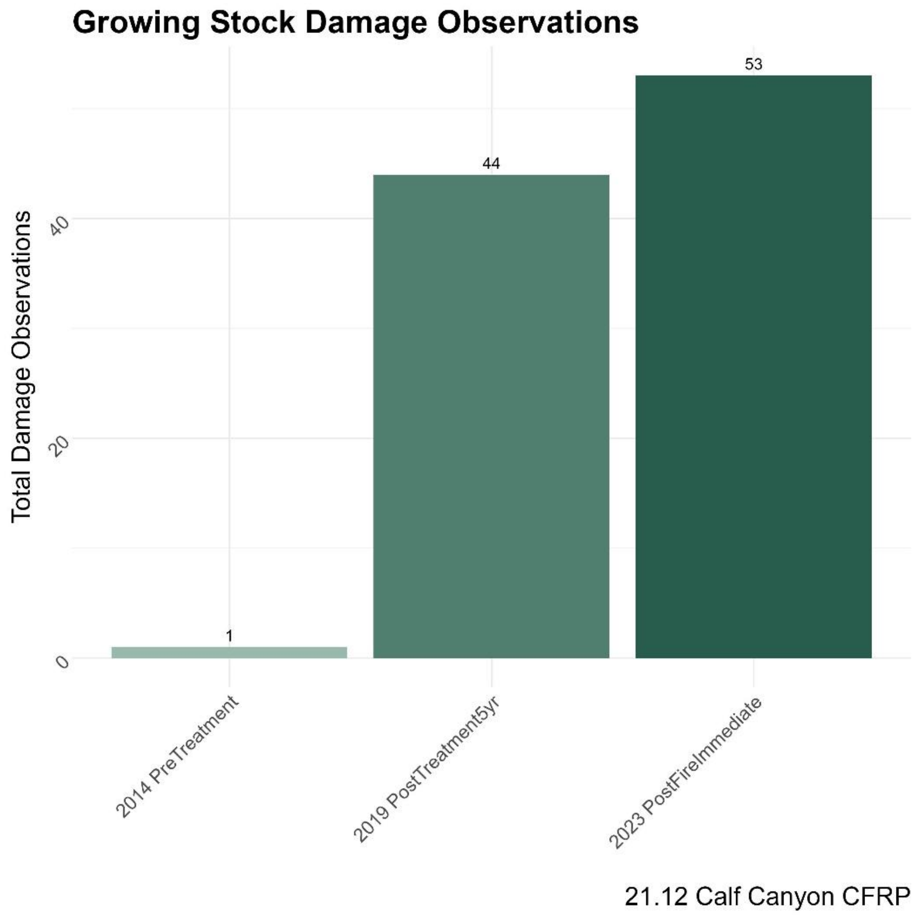


Figure 13. *Counts of damages recorded to growing stock trees in each monitoring year.*

Table 2. *List of damages observed on growing stock trees across all measurement periods by code and description. Count represents the number of observations of each damage type, individual trees may have more than one damage recorded. Note: In 2023, the 25000 "Foliage disease" damage code was used to denote witches broom.*

21.12 Calf Canyon CFRP : Growing Stock Trees by Damage Code

Monitoring.Status	Damage	Count	Description
2014 PreTreatment	99,001	1	Broken top
2019 PostTreatment5yr	23,001	13	Mistletoe
2019 PostTreatment5yr	30,000	10	Fire scar, char and/or scorch
2019 PostTreatment5yr	11,000	9	Bark beetles
2019 PostTreatment5yr	40,000	3	Mammal damage
2019 PostTreatment5yr	99,026	3	Wounds or cracks
2019 PostTreatment5yr	70,000	2	Human caused damage
2019 PostTreatment5yr	99,004	2	Uncharacteristic forked top, above or below DBH
2019 PostTreatment5yr	99,001	1	Broken top
2019 PostTreatment5yr	99,037	1	Leaning bole
2023 PostFireImmediate	30,000	26	Fire scar, char and/or scorch
2023 PostFireImmediate	25,000	6	Witches' broom
2023 PostFireImmediate	41,010	4	Bird damage
2023 PostFireImmediate	99,004	3	Uncharacteristic forked top, above or below DBH
2023 PostFireImmediate	11,000	2	Bark beetles
2023 PostFireImmediate	23,001	2	Mistletoe
2023 PostFireImmediate	50,008	2	Lightning scar
2023 PostFireImmediate	99,001	2	Broken top
2023 PostFireImmediate	99,036	2	Fire scar (catface)
2023 PostFireImmediate	10,000	1	General insects
2023 PostFireImmediate	22,000	1	Conk fungus
2023 PostFireImmediate	40,000	1	Mammal damage
2023 PostFireImmediate	99,016	1	Unusually sparse foliage

The most common damage recorded for snags in 2019 was bark beetle, followed by a broken top. Note that bark beetle species only infest living trees – therefore, the 7 occurrences in snags indicates trees killed in part by bark beetle, not necessarily a current infestation. In 2023, immediately post wildfire, the most common damages were fire scars, followed by damage by birds. Bird damage in snags is expected, as insect activity is a natural part of decay in a forest.

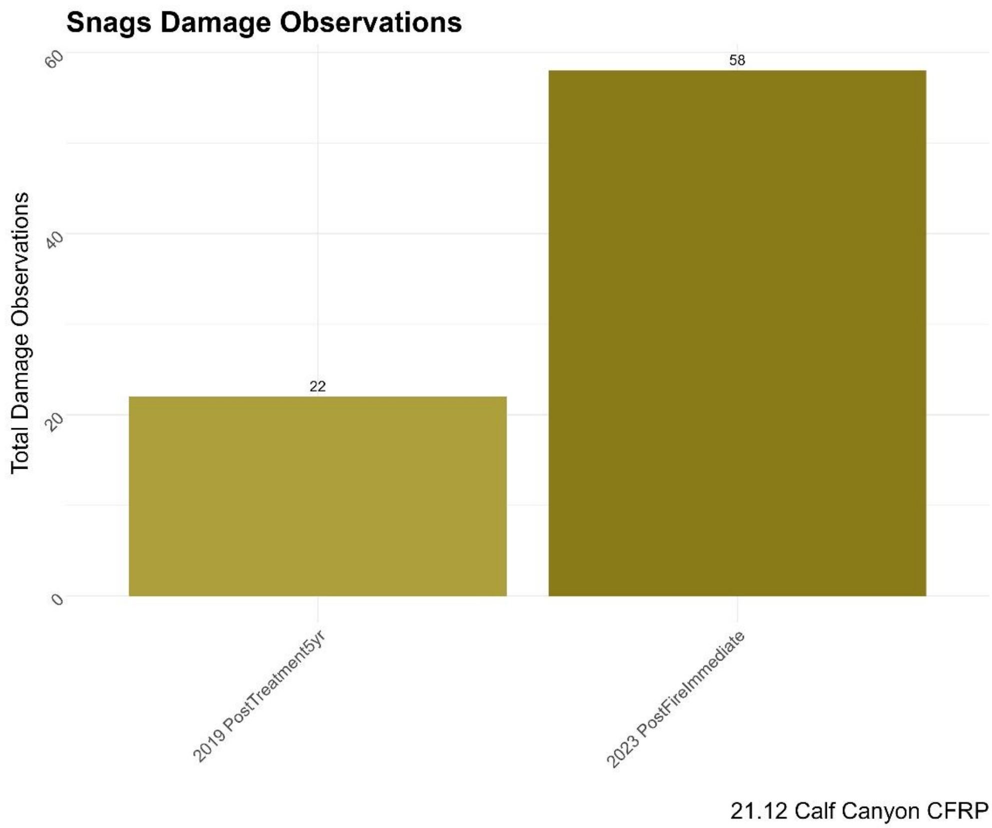


Figure 14.*Count of damages recorded to dead trees across monitoring periods.*

***Table 3**. Counts of damages recorded to dead trees across monitoring periods.*

21.12 Calf Canyon CFRP : Snags by Damage Code			
Monitoring.Status	**Damage**	**Count**	**Description**
2019 PostTreatment5yr	11,000	7	Bark beetles
2019 PostTreatment5yr	99,001	6	Broken top
2019 PostTreatment5yr	30,000	4	Fire scar, char and/or scorch
2019 PostTreatment5yr	23,001	2	Mistletoe
2019 PostTreatment5yr	99,036	2	Fire scar (catface)
2019 PostTreatment5yr	99,037	1	Leaning bole
2023 PostFireImmediate	30,000	21	Fire scar, char and/or scorch
2023 PostFireImmediate	41,010	10	Bird damage
2023 PostFireImmediate	99,001	8	Broken top
2023 PostFireImmediate	11,000	7	Bark beetles
2023 PostFireImmediate	25,000	4	Witches' broom
2023 PostFireImmediate	99,004	2	Uncharacteristic forked top, above or below DBH
2023 PostFireImmediate	10,000	1	General insects
2023 PostFireImmediate	19,000	1	
2023 PostFireImmediate	22,000	1	Conk fungus
2023 PostFireImmediate	40,000	1	Mammal damage
2023 PostFireImmediate	50,008	1	Lightning scar
2023 PostFireImmediate	99,037	1	Leaning bole

Char & Scorch

Immediately post-wildfire, char height (highest point of blackened bark) averaged 11 ft and scorch height (highest point of heat-killed needles) averaged 35 ft. 78.2% of trees were charred, while only 25.5% of trees were scorched – this suggests that in the majority of the project area, the fire burned relatively low to the ground, only jumping into the canopy about a quarter of the time. This is corroborated by the Composite Burn Index (CBI), that shows the majority of the project area burned at low severity, with lesser areas at moderate to high severity.

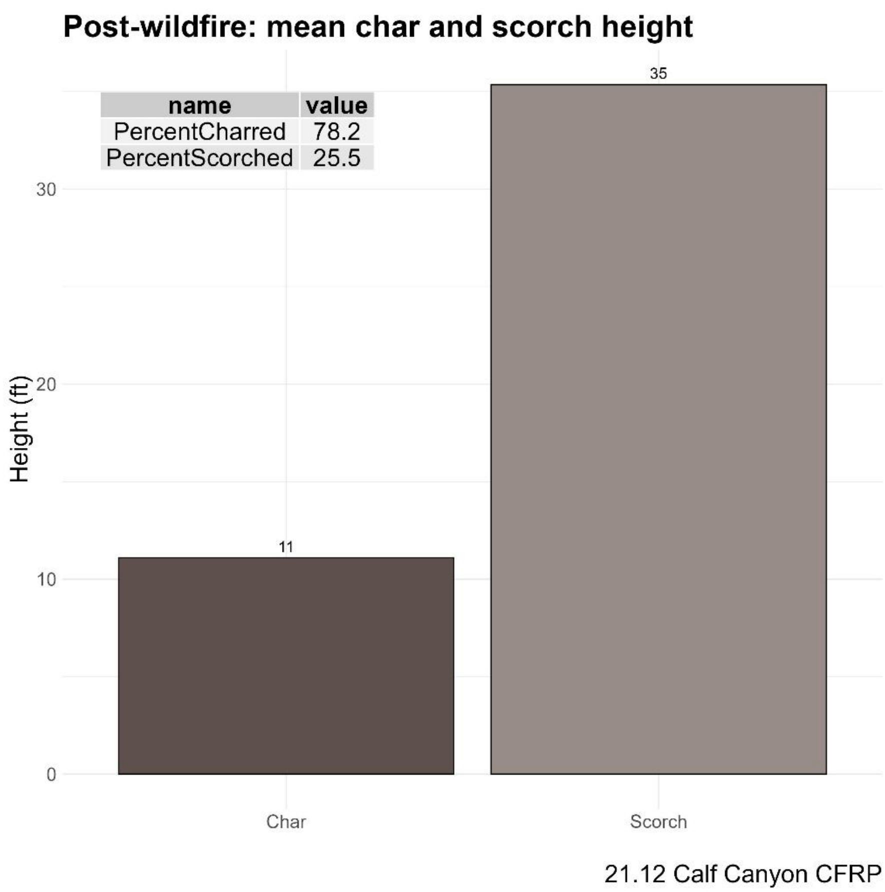


Figure 15. *Mean char and scorch heights for trees measured immediately post-wildfire. Mean values represent averages of plot means for each monitoring status*

Regeneration: Trees & Shrubs

Mean live tree seedling density decreased from 740 individuals/acre pre-treatment to 680 individuals/acre 5 years post-treatment, followed by an increase to 1200 individuals/acre immediately post-wildfire. Sapling densities were not recorded pre-treatment. Mean live tree sapling density decreased from 130 individuals/acre 5 years post-treatment to 89 individuals/acre immediately post-wildfire. Mean live shrub seedling density was not recorded in 2014, but decreased from 6700 individuals per acre 5 years post-treatment to 5400 individuals/acre immediately post-wildfire. No live shrubs of sapling stature were detected across any measurement period.

The jump in recruitment of tree seedlings immediately post-fire is likely due to increased canopy openings and seeds having more bare soil to germinate in. The drop in tree saplings is due to sapling die-off due to fire – we see below that dead tree saplings increased in density immediately post-fire.

Dead tree seedling density was not measured in 2014, but increased from 120 individuals/acre 5 years post-treatment to 140 individuals/acre immediately post-wildfire. Sapling densities were not recorded pre-treatment. Mean dead tree sapling density increased from 44 individuals/acre 5 years post-treatment to 120 individuals/acre immediately post-wildfire. Mean dead shrub seedling density was not recorded in 2014, but decreased from 67 individuals/acre 5 years post-treatment to 22 individuals per acre immediately post-wildfire. No dead shrubs of sapling stature were detected across any measurement period.

The dominant tree seedlings (by density) for each monitoring period are as follows: white fir in 2014 pretreatment, quaking aspen in 2019 5 years post-treatment, and quaking aspen again immediately post-fire. The dominant tree sapling in 2019 5 years post-treatment and in 2023 immediately post-fire was quaking aspen. The dominance of quaking aspen regeneration after disturbance is due to its ability to reproduce through sending up shoots that are clones of the parent plant; it does not depend wholly on seed production and germination for reproduction. Kinnikinnick (red bearberry) was the dominant shrub seedling recorded in 2019 and in 2023. See Supplementary Figures for a full breakdown of regeneration densities by species.

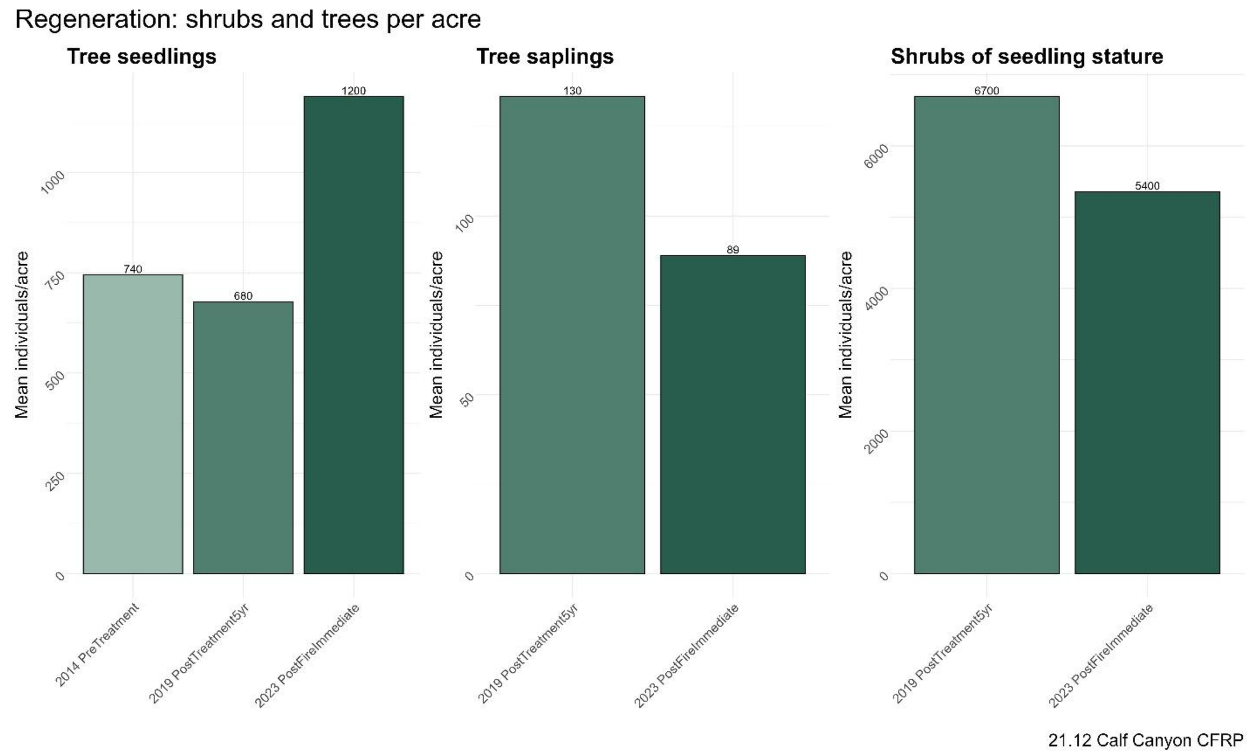


Figure 16. *Regeneration densities of trees and shrubs in the seedling and saplings classes across all measurement periods. No shrubs of seedling stature were observed any year. Shrubs were not measured in 2014. Tree sapling measurements were part of the protocol in 2014, but none were recorded.*

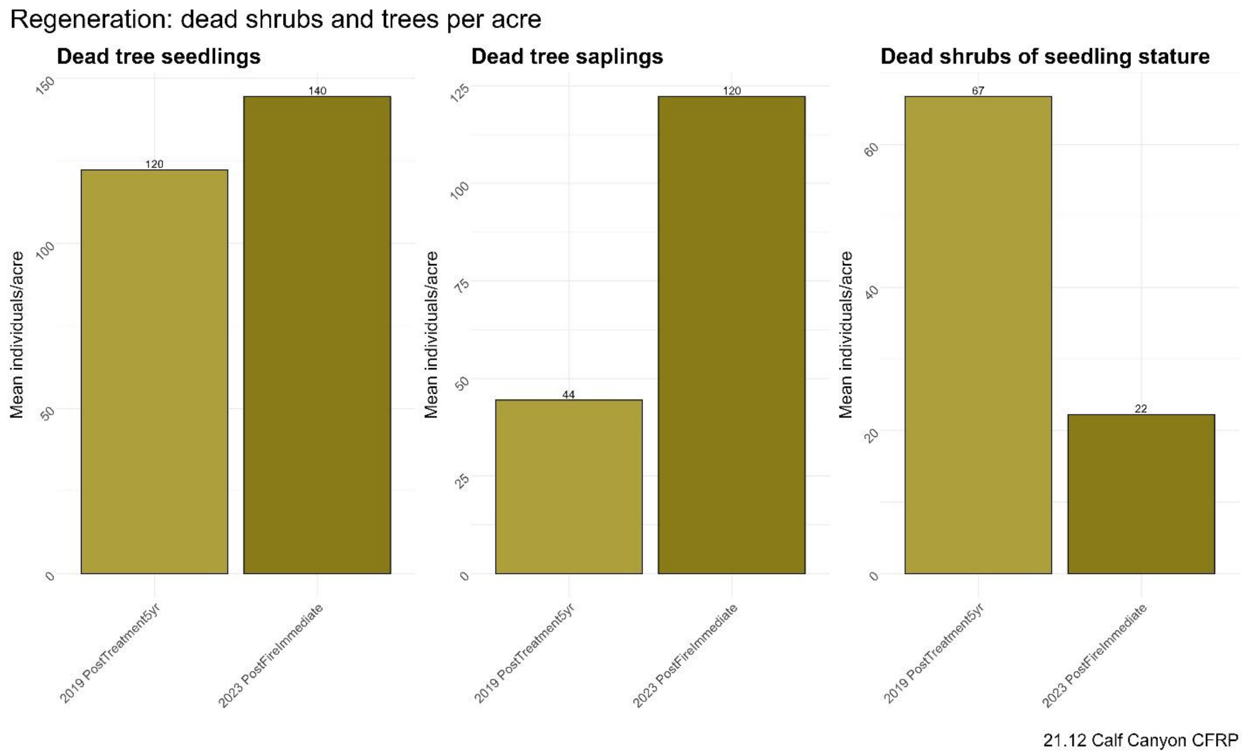


Figure 17*. Regeneration densities of trees and shrubs in the seedling and sapling classes across all measurement periods. No shrubs of seedling stature were observed any year. Shrubs and dead tree seedlings were not measured in 2014. Tree seedlings and saplings were recorded in 2014, but protocol did not differentiate between living and dead.*

Stand Tables

Stand tables provide another way to visualize trees in an area. They represent the number of trees per acre in certain diameter classes and provide other summary values in a concise format.

2014 Pre-treatment

***Table 4**. Stand table of forestland species metrics for the 2014 pre-treatment measurement period*

Forestland Species		Saplings			Pole			Mature Trees											Total by Species & Covertype	%Species for all G-Stock
Diameter Class		0	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32		
ABCO White fir	COUNT	0	0	0	1	2	4	0	0	1	0	0	0	0	0	0	0	0	*8.0*	
	TPA	0.00	0.00	0.00	1.11	2.22	4.44	0.00	0.00	1.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*8.9*	*9.6%*
	BA/AC	0.00	0.00	0.00	0.19	0.92	2.34	0.00	0.00	1.44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*4.9*	*5.1%*
	AVE HT. (HL)	0.00	0.00	0.00	33.00	42.25	55.53	0.00	0.00	69.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
PIPO Ponderosa pine	COUNT	0	0	0	2	2	0	1	2	3	1	3	0	2	0	1	0	2	*19*	
	TPA	0.00	0.00	0.00	2.22	2.22	0.00	1.11	2.22	3.33	1.11	3.33	0.00	2.22	0.00	1.11	0.00	2.22	*21*	*23%*
	BA/AC	0.00	0.00	0.00	0.40	0.65	0.00	0.73	2.10	4.35	1.99	7.06	0.00	7.01	0.00	4.75	0.00	13.40	*42*	*44%*
	AVE HT. (HL)	0.00	0.00	0.00	33.72	34.64	0.00	45.00	52.21	48.81	72.00	69.27	0.00	90.46	0.00	101.00	0.00	94.06		
PSME Douglas-fir	COUNT	0	0	1	4	7	9	3	6	6	2	1	1	0	1	0	0	0	*41*	
	TPA	0.00	0.00	1.11	4.44	7.78	10.00	3.33	6.67	6.67	2.22	1.11	1.11	0.00	1.11	0.00	0.00	0.00	*46*	*49%*
	BA/AC	0.00	0.00	0.10	0.70	2.65	5.53	2.48	7.11	8.70	4.08	2.21	2.67	0.00	4.19	0.00	0.00	0.00	*40*	*42%*
	AVE HT. (HL)	0.00	0.00	20.00	27.02	46.10	51.66	58.16	61.01	67.27	83.04	73.00	0.00	0.00	71.00	0.00	0.00	0.00		
PIFL2 Limber pine	COUNT	0	0	0	3	2	1	0	0	0	0	1	0	0	0	0	0	0	*7.0*	
	TPA	0.00	0.00	0.00	3.33	2.22	1.11	0.00	0.00	0.00	0.00	1.11	0.00	0.00	0.00	0.00	0.00	0.00	*7.8*	*8.4%*
	BA/AC	0.00	0.00	0.00	0.66	0.65	0.56	0.00	0.00	0.00	0.00	2.55	0.00	0.00	0.00	0.00	0.00	0.00	*4.4*	*4.6%*
	AVE HT. (HL)	0.00	0.00	0.00	27.75	31.42	41.00	0.00	0.00	0.00	0.00	20.00	0.00	0.00	0.00	0.00	0.00	0.00		
POTR5 Aspen	COUNT	0	0	0	2	5	0	0	1	0	0	0	0	0	0	0	0	0	*8.0*	
	TPA	0.00	0.00	0.00	2.22	5.56	0.00	0.00	1.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*8.9*	*9.6%*
	BA/AC	0.00	0.00	0.00	0.45	1.89	0.00	0.00	1.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*3.4*	*3.6%*
	AVE HT. (HL)	0.00	0.00	0.00	27.17	61.17	0.00	0.00	63.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
Forestland Species Sub-total	*COUNT*	*0*	*0*	*1*	*12*	*18*	*14*	*4*	*9*	*10*	*3*	*5*	*1*	*2*	*1*	*1*	*0*	*2*	*83*	
	TPA	*0.00*	*0.00*	*1.11*	*13.33*	*20.00*	*15.56*	*4.44*	*10.00*	*11.11*	*3.33*	*5.56*	*1.11*	*2.22*	*1.11*	*1.11*	*0.00*	*2.22*	*92*	*100%*
	BA/AC	*0.00*	*0.00*	*0.10*	*2.40*	*6.75*	*8.43*	*3.21*	*10.27*	*14.49*	*6.07*	*11.82*	*2.67*	*7.01*	*4.19*	*4.75*	*0.00*	*13.40*	*96*	*100%*
	AVE HT. (HL)	*0.00*	*0.00*	*20*	*29*	*47*	*52*	*55*	*59*	*62*	*79*	*59*	*0*	*90*	*71*	*101*	*0.00*	*94*		
Summary by Size Class for Forestland Species	*TPA*	*1.1*			*49*			*42*											*92*	
	TPA %	*1.2%*			*53%*			*46%*											*100%*	
	BA/AC	*0.097*			*18*			*78*											*96*	
	BA/AC %	*0.10%*			*18%*			*82%*											*100%*	
	QUADRATIC MEAN DIA.	*4.00*			*8.12*			*18.4*											*13.8*	
	AVE HT. (HL)	*20*			*47*			*71*											*67*	

Stand Total		Saplings			Pole			Tree or Sawlog											Total by Class, Growing Stock & Dead	% by Class, Growing Stock vs Dead
Diameter Class		*0*	*2*	*4*	*6*	*8*	*10*	*12*	*14*	*16*	*18*	*20*	*22*	*24*	*26*	*28*	*30*	*32*		
Growing Stock (All living trees in woodland & forestland)	COUNT	0	0	1	12	18	14	4	9	10	3	5	1	2	1	1	0	2	*83*	
	TPA	0.00	0.00	1.11	13.33	20.00	15.56	4.44	10.00	11.11	3.33	5.56	1.11	2.22	1.11	1.11	0.00	2.22	*92*	*72%*
	BA/AC	0.00	0.00	0.10	2.40	6.75	8.43	3.21	10.27	14.49	6.07	11.82	2.67	7.01	4.19	4.75	0.00	13.40	*96*	*82%*
	AVE HT, HL	0.00	0.00	20	29	47	52	55	59	62	79	59	0	90	71	101	0.00	94		
Summary by Size Class (All living trees in woodland & forestland)	TPA	1.11			48.89			42.22											*92*	
	TPA %	1.20%			53.01%			45.78%											*100%*	
	BA/AC	0.10			17.58			77.89											*96*	
	BA/AC %	0.10%			18.40%			81.50%											*100%*	
	QMD MEAN DIA.	4.00			8.12			18.39											*14*	
	AVE HT, HL	20			47			71											*67*	
Dead (All dead trees in woodland & forestland)	COUNT	0	0	1	10	10	6	2	0	1	1	0	1	0	1	0	0	0	*33*	
	TPA	0.00	0.00	1.11	11.11	11.11	6.67	2.22	0.00	1.11	1.11	0.00	1.11	0.00	1.11	0.00	0.00	0.00	*37*	*28%*
	BA/AC	0.00	0.00	0.12	2.14	3.97	3.10	1.74	0.00	1.63	1.75	0.00	2.70	0.00	4.19	0.00	0.00	0.00	*21*	*18%*
	AVE HT, HL	0.00	0.00	18	33	39	50	74	0.00	6	68	0.00	11	0.00	70	0.00	0.00	0.00	*45*	
Total for all sample trees including Growing Stock and Dead	COUNT	0	0	2	22	28	20	6	9	11	4	5	2	2	2	1	0	2	*116*	
	TPA	0.00	0.00	2.22	24.44	31.11	22.22	6.67	10.00	12.22	4.44	5.56	2.22	2.22	2.22	1.11	0.00	2.22	*129*	*100%*
	BA/AC	0.00	0.00	0.21	4.54	10.73	11.53	4.95	10.27	16.12	7.82	11.82	5.37	7.01	8.38	4.75	0.00	13.40	*117*	*100%*

2019 Post-treatment 5yr

***Table 5**. Stand table of forestland species metrics for the 2019 post-treatment 5yr measurement period*

Forestland Species		Saplings			Pole			Mature Trees											Total by Species & Covertype	%Species for all G-Stock
Diameter Class		0	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32		
ABCO White fir	COUNT	0	0	1	0	3	3	2	1	0	1	0	0	0	0	0	0	0	11	
	TPA	0.00	0.00	1.11	0.00	3.33	3.33	2.22	1.11	0.00	1.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	12	24%
	BA/AC	0.00	0.00	0.11	0.00	1.16	1.92	1.66	1.20	0.00	2.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.2	14%
	AVE HT. (HL)	0.00	0.00	70.00	0.00	55.73	60.40	64.22	61.00	0.00	117.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
PIPO Ponderosa pine	COUNT	0	0	0	0	3	0	1	1	1	1	1	1	0	1	1	0	1	12	
	TPA	0.00	0.00	0.00	0.00	3.33	0.00	1.11	1.11	1.11	1.11	1.11	1.11	0.00	1.11	1.11	0.00	1.11	13	27%
	BA/AC	0.00	0.00	0.00	0.00	1.08	0.00	0.92	1.35	1.40	1.96	2.23	2.78	0.00	3.79	4.75	0.00	6.80	27	47%
	AVE HT. (HL)	0.00	0.00	0.00	0.00	52.34	0.00	62.00	90.00	103.00	62.00	70.00	97.00	0.00	120.00	120.00	0.00	98.00		
PSME Douglas-fir	COUNT	0	0	0	0	0	2	0	3	4	0	2	1	0	0	0	0	0	12	
	TPA	0.00	0.00	0.00	0.00	0.00	2.22	0.00	3.33	4.44	0.00	2.22	1.11	0.00	0.00	0.00	0.00	0.00	13	27%
	BA/AC	0.00	0.00	0.00	0.00	0.00	1.29	0.00	3.52	6.31	0.00	4.75	2.75	0.00	0.00	0.00	0.00	0.00	19	33%
	AVE HT. (HL)	0.00	0.00	0.00	0.00	0.00	60.59	0.00	79.30	88.30	0.00	83.08	0.00	0.00	0.00	0.00	0.00	0.00		
PIFL2 Limber pine	COUNT	0	0	0	3	2	0	0	0	0	0	0	0	0	0	0	0	0	5.0	
	TPA	0.00	0.00	0.00	3.33	2.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.6	11%
	BA/AC	0.00	0.00	0.00	0.57	0.66	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.2	2.2%
	AVE HT. (HL)	0.00	0.00	0.00	33.68	37.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
PIPU Colorado blue spruce	COUNT	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1.0	
	TPA	0.00	0.00	0.00	0.00	0.00	1.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.1	2.2%
	BA/AC	0.00	0.00	0.00	0.00	0.00	0.54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.54	0.94%
	AVE HT. (HL)	0.00	0.00	0.00	0.00	0.00	69.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
POTR5 Aspen	COUNT	0	0	0	1	3	0	0	0	0	0	0	0	0	0	0	0	0	4.0	
	TPA	0.00	0.00	0.00	1.11	3.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.4	8.9%
	BA/AC	0.00	0.00	0.00	0.26	1.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.5	2.6%
	AVE HT. (HL)	0.00	0.00	0.00	84.00	93.31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
Forestland Species Sub-total	*COUNT*	*0*	*0*	*1*	*4*	*11*	*6*	*3*	*5*	*5*	*2*	*3*	*2*	*0*	*1*	*1*	*0*	*1*	*45*	
	TPA	*0.00*	*0.00*	*1.11*	*4.44*	*12.22*	*6.67*	*3.33*	*5.56*	*5.56*	*2.22*	*3.33*	*2.22*	*0.00*	*1.11*	*1.11*	*0.00*	*1.11*	*50*	*100%*
	BA/AC	*0.00*	*0.00*	*0.11*	*0.82*	*4.15*	*3.74*	*2.58*	*6.07*	*7.71*	*4.08*	*6.99*	*5.52*	*0.00*	*3.79*	*4.75*	*0.00*	*6.80*	*57*	*100%*
	AVE HT. (HL)	*0.00*	*0.00*	*70*	*49*	*63*	*62*	*63*	*78*	*91*	*91*	*79*	*49*	*0.00*	*120*	*120*	*0.00*	*98*		
Summary by Size Class for Forestland Species	*TPA*		*1.1*			*23*							*26*						*50*	
	TPA %		*2.2%*			*47%*							*51%*						*100%*	
	BA/AC		*0.11*			*8.7*							*48*						*57*	
	BA/AC %		*0.19%*			*15%*							*85%*						*100%*	
	QUADRATIC MEAN DIA.		*4.20*			*8.28*							*18.6*						*14.5*	
	AVE HT. (HL)		*70*			*61*							*87*						*83*	

Stand Total		Saplings			Pole			Tree or Sawlog											Total by Class, Growing Stock & Dead	% by Class, Growing Stock vs Dead
Diameter Class		*0*	*2*	*4*	*6*	*8*	*10*	*12*	*14*	*16*	*18*	*20*	*22*	*24*	*26*	*28*	*30*	*32*		
Growing Stock (All living trees in woodland & forestland)	COUNT	0	0	1	4	11	6	3	5	5	2	3	2	0	1	1	0	1	*45*	
	TPA	0.00	0.00	1.11	4.44	12.22	6.67	3.33	5.56	5.56	2.22	3.33	2.22	0.00	1.11	1.11	0.00	1.11	*50*	*73%*
	BA/AC	0.00	0.00	0.11	0.82	4.15	3.74	2.58	6.07	7.71	4.08	6.99	5.52	0.00	3.79	4.75	0.00	6.80	*57*	*71%*
	AVE HT, HL	0.00	0.00	70	49	63	62	63	78	91	91	79	49	0.00	120	120	0.00	98		
Summary by Size Class (All living trees in woodland & forestland)	TPA	1.11			23.33			25.56											*50*	
	TPA %	2.22%			46.67%			51.11%											*100%*	
	BA/AC	0.11			8.72			48.29											*57*	
	BA/AC %	0.19%			15.26%			84.55%											*100%*	
	QMD MEAN DIA.	4.20			8.28			18.61											*14.5*	
	AVE HT, HL	70			61			87											*83*	
Dead (All dead trees in woodland & forestland)	COUNT	0	0	0	1	3	1	2	3	5	1	0	0	0	0	0	0	1	*17*	
	TPA	0.00	0.00	0.00	1.11	3.33	1.11	2.22	3.33	5.56	1.11	0.00	0.00	0.00	0.00	0.00	0.00	1.11	*19*	*27%*
	BA/AC	0.00	0.00	0.00	0.25	1.12	0.61	1.49	3.77	7.71	1.90	0.00	0.00	0.00	0.00	0.00	0.00	6.21	*23*	*29%*
	AVE HT, HL	0.00	0.00	0.00	8	32	48	56	58	28	95	0.00	0.00	0.00	0.00	0.00	0.00	13	*37*	
Total for all sample trees including Growing Stock and Dead	COUNT	0	0	1	5	14	7	5	8	10	3	3	2	0	1	1	0	2	*62*	
	TPA	0.00	0.00	1.11	5.56	15.56	7.78	5.56	8.89	11.11	3.33	3.33	2.22	0.00	1.11	1.11	0.00	2.22	*69*	*100%*
	BA/AC	0.00	0.00	0.11	1.07	5.27	4.35	4.07	9.84	15.42	5.98	6.99	5.52	0.00	3.79	4.75	0.00	13.01	*80*	*100%*

2023 Post-wildfire immediate

Table 6. *Stand table of forestland species metrics for the 2023 post-wildfire immediate measurement period*

Forestland Species		Saplings			Pole			Mature Trees											*Total by Species & Covertype*	*%Species for all G-Stock*
Diameter Class		*0*	*2*	*4*	*6*	*8*	*10*	*12*	*14*	*16*	*18*	*20*	*22*	*24*	*26*	*28*	*30*	*32*		
ABCO White fir	COUNT	0	0	0	0	3	1	3	1	0	1	0	0	0	0	0	0	0	*9.0*	
	TPA	0.00	0.00	0.00	0.00	3.33	1.11	3.33	1.11	0.00	1.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*10*	*29%*
	BA/AC	0.00	0.00	0.00	0.00	1.26	0.66	2.47	1.27	0.00	2.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*7.8*	*20%*
	AVE HT. (HL)	0.00	0.00	0.00	0.00	40.46	32.30	50.98	56.80	0.00	82.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
PIPO Ponderosa pine	COUNT	0	0	0	1	2	0	1	0	2	1	1	1	0	0	1	0	0	*10*	
	TPA	0.00	0.00	0.00	1.11	2.22	0.00	1.11	0.00	2.22	1.11	1.11	1.11	0.00	0.00	1.11	0.00	0.00	*11*	*32%*
	BA/AC	0.00	0.00	0.00	0.28	0.83	0.00	0.99	0.00	2.91	1.94	2.19	2.75	0.00	0.00	4.89	0.00	0.00	*17*	*42%*
	AVE HT. (HL)	0.00	0.00	0.00	36.00	39.70	0.00	47.20	0.00	73.85	76.90	83.10	74.90	0.00	0.00	105.50	0.00	0.00		
PSME Douglas-fir	COUNT	0	0	0	0	0	0	1	3	1	0	2	1	0	0	0	0	0	*8.0*	
	TPA	0.00	0.00	0.00	0.00	0.00	0.00	1.11	3.33	1.11	0.00	2.22	1.11	0.00	0.00	0.00	0.00	0.00	*8.9*	*26%*
	BA/AC	0.00	0.00	0.00	0.00	0.00	0.00	0.77	3.54	1.65	0.00	4.80	2.83	0.00	0.00	0.00	0.00	0.00	*14*	*34%*
	AVE HT. (HL)	0.00	0.00	0.00	0.00	0.00	0.00	48.30	67.81	78.10	0.00	80.41	77.10	0.00	0.00	0.00	0.00	0.00		
PIFL2 Limber pine	COUNT	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	*2.0*	
	TPA	0.00	0.00	0.00	1.11	1.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*2.2*	*6.5%*
	BA/AC	0.00	0.00	0.00	0.24	0.36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*0.60*	*1.5%*
	AVE HT. (HL)	0.00	0.00	0.00	31.50	31.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
PIPU Colorado blue spruce	COUNT	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	*1.0*	
	TPA	0.00	0.00	0.00	0.00	0.00	1.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*1.1*	*3.2%*
	BA/AC	0.00	0.00	0.00	0.00	0.00	0.54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*0.54*	*1.4%*
	AVE HT. (HL)	0.00	0.00	0.00	0.00	0.00	48.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
POTR5 Aspen	COUNT	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	*1.0*	
	TPA	0.00	0.00	0.00	0.00	0.00	1.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*1.1*	*3.2%*
	BA/AC	0.00	0.00	0.00	0.00	0.00	0.49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*0.49*	*1.2%*
	AVE HT. (HL)	0.00	0.00	0.00	0.00	0.00	67.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
Forestland Species Sub-total	*COUNT*	*0*	*0*	*0*	*2*	*6*	*3*	*5*	*4*	*3*	*2*	*3*	*2*	*0*	*0*	*1*	*0*	*0*	*31*	
	TPA	*0.00*	*0.00*	*0.00*	*2.22*	*6.67*	*3.33*	*5.56*	*4.44*	*3.33*	*2.22*	*3.33*	*2.22*	*0.00*	*0.00*	*1.11*	*0.00*	*0.00*	*34*	*100%*
	BA/AC	*0.00*	*0.00*	*0.00*	*0.52*	*2.45*	*1.68*	*4.23*	*4.81*	*4.56*	*4.06*	*6.99*	*5.58*	*0.00*	*0.00*	*4.89*	*0.00*	*0.00*	*40*	*100%*
	AVE HT. (HL)	*0.00*	*0.00*	*0.00*	*34*	*39*	*48*	*50*	*65*	*75*	*80*	*81*	*76*	*0.00*	*0.00*	*106*	*0.00*	*0.00*		
Summary by Size Class for Forestland Species	*TPA*	*0.0*			*12*			*22*											*34*	
	TPA %	*0.0%*			*35%*			*65%*											*100%*	
	BA/AC	*0.0*			*4.7*			*35*											*40*	
	BA/AC %	*0.0%*			*12%*			*88%*											*100%*	
	QUADRATIC MEAN DIA.	*N/A*			*8.35*			*17.0*											*14.6*	
	AVE HT. (HL)	*N/A*			*41*			*77*											*73*	

Stand Total		Saplings			Pole			Tree or Sawlog											Total by Class,Growing Stock & Dead	% by Class, Growing Stock vs Dead
Diameter Class		*0*	*2*	*4*	*6*	*8*	*10*	*12*	*14*	*16*	*18*	*20*	*22*	*24*	*26*	*28*	*30*	*32*		
Growing Stock (All living trees in woodland & forestland)	COUNT	0	0	0	2	6	3	5	4	3	2	3	2	0	0	1	0	0	***31***	
	TPA	0.00	0.00	0.00	2.22	6.67	3.33	5.56	4.44	3.33	2.22	3.33	2.22	0.00	0.00	1.11	0.00	0.00	***34***	***56%***
	BA/AC	0.00	0.00	0.00	0.52	2.45	1.68	4.23	4.81	4.56	4.06	6.99	5.58	0.00	0.00	4.89	0.00	0.00	***40***	***59%***
	AVE HT, HL	0.00	0.00	0.00	34	39	48	50	65	75	80	81	76	0.00	0.00	106	0.00	0.00		
Summary by Size Class (All living trees in woodland & forestland)	TPA	0.00			12.22			22.22											***34***	
	TPA %	0.00%			35.48%			64.52%											***100%***	
	BA/AC	0.00			4.65			35.12											***40***	
	BA/AC %	0.00%			11.70%			88.30%											***100%***	
	QMD MEAN DIA.	#DIV/0!			8.35			17.02											***14.6***	
	AVE HT, HL	0.00			41			77											***73***	
Dead (All dead trees in woodland & forestland)	COUNT	0	0	0	5	5	2	1	4	3	1	1	0	0	1	1	0	0	***24***	
	TPA	0.00	0.00	0.00	5.56	5.56	2.22	1.11	4.44	3.33	1.11	1.11	0.00	0.00	1.11	1.11	0.00	0.00	***27***	***44%***
	BA/AC	0.00	0.00	0.00	1.06	1.97	1.13	1.01	4.87	4.51	1.86	2.35	0.00	0.00	3.91	4.82	0.00	0.00	***27***	***41%***
	AVE HT, HL	0.00	0.00	0.00	31	46	35	15	40	67	67	6	0.00	0.00	98	8	0.00	0.00	***45***	
Total for all sample trees including Growing Stock and Dead	COUNT	0	0	0	7	11	5	6	8	6	3	4	2	0	1	2	0	0	***55***	
	TPA	0.00	0.00	0.00	7.78	12.22	5.56	6.67	8.89	6.67	3.33	4.44	2.22	0.00	1.11	2.22	0.00	0.00	***61***	***100%***
	BA/AC	0.00	0.00	0.00	1.58	4.42	2.81	5.24	9.68	9.07	5.92	9.34	5.58	0.00	3.91	9.71	0.00	0.00	***67***	***100%***

Understory & Forest Floor Component

Ground & Aerial Cover

Cover data was taken under a different protocol during the pre-treatment measure in 2014 (pre-treatment) and values are not directly comparable to each category of cover data collected in the following measurements. Canopy was recorded to increase from 28% pre-treatment, to 38% 5 years post-treatment, to 41% immediately post-wildfire. It is worth noting that our understanding of the exact cause of the canopy cover variation is limited, and may be in part due to variation in data collection between crews.

Percent ground covered by litter, tree bole, and rock decreased from 2019 5 years post-treatment to 2023 immediately post-fire. Cover of bare soil, gravel and plant basal increased post-fire. Litter and boles were consumed by the fire, exposing more bare soil and rock. The increase in plant basal is consistent with the jump in graminoid and forb aerial cover, seen below.

The aerial cover of tree regeneration and shrubs decreased post-fire because these were likely consumed by the fire. Graminoids and forb aerial cover increased post-fire; the fire opened the canopy, providing more light and other resources to spur herbaceous plant growth.

21.12 Calf Canyon: Pre-treatment Cover

Table 7. Mean percent cover by monitoring status and category (results are listed in combined ground/aerial cover format from previous protocol)

Monitoring Status	Seedlings/saplings	Shrubs	Graminoids	Forbs	Litter	Bare Soil
2014 PreTreatment	12%	0%	27%	34%	52%	4%

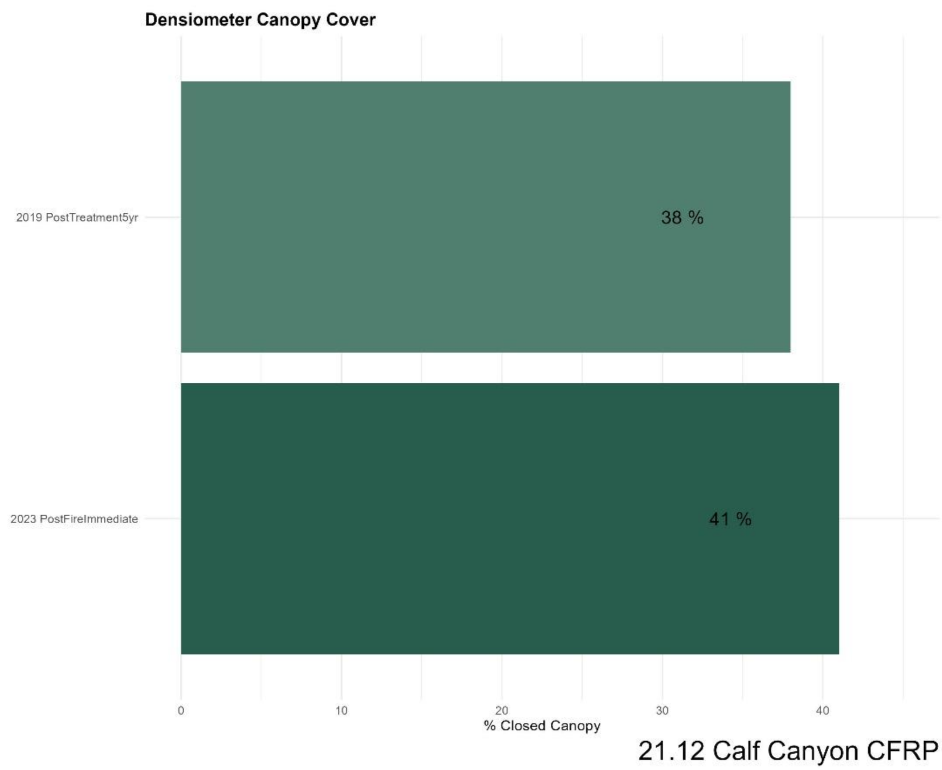


***Figure 18**: Mean canopy cover across plots, as measured with spherical concave densiometer, by monitoring status.*

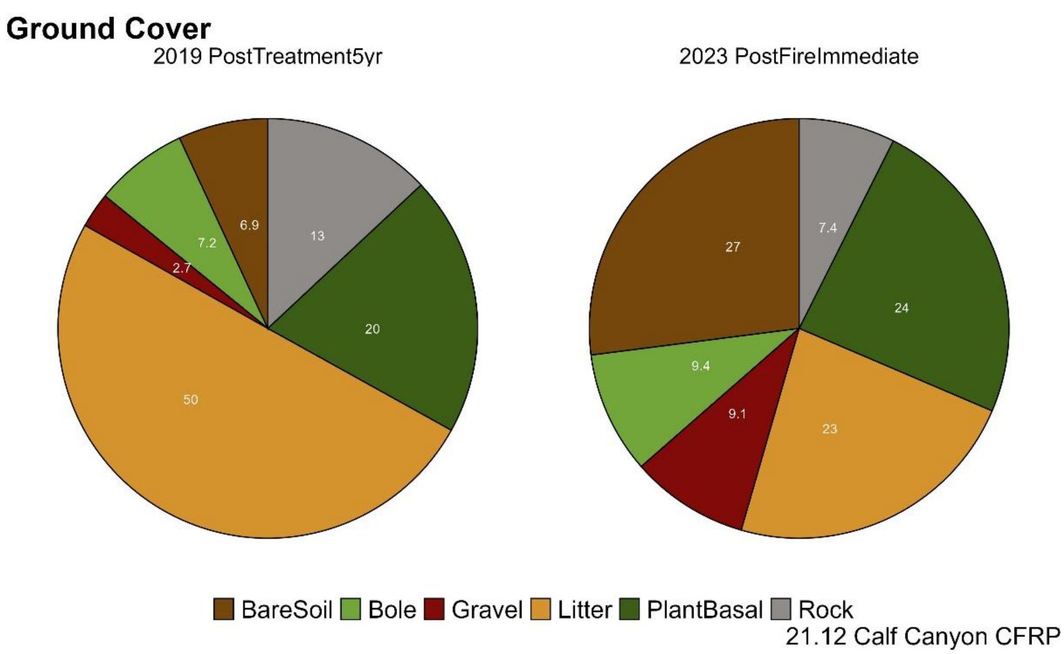


***Figure 19:** Mean percent ground cover across macroplots, by cover class and monitoring status.*

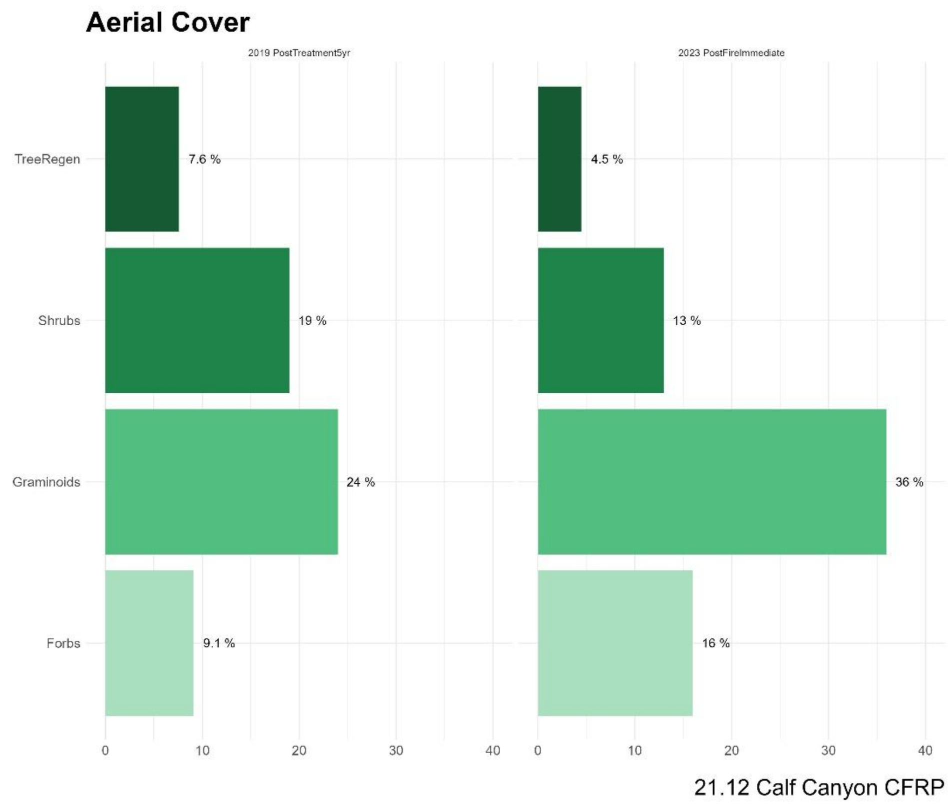


Figure 20: *Mean aerial cover across plots, by monitoring status and cover class.*

Surface Fuels Vegetation (Ladder Fuels)

Fuel Type	Definition
HD	Herbaceous Dead
HL	Herbaceous Live
SD	Woody Dead
SL	Woody Live

Average biomass of ladder fuels decreased substantially from 410 tons per acre pretreatment to 35 tons per acre 5 years post-treatment, before increasing slightly to 51 tons per acre immediately post-fire. Pretreatment and 5 years post-treatment, the dominant ladder fuel component by biomass was live woody fuels at 230 and 9.3 tons per acre, respectively. Immediately post-fire, the dominant component was live herbaceous fuels, at 18 tons per acre. Percent cover was dominated by live herbaceous fuels across all monitoring periods, but average heights remained less than 1ft.

As described above, NMFWRI does not possess specific details on treatment prescriptions. However, photos and other data suggest significant manual thinning and prescribed fire at some point between 2014 and 2019; this explains the substantial drop in ladder fuel biomass between these monitoring periods. The increase in ladder fuel biomass from 2019 to 2023 is not consistent with the expectation that fire will consume, and therefore decrease, ladder fuels. However, this is likely explained by a surge in plant growth, as demonstrated by our aerial cover and regeneration metrics.

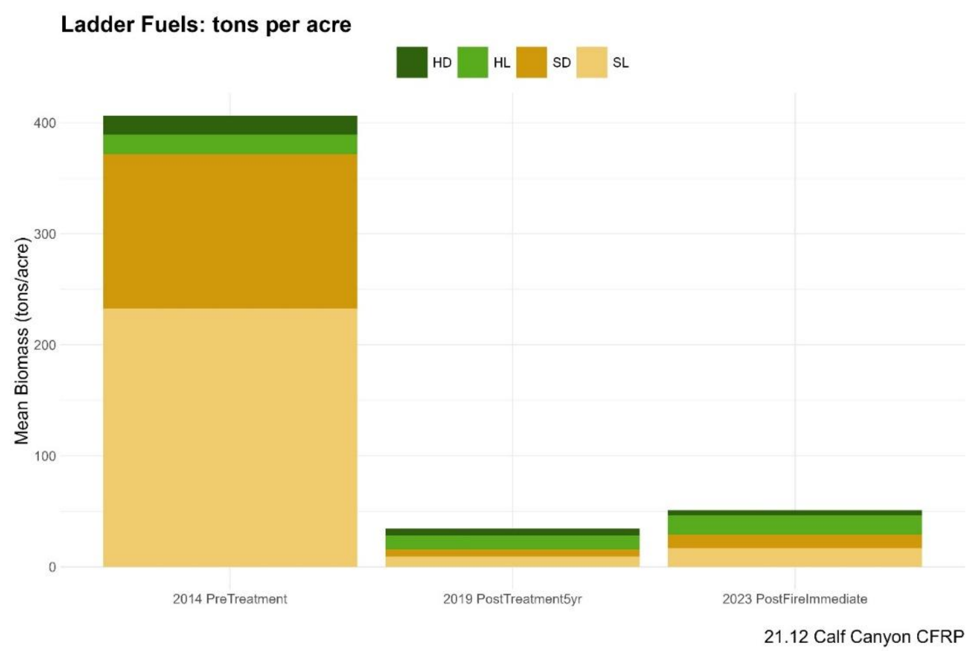


Figure 21: *Mean biomass (in tons per acre) of ladder fuels across plots, by fuel type and monitoring period.*

Table 8. *Ladder fuel average percent cover, height, and biomass for each category and monitoring status*

Monitoring Status	Vegetation	Mean % Cover	Mean Height (ft)	Mean Biomass (tons/acre)	Total Biomass (tons/acre)
2014 PreTreatment	HD	11	0.53	17	
	HL	19	0.51	18	
	SD	4.9	4.4	140	
	SL	7.6	5	230	
					410
2019 PostTreatment5yr	HD	9.6	0.25	6	
	HL	23	0.45	13	
	SD	0.22	2.8	6.5	
	SL	0.97	2.2	9.3	
					35
2023 PostFireImmediate	HD	8.9	0.29	4.5	
	HL	22	0.67	18	
	SD	0.75	2.7	12	
	SL	4	1.3	17	
					51

Surface Fuels

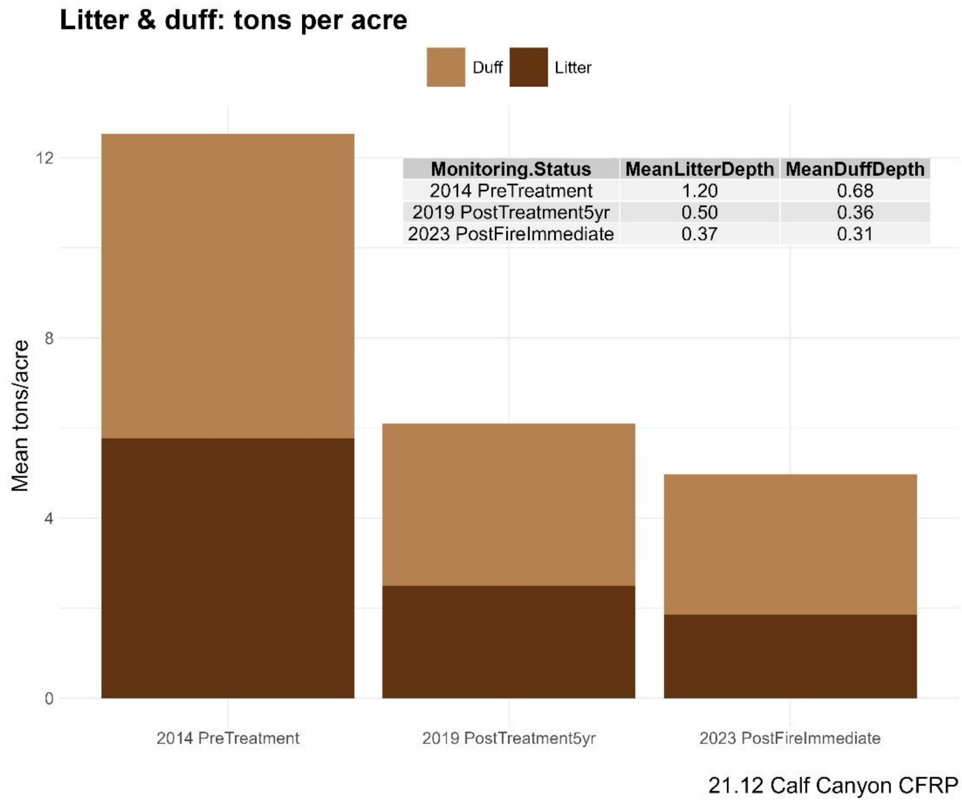
Total fine fuels, total wood fuels, and total surface fuels all decreased across each measurement period. Total surface fuels dropped from 47 tons per acre pre-treatment to 31 tons per acre 5 years post-treatment, to 22 tons per acre immediately post-wildfire. This is consistent with the effects of forest restoration treatment prescriptions and wildfire, which both consume and/or remove fuels from the landscape.

Table 9. *Fuel loads by type and monitoring status*

21.12 Calf Canyon CFRP										
Monitoring Status	**1-hr (tons/acre)**	**10-hr (tons/acre)**	**100-hr (tons/acre)**	**1000-hr sound (tons/acre)**	**1000-hr rotten (tons/acre)**	**Litter (tons/acre)**	**Duff (tons/acre)**	**Total Fine Fuels (tons/acre)**	**Total Wood Fuels (tons/acre)**	**Total Surface Fuels (tons/acre)**
2014 PreTreatment	0.34	1.4	1.6	24	27	5.8	6.8	3.4	54	67
2019 PostTreatment5yr	0.017	0.28	2.2	32	3.6	2.5	3.6	2.5	38	44
2023 PostFireImmediate	0.086	0.49	0.52	20	1.8	1.9	3.1	1.1	23	28

Litter and Duff

Litter and duff fuel loads decreased steadily across each measurement period. Litter fuel loads dropped from 5.8 tons per acre pre-treatment to 2.5 tons per acre 5 years post-treatment, to 1.9 tons per acre immediately post-wildfire. Likewise, duff fuel loads dropped from 6.8 tons per acre pre-treatment, to 3.6 tons per acre 5 years post-treatment, to 3.1 tons per acre immediately post-wildfire. This suggests that the wildfire didn't burn intensely near the soil, as most of the duff and litter load remained intact.



Monitoring.Status	MeanLitterDepth	MeanDuffDepth
2014 PreTreatment	1.20	0.68
2019 PostTreatment5yr	0.50	0.36
2023 PostFireImmediate	0.37	0.31

***Figure 22**. Mean litter and duff loads by monitoring status*

Fine Fuels

Total fine fuels decreased steadily across each measurement period, with some variation within each fine fuel category. These decreases are consistent with the fact that fire consumes fuels. 1-hr fuels decreased from 0.34 tons per acre pre-treatment to 0.017 tons per acre 5 years post-treatment, before increasing to 0.086 tons per acre immediately post-wildfire. 10-hr fuels decreased from 1.4 tons per acre pre-treatment to 0.28 tons per acre 5 years post-treatment, before increasing to 0.49 tons per acre immediately post-wildfire. 100-hr fuels increased from 1.6 tons per acre pre-treatment to 2.2 tons per acre 5 years post-treatment, before decreasing to 0.52 tons per acre immediately post-wildfire.

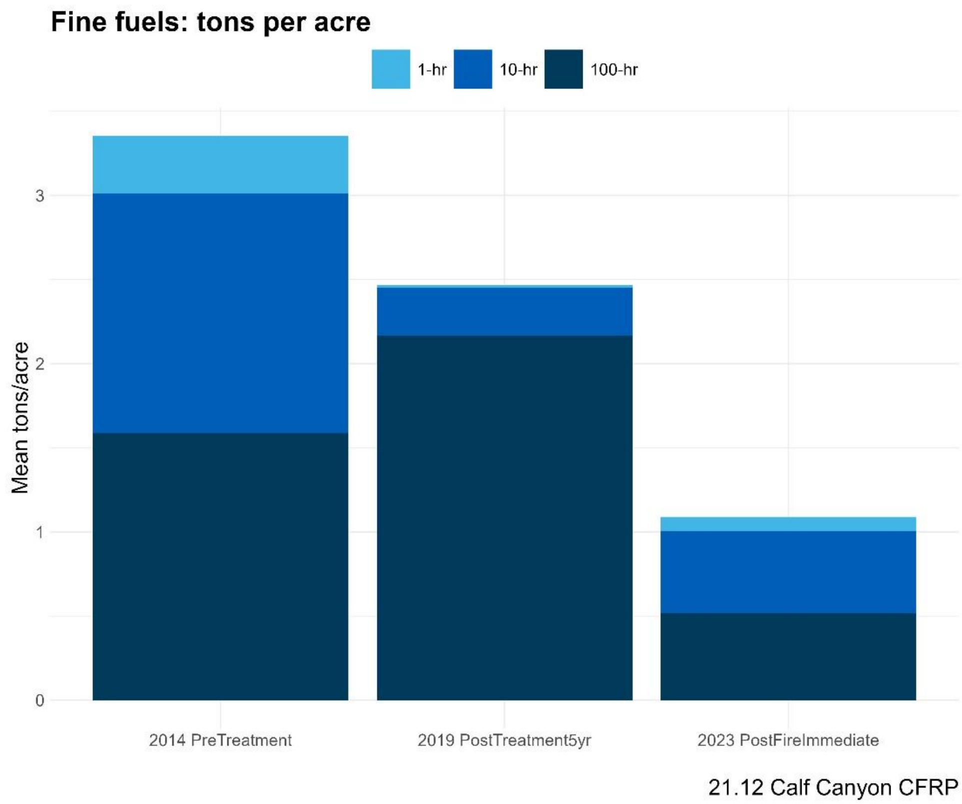


Figure 23. *Mean litter and duff loads by monitoring status*

Thousand-Hour Fuels

Rotten 1000-hr fuels decreased substantially from 15 tons per acre pre-treatment to 1.6 tons per acre 5 years post-treatment to 0.4 tons per acre immediately post-wildfire. Conversely, sound 1000-hr fuel loads remained relatively steady throughout measurement periods, with a slight increase 5 years post-treatment from 16 to 21 tons per acre and a return to pre-treatment levels (16 tons per acres) immediately post-wildfire.

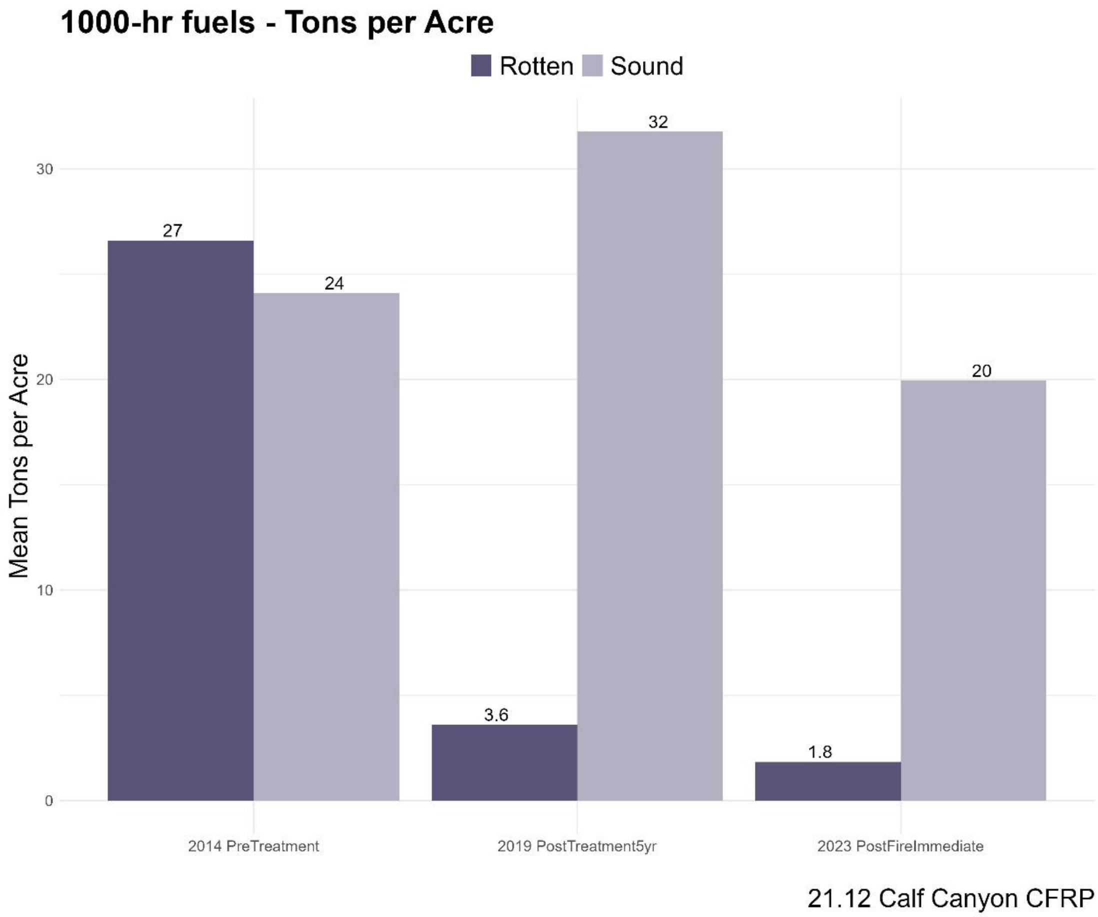


***Figure 24**. Mean thousand-hour fuel loads by monitoring status*

While class 5 rotten 1000-hr fuels made up the highest proportion of 1000-hr fuels pre-treatment, 5 years post-treatment and immediately post-wildfire, class 3 sound 1000-hr fuels made up the highest proportion of 1000-hr fuels.

The reason for the disappearance of rotten logs post-treatment is unclear: they could have been removed, decomposed past class 5 in the intervening time, or were consumed by the assumed prescribed fire in the project area. It is notable that immediately post-fire, we do not see a larger increase in class 1 and 2 1000-hour fuels, despite the presence of newly fire-killed snags in the area. This means that these snags will be falling in the coming years, and we should expect an increase in 1000-hour fuels.

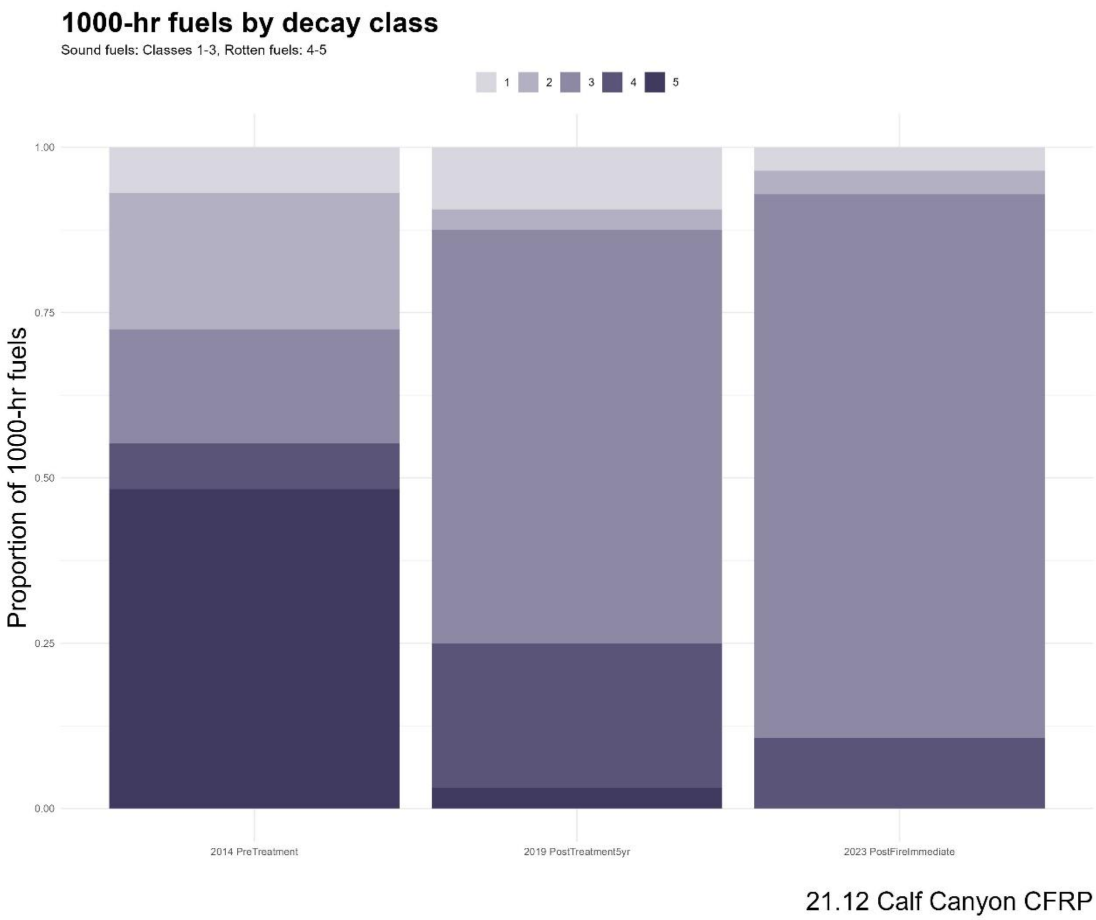
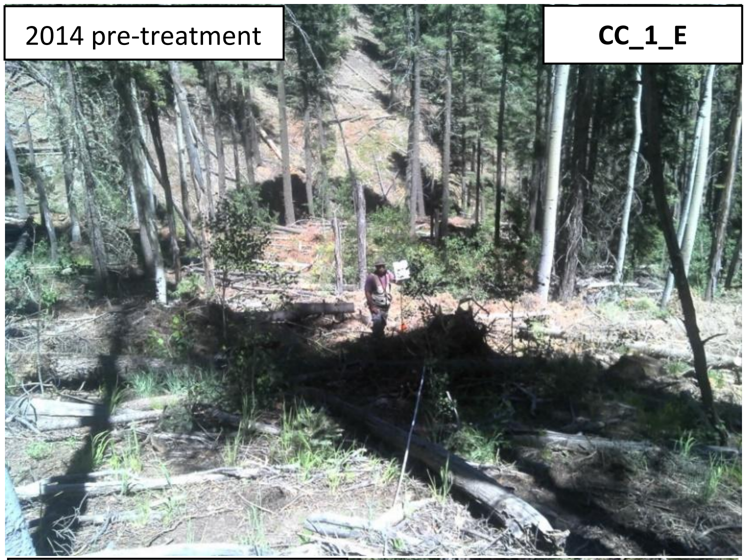


Figure 25. *Proportion of total thousand-hour fuels by decay class and monitoring status*

Photo Comparisons:



2014 pre-treatment

CC_1_E

2019 5yr post-treatment

2023 post-wildfire immediate

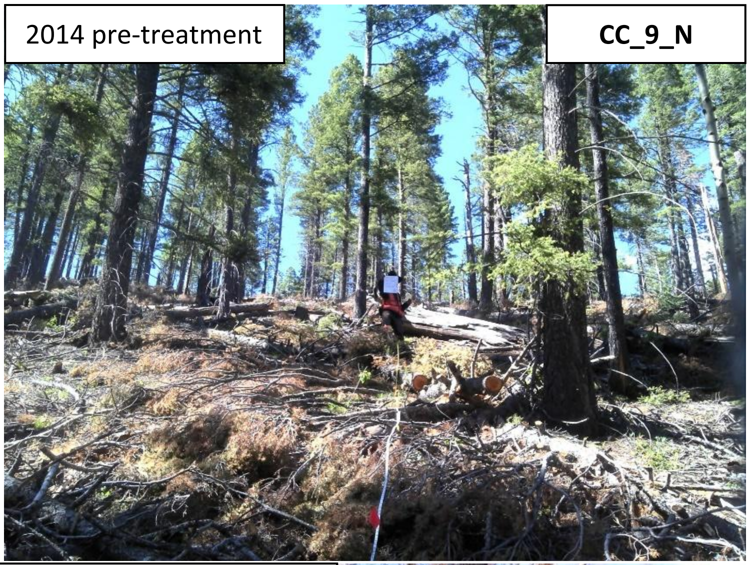
2014 pre-treatment

CC_7_S

2019 5yr post-treatment

2023 post-wildfire immediate

CC_9_N



2014 pre-treatment

2019 5yr post-treatment

2023 post-wildfire immediate

Additional Resources

In 2023, NMFWRI published their first version of a field manual: "Guidelines and Protocols for Monitoring Upland Forests – Field Manual." - https://nmfwri.org/resources/upland-forests-monitoring-field-manual/

For more information regarding monitoring criteria and methodology please contact NMFWRI or consult the 2008 document authored by Derr, et. al., *Monitoring the Long Term Ecological Impacts Of New Mexico's Collaborative Forest Restoration Program, New Mexico Forest Restoration Series Working Paper 5*, available on NMFWRI's website here: http://nmfwri.org/collaborative-forest-restoration-program/cfrp-long-term-monitoring.

For additional information on forest health, forest insects and disease, and non-native species management see resources from the New Mexico Forest and Watershed Health Office: https://www.emnrd.nm.gov/sfd/forest-and-watershed-health-office/

For additional information on post-wildfire community resources, events, and recovery action strategy see the Hermit's Peak/Calf Canyon Post-Fire Resource Hub: https://hermits-peak-calf-canyon-fire-resources-nmhu.hub.arcgis.com/

Works Cited

A. Conklin, D., & A. Armstrong, W. (2005). Effects of Three Prescribed Fires on Dwarf Mistletoe Infection in Southwestern Ponderosa Pine. *United States Department of Agriculture Forest Service*. https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5238544.pdf

Derr, T., McGrath, D., Estrada, V., Krasilovsky, E., & Evans, Z. (n.d.). *MONITORING THE LONG TERM ECOLOGICAL IMPACTS OF NEW MEXICO'S COLLABORATIVE FOREST RESTORATION PROGRAM*.

New Mexico Forest and Watershed Restoration Institute. (2022, August 24). *Hermit's Peak and Calf Canyon Fire*. ArcGIS StoryMaps. https://storymaps.arcgis.com/stories/d48e2171175f4aa4b5613c2d11875653

Southwest Forest Health and Wildfire Prevention Act of 2004, no. 108–317, 108th Congress (2004). https://www.congress.gov/108/plaws/publ317/PLAW-108publ317.pdf

Supplementary Information

Species Lists

Table S10. *List of observed tree and shrub species by species symbol, scientific name, and common name*

Tree Species

Species Symbol	Scientific Name	Common Name
ABCO	*Abies concolor*	white fir
JUMO	*Juniperus monosperma*	one-seed juniper
JUSC2	*Juniperus scopulorum*	rocky mountain juniper
PIED	*Pinus edulis*	pinon
PIPO	*Pinus ponderosa*	ponderosa pine
PSME	*Psuedotsuga menziesii*	Douglas-fir
QUERC	*Quercus sp.*	oak sp.
QUGA	*Quercus gambelii*	Gambel oak

Shrub Species

Species Symbol	Scientific Name	Common Name
AMAL2	*Amelanchier alnifolia*	Saskatoon serviceberry
ARUV	*Arctostaphylos uva-ursi*	kinnickinnick
CEFE	*Ceanothus fendleri*	Fendler’s ceanothus
JUCO6	*Juniperus communis*	common juniper
MARE11	*Mahonia repens*	creeping barberry
PAMY	*Paxistima myrsinites*	Oregon boxleaf
ROWO	*Rosa woodsii*	Woods’ rose
RUPA	*Rubus parviflorus*	thimbleberry

Table S11. *List of plots coordinates by plot name, latitude, and longitude*

Plot Center Coordinates

Plot Name	Latitude	Longitude
CC_01	-105.503866	35.716167
CC_02	-105.505026	35.716833
CC_03	-105.507794	35.717272
CC_04	-105.507558	35.719305
CC_05	-105.508507	35.715703
CC_06	-105.510635	35.716138
CC_07	-105.511464	35.715365
CC_08	-105.509525	35.71798
CC_09	-105.512213	35.717047

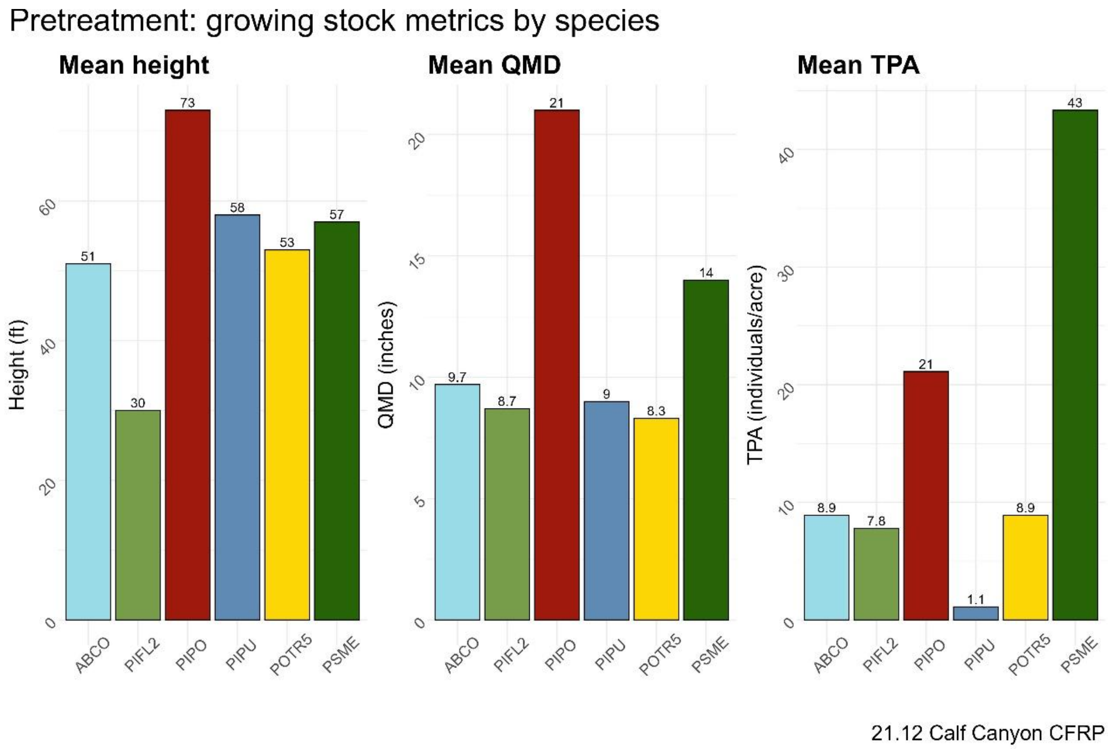
Table S12. *List of abbreviated terms by abbreviation and definition*

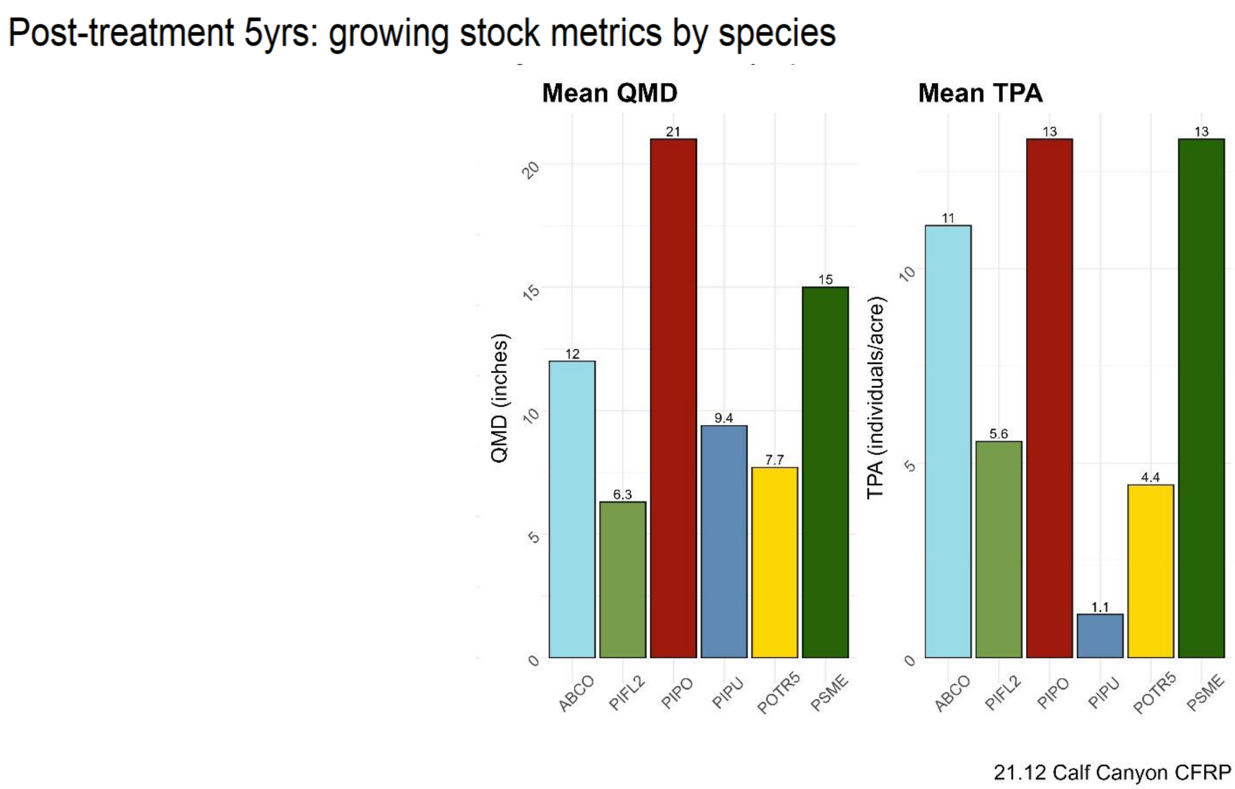
Abbreviations & Acronyms

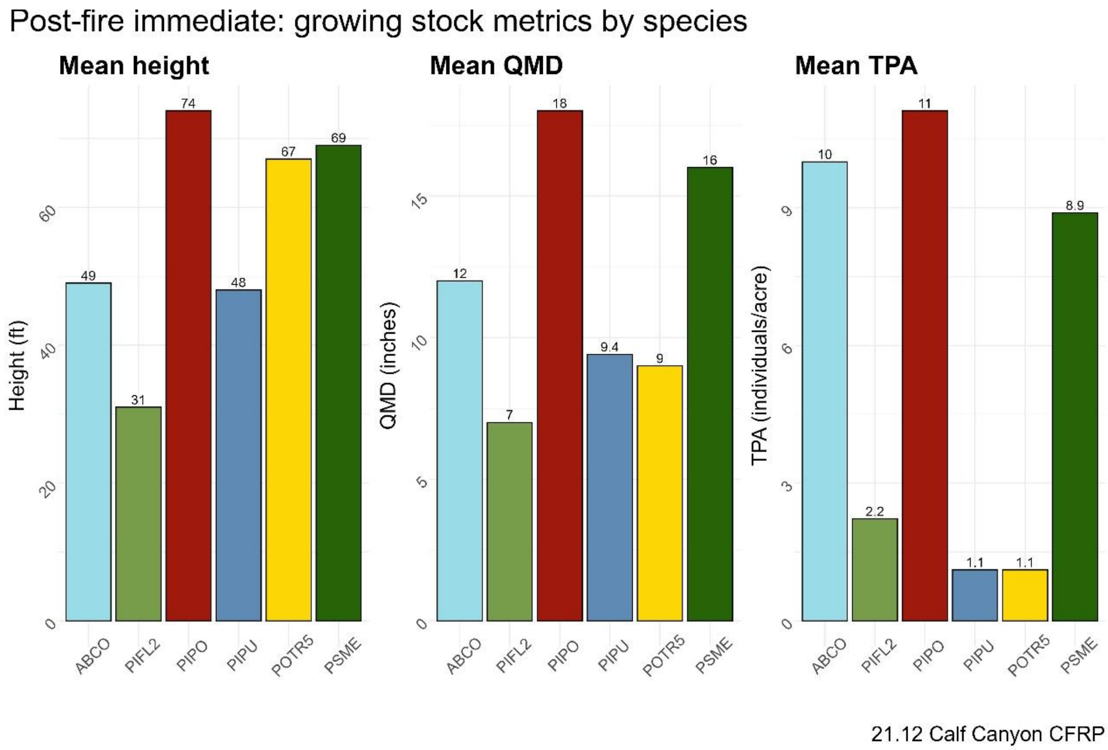
Acronym/Abbreviation/Term	Definition as used by NMFWRI
1-hr fuel	Woody surface debris < 0.25 inches in diameter
10-hr fuel	Woody surface debris 0.25 – 1 inch in diameter
100-hr fuel	Woody surface debris 1.0 – 3.0 inches in diameter
1000-hr fuel	Woody surface debris > 3.0 inches in diameter
CFRP	Collaborative Forest Restoration Program
DBH	Diameter at breast height (4.5 feet)
FFI	FEAT/FIREMON Integrated
FEAT	Fire Ecology Assessment Tool
FIREMON	Fire Effects Monitoring and Inventory System
HD	Herbaceous dead (dead non-woody species)
HL	Herbaceous live (live non-woody species)
NMFWRI	New Mexico Forest and Watershed Restoration Institute
USFS	United States Forest Service
Sapling	Height > 4.5 feet & DBH < 1 inch
Seedling	Height <4.5 feet
SD	Standing dead (dead woody species)
SL	Standing live (live woody species)
“Sick”	Attribute given to trees/shrubs not expected to survive long term
SWERI	Southwest Ecological Restoration Institute
TPA	Trees per acre (trees/acre)
Tree	Height > 4.5 feet & DBH > 1 inch

Supplementary Figures

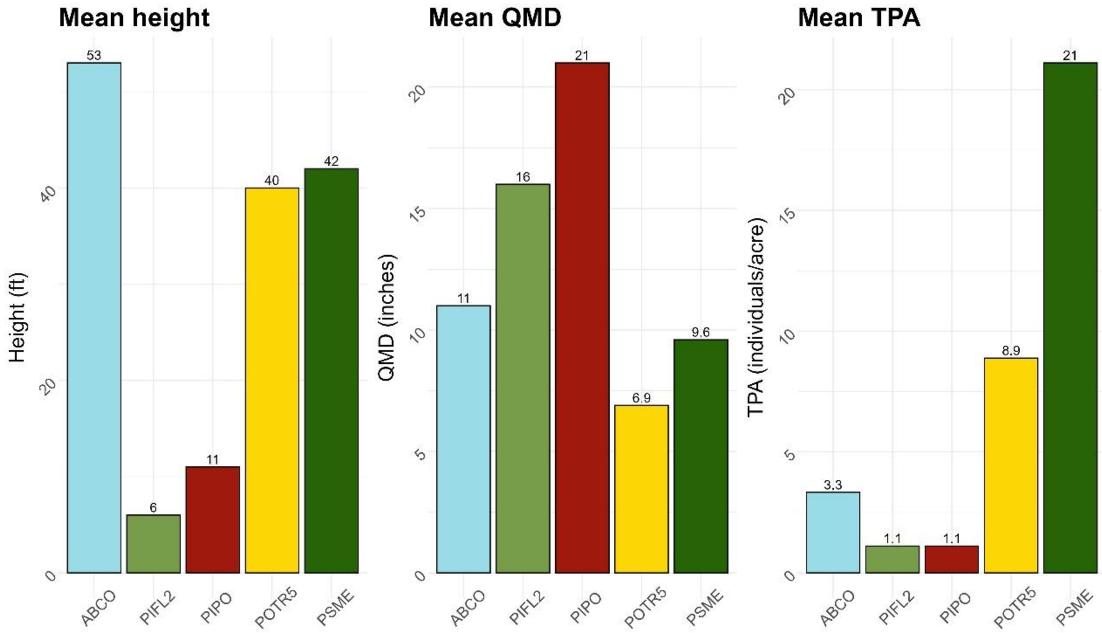
Figure S26. *The following figures show tree (>5" DBH) metrics at the species level by status and measurement period*





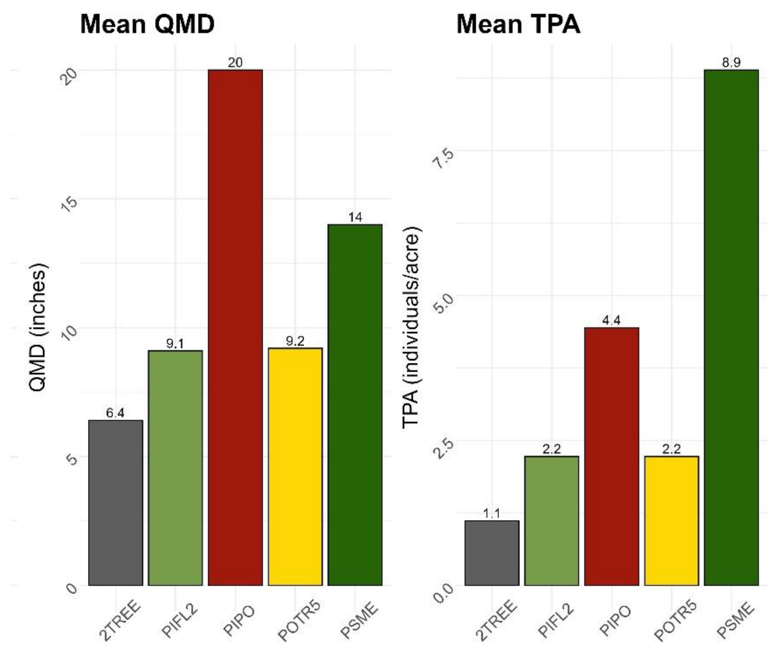

Post-fire immediate: growing stock metrics by species
Mean height
Height (ft)
0
20
40
60
49
31
74
48
67
69
Mean QMD
QMD (inches)
0
5
10
15
12
7
18
9.4
9
16
Mean TPA
TPA (individuals/acre)
0
3
6
9
10
2.2
11
1.1
1.1
8.9
ABCO
PIFL2
PIPO
PIPU
POTR5
PSME
21.12 Calf Canyon CFRP

Pretreatment: snag metrics by species

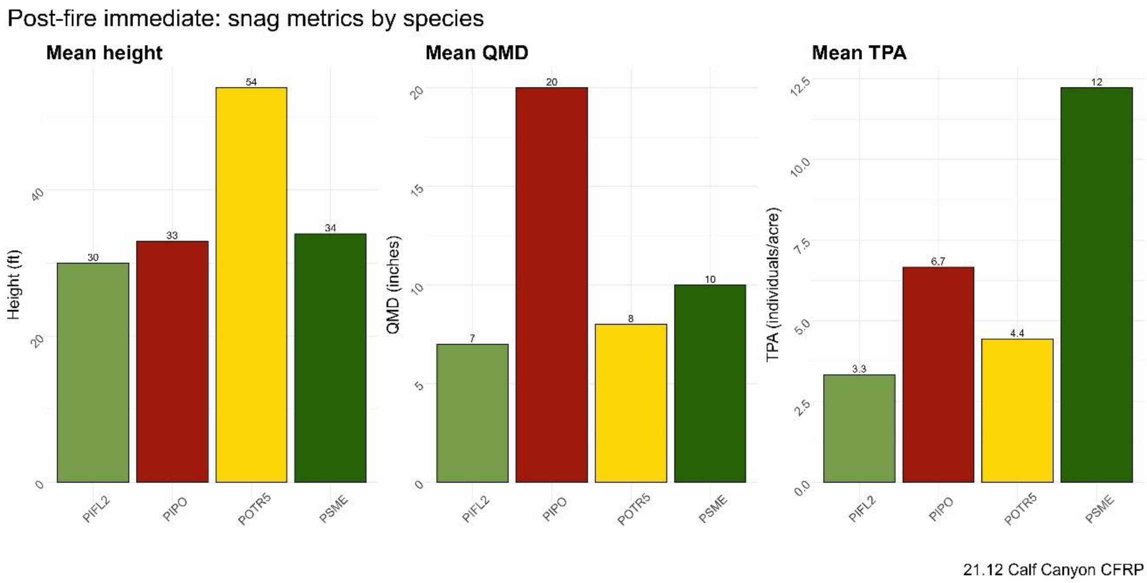


21.12 Calf Canyon CFRP

Post-treatment 5yrs: snag metrics by species



21.12 Calf Canyon CFRP



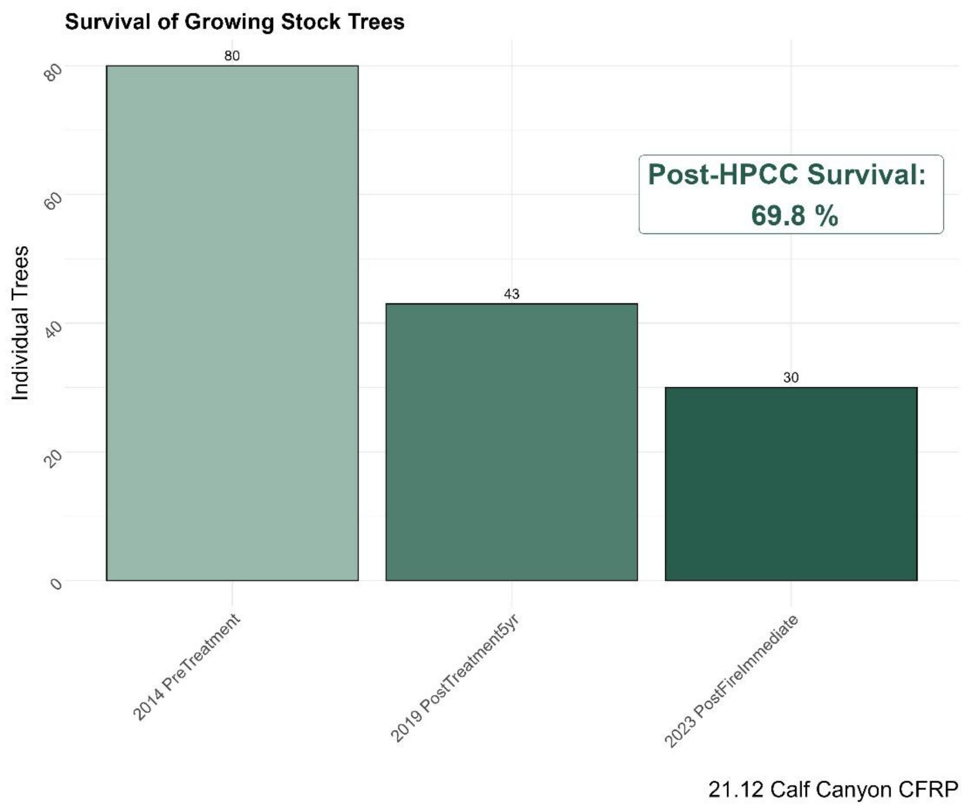
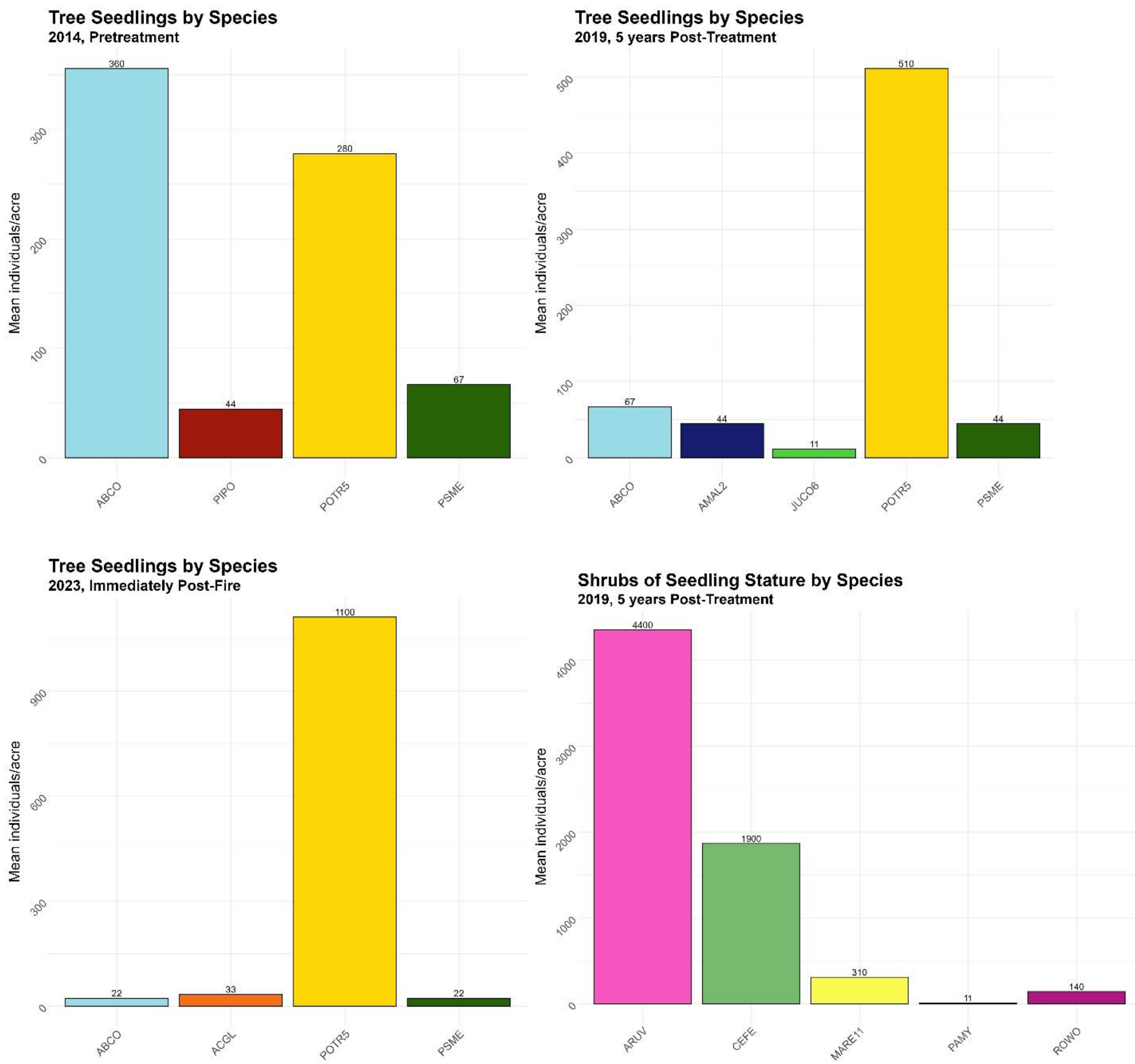
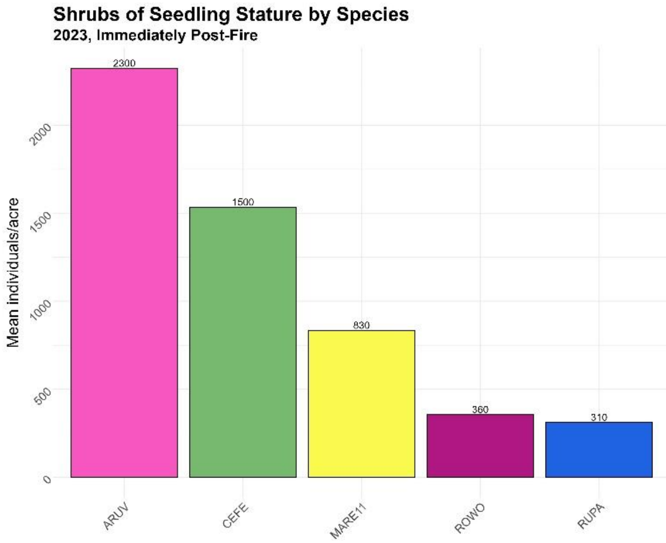
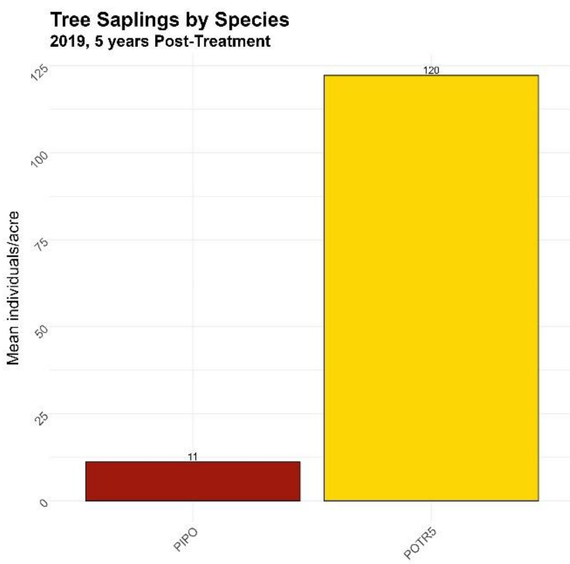


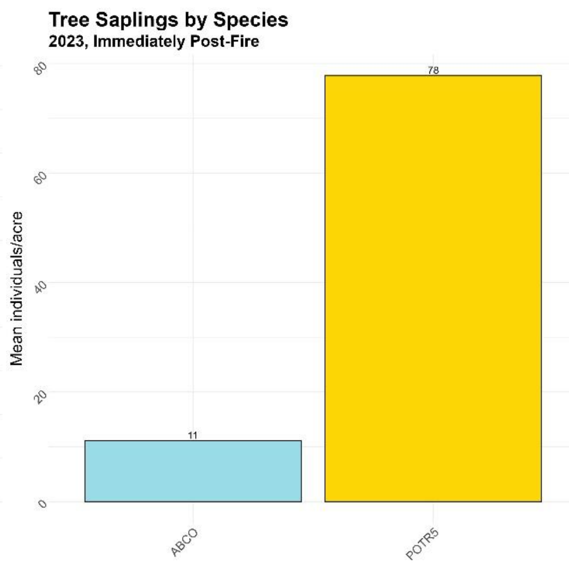
Figure S27: *Survival of Growing Stock Trees by count of individual trees, post-HPCC wildfire.*

Figure S28*. The following figures show seedling and sapling densities by status and measurement period*




Shrubs of Seedling Stature by Species
2023, Immediately Post-Fire
Mean individuals/acre
2300
1500
830
360
310
0
500
1000
1500
2000
ARUV
CEFE
MARE11
ROWO
RUPA


Tree Saplings by Species
2019, 5 years Post-Treatment
Mean individuals/acre
11
120
0
25
50
75
100
125
PIPO
POTR5


Tree Saplings by Species
2023, Immediately Post-Fire
Mean individuals/acre
11
78
0
20
40
60
80
ABCO
POTR5