31.10 Walker Flats Final Phase Trujillo
2023 Post-Wildfire Immediate
Field Inventory Summary
New Mexico Forest and Watershed Restoration Institute

Photos by NMFWRI Field Crew

Submitted by

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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 August 2020 and June 2023, the NMFWRI inventory and monitoring crews measured 8 plots across approximately 178 acres in the Walker Flats region of the Rio Mora watershed in the Pecos-Las Vegas Ranger District of the Santa Fe National Forest. These plots were established to monitor the CFRP project 31.10 entitled *"Walker Flats Watershed Improvement Project – Final Phase,"* hereafter referred to as *"Walker Flats Final Phase Trujillo CFRP*." This project is accessible on foot on forest land via Encinal Road and NM Highway 518 northwest of Las Vegas, in Mora County, New Mexico. The site is mixed-conifer, including Douglas-fir, white fir, ponderosa pine, limber pine, and quaking aspen; and ranges in elevation between 8760 - 9480 feet with moderate to steep slopes.

The treatment, as proposed in the 2010 CFRP application, was intended to reduce excessive stocking levels and produce wood products. Much of the projected 2,000 tons of harvested material was intended to be used as firewood for economically challenged communities in the area. Spatial data from the Pecos/Las Vegas Ranger District of the Santa Fe National Forest indicate that mechanical thinning treatments for this area were planned for years 2010, 2011, and 2012. NMFWRI monitoring photos from 2020 indicate that treatments had taken place in some years previous. 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, 14.5% was classified as high soil burn severity, 33.3% was classified as moderate soil burn severity, 39.3% was classified as low soil burn severity, and 12.8% 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 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 Walker Flats Final Phase Trujillo CFRP project area, with dominant species including quaking aspen, Douglas-fir, and ponderosa pine (**Figure 6**). Following treatments and fire, ponderosa pine and Douglas-fir increased in dominance, while quaking aspen experience a reduction in total population. Tree health concerns for sick trees observed were primarily fire char and/or needle scorch (**Table 2**). This area lies within the footprint of the Hermit's Peak Calf Canyon fire; the composite burn index for the project area was primarily classified at low (39.3%) to moderate severity (33.3%) (**Figure 5**).

Growing stock basal area and tree density both decreased following treatments and wildfire (**Figure 8**). Snag basal area increased as well as snag density (**Figure 9**). The basal area of growing stock trees was greater than snag density 5 years post-treatment, at 85 sqft/acre and 18 squft/acre, respectively. These metrics are swapped immediately post-wildfire; growing stock at 25 sqft/acre and snags at 85 sqft/acre.

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 15**). Following wildfire, live sapling densities decreased while dead sapling densities increased (**Figure 16**). Aspen also made up the majority of saplings recorded (**Supplementary Figures**). Live shrub densities also decreased from the 5-year post-treatment measurement to the immediate post-wildfire measurement, while dead shrubs increased post-wildfire (**Figure 15**). Kinnikinnick and Fendler's ceanothus dominated the shrub class 5 years post-treatment, but Woods' rose dominated immediately post-wildfire (**Supplementary Figures**).

Total surface fuel loads declined following wildfire, with surface fuel loads immediately post-wildfire measuring at less than a quarter of pre-treatment levels (**Table 8**). 1000-hr fuels shifted towards predominantly rotten fuels following wildfire (**Figure 24**). Ladder fuel loads also decreased post-wildfire, and shifted towards predominantly live herbaceous fuels (**Table 7**).

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 to moderate burn severities and high tree seedling densities, 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. Quaking aspen dominated regeneration totals, with little conifer regeneration recorded. However, this can be explained by aspen's habit to readily sprout from underground rhizomes, while conifers require specific conditions for their seeds to germinate. An increase of bare soil ground cover from 3.4% 5 years post-treatment to 32% immediately post-wildfire does indicate an increased risk of soil erosion post-wildfire. The field crew noted mullein on multiple plots immediately post-wildfire. While this is non-native species of potential concern for outcompeting native plants, it may also play 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: 31.10 Walker Flats Final Phase Trujillo. Species dominance is based on numeric density*

Walker Flats Final Phase Trujillo		
Metric	**2020 PostTreatment5yr**	**2023 PostFireImmediate**
Dominant Growing Stock Species	ACGL	PIPO, PSME
Dominant Snag Species	ACGL	POTR5
Dominant Live Seedling	ABCO	POTR5
Dominant Live Sapling	POTR5	POTR5
Dominant Live Shrub (Seedling Class)	ARUV	ROWO
Average Aspect (degrees)	84.9	104
Trees per Acre (growing stock)	221	58
Basal Area (growing stock, sqft/acre)	85.4	40.5
QMD (growing stock, inches)	8.86	11.6
Average Tree Height (ft)	29.9	42.7
Average Live Crown Base Height (ft)	10.2	24.1
Height of Tallest Tree (ft)	72.9	61.4
Live Tree Seedlings Per Acre	329	712
Live Tree Saplings Per Acre	75	25
Live Shrub Seedlings Per Acre	1180	445
Tree Canopy Cover (%)	50	43
Grass & Forb Cover (%)	16.5	15.7
Total Tons Surface Fuels per Acre	27.6	6.17

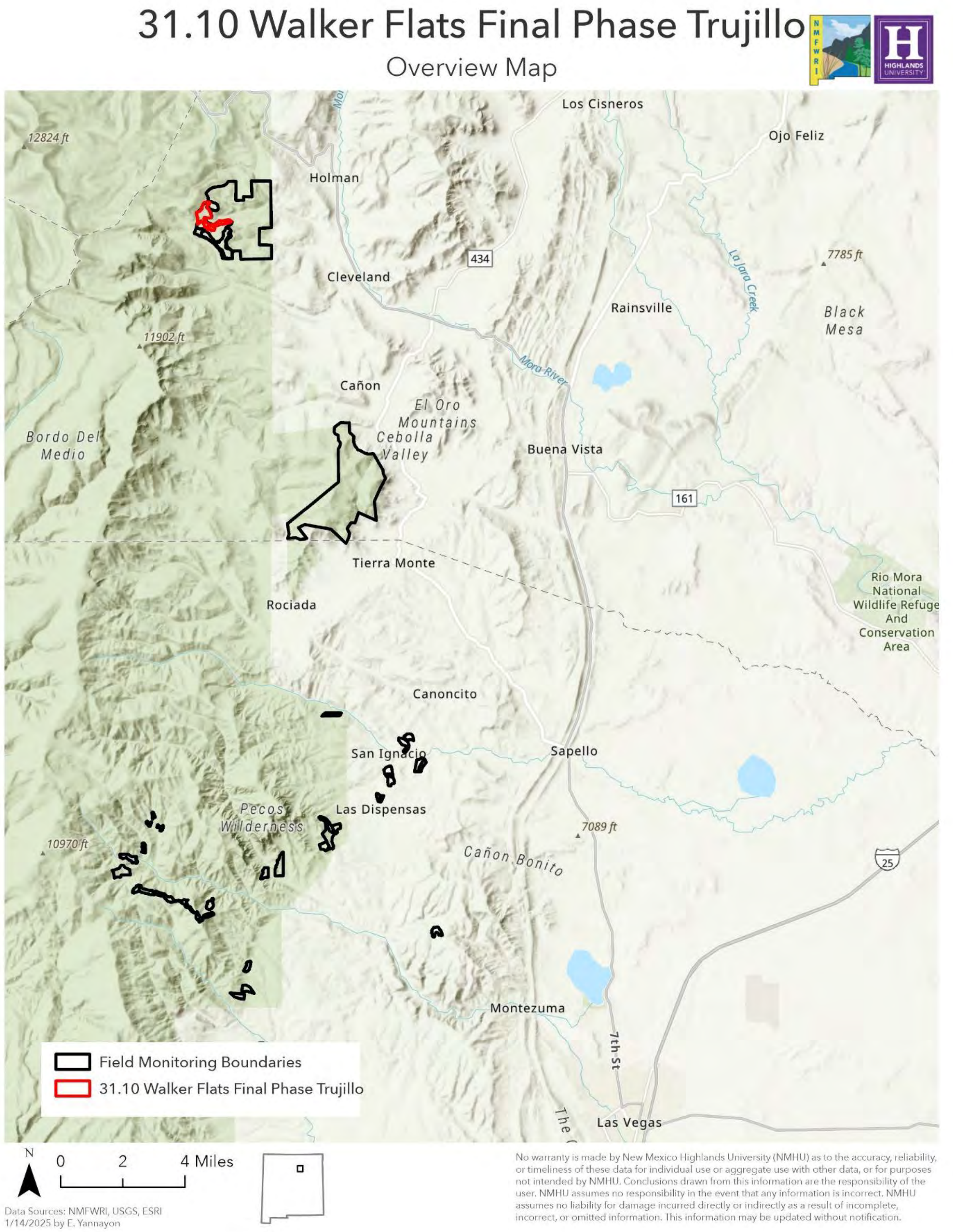


Figure 1. *Regional overview map of the 31.10 Walker Flats Final Phase Trujillo CFRP project*

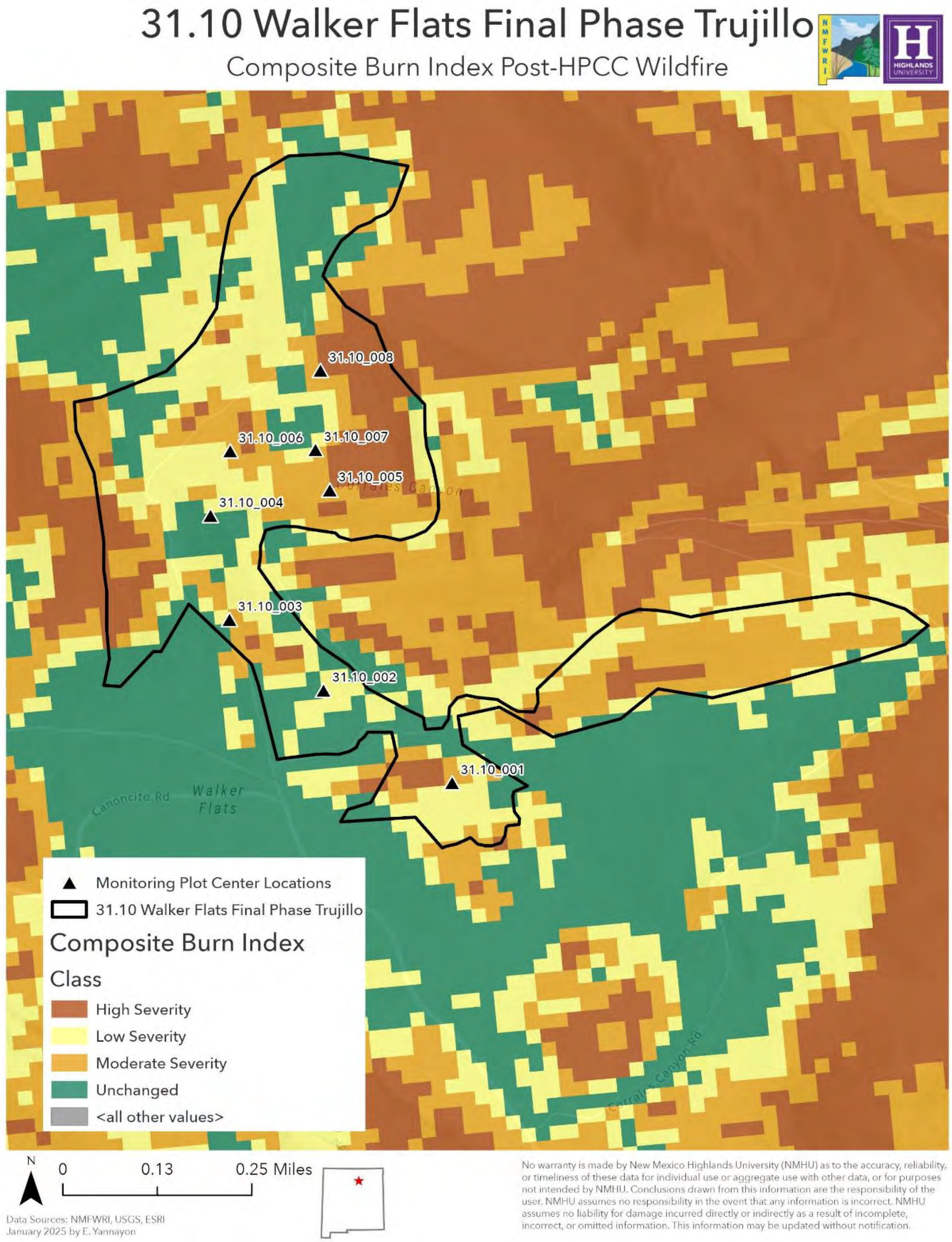


Figure 2*. Composite Burn Index of the 31.10 Walker Flats Final Phase Trujillo CFRP project following the 2022 Hermit's Peak Calf Canyon fire*

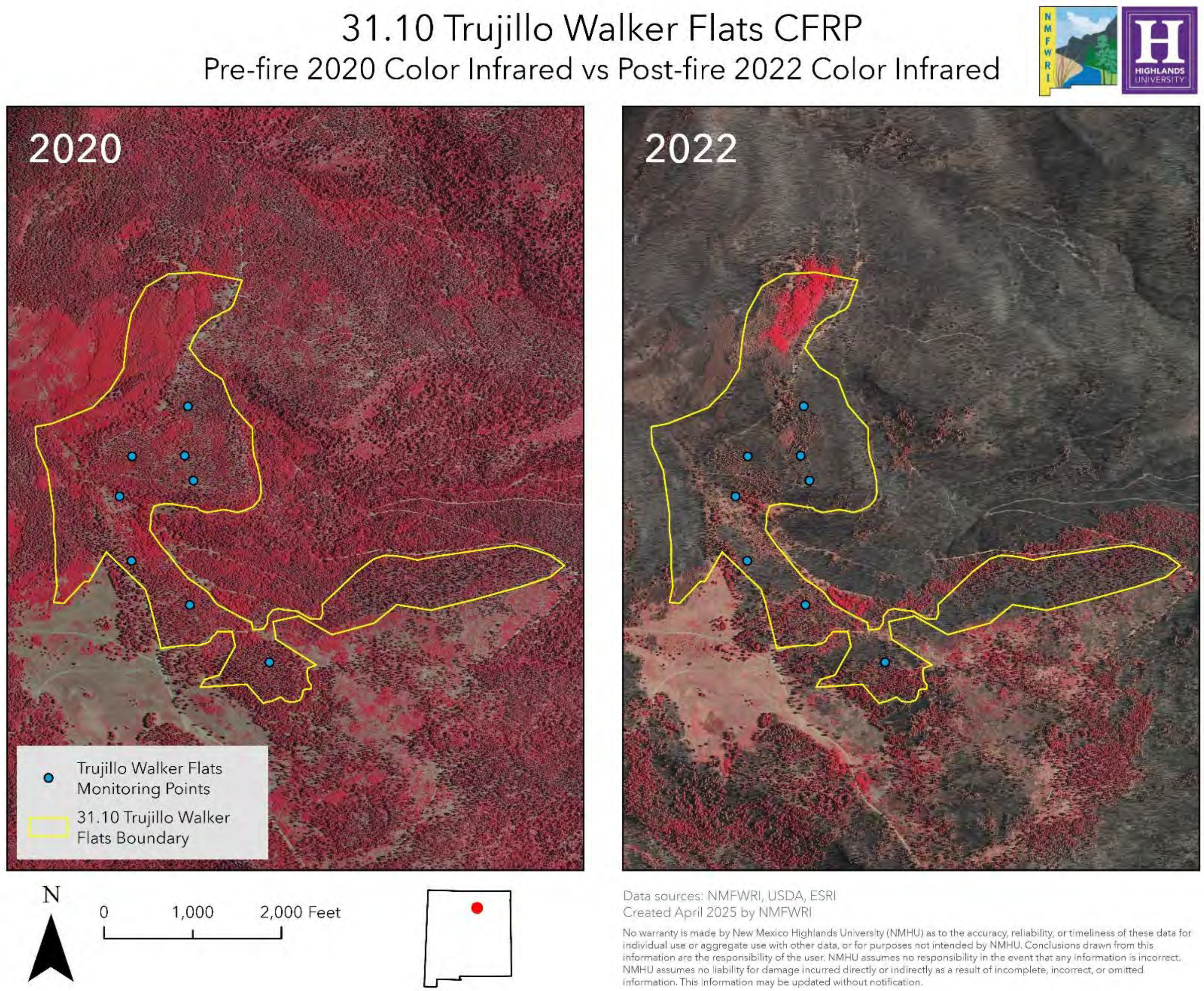


***Figure 3**. Map of color infrared of 21.12 Calf Canyon CFRP project before and after the Hermit's Peak Calf Canyon fire*

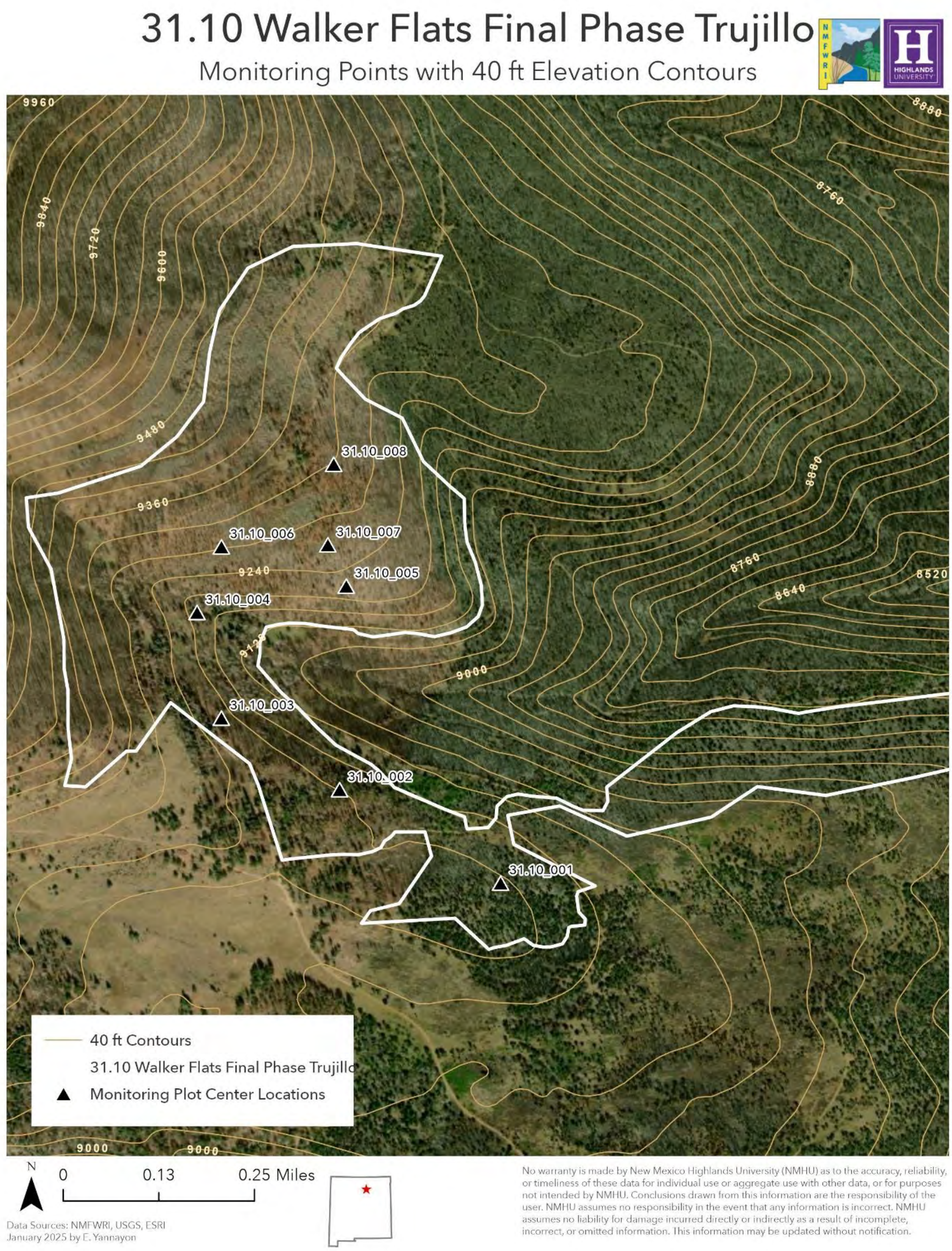


Figure 4. *31.10 Walker Flats Final Phase Trujillo CFRP project with monitoring plots and contour lines*

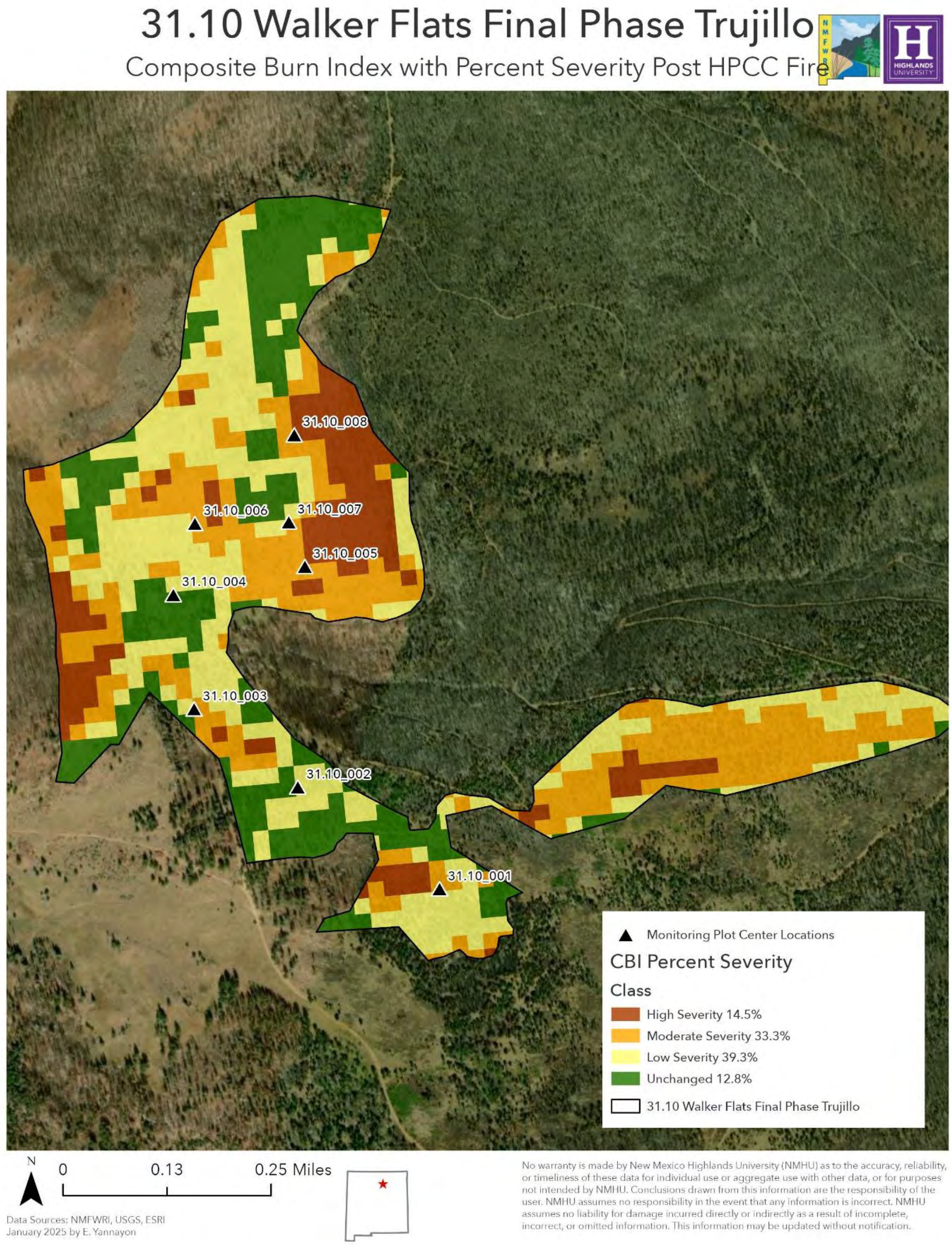


***Figure 5**. 31.10 Walker Flats Final Phase Trujillo CFRP project with composite burn index. The breakdown of percent burn severity within the project area is listed in the legend*

Monitoring Detail - Tree Component

Overstory trees

The overstory (trees >1" DBH) showed high diversity with six species represented across measurement periods. While quaking aspen was originally the dominant species in the growing stock overstory pre-treatment, ponderosa pine and Douglas-fir became dominant by the immediate post-wildfire measurement. The snag overstory was dominated by quaking aspen in both measurement periods. The accuracy of snag species identification immediately post-wildfire in 2023 was problematic due to the severity of the burn in some areas.

Species Symbol	**Scientific Name**	**Common Name**
ABCO	*Abies concolor*	white fir
ACGL	*Acer glabrum*	Rocky Mountain maple
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

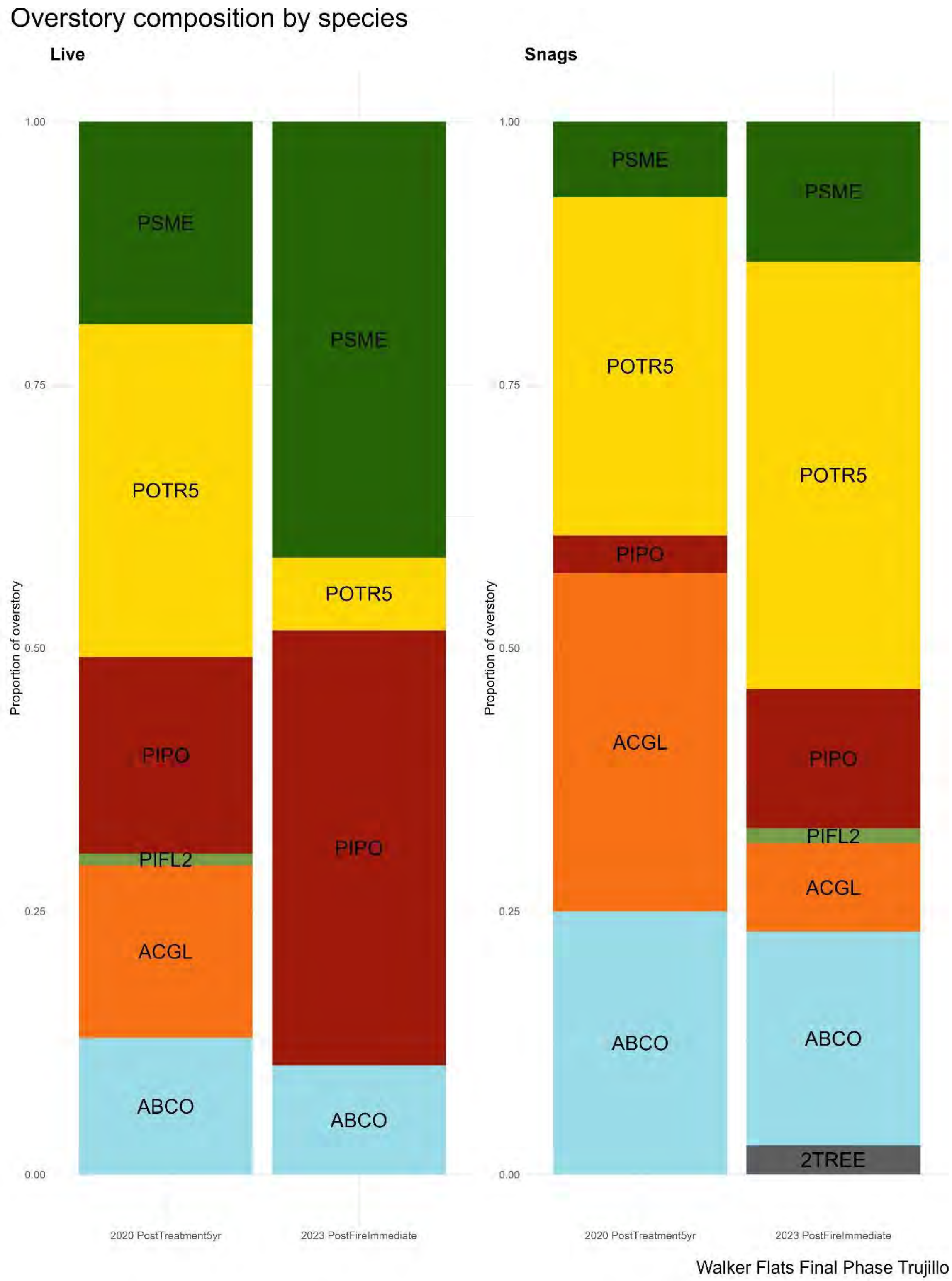


Figure 6. Species composition by status across all measurement periods for all trees (>1" DBH).

Growing Stock

Heights from the 2020 PostTreatment5yr monitoring period, through NMFWRI's QC process, were proven to be artificially inflated and therefore an inaccurate representation of these stands of trees. There is a proven positive correlation between the DBH and height of a tree, although this is species- and site-specific. Using this relationship, we performed a linear regression on the existing data for other years of monitoring for this project. The equation derived from that regression was used to infer the heights of all trees for the 2020 PostTreatment5yr monitoring period. For the same reasons expressed above, Live Crown Base Heights from the 2020 PostTreatment5yr monitoring period, may not be accurate. The LCBHs of individual trees are extremely site-dependent and have a relationship with several confounding variables. Therefore, we report these values as they were collected, but emphasize that LCBH measurements from 2020 may not be an accurate representation of tree stands.

Mean height of all living trees increased from 32 feet 5 years post-treatment to 44 feet immediately post-wildfire. This indicates that taller trees were more likely to have survived the fire, while smaller trees were killed. Mean height to live crown also increased, from 11 feet 5 years post-treatment to 27 feet immediately post-wildfire. This indicates the wildfire raised the height to live crown by killing lower branches.

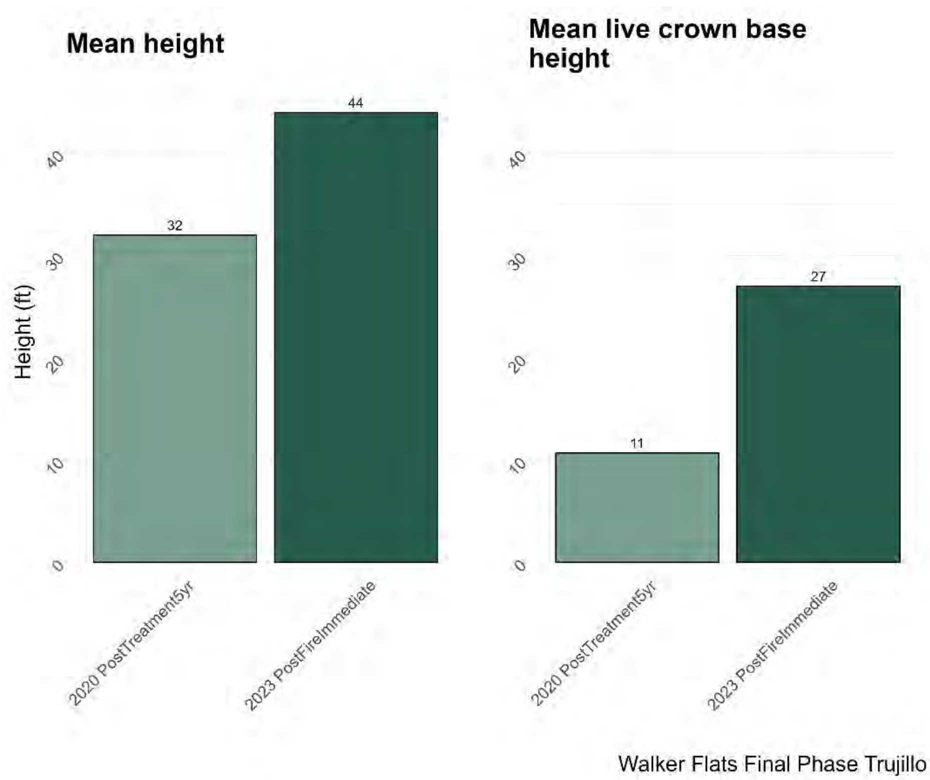


Figure 7. Mean height and live crown base height for growing stock trees (>1" DBH, live + sick status). Mean values represent averages of plot means for each monitoring status

Growing stock mean basal area decreased from 85 sqft/acre 5-years post-treatment to 27 sqft/acre immediately post-wildfire. Likewise, mean tree density decreased from 220 trees per acre 5-years post-treatment, to 36 trees per acre immediately post-wildfire. Quadratic mean diameter increased from 8.86 inches 5-years post-treatment to 11.6 inches immediately post-wildfire. These trends are reflective of the reduction in growing stock trees following fire, but do not indicate any major change in the mean diameter of trees remaining.

Percent Growing Stock Survival
Post-HPCC wildfire
18.7%

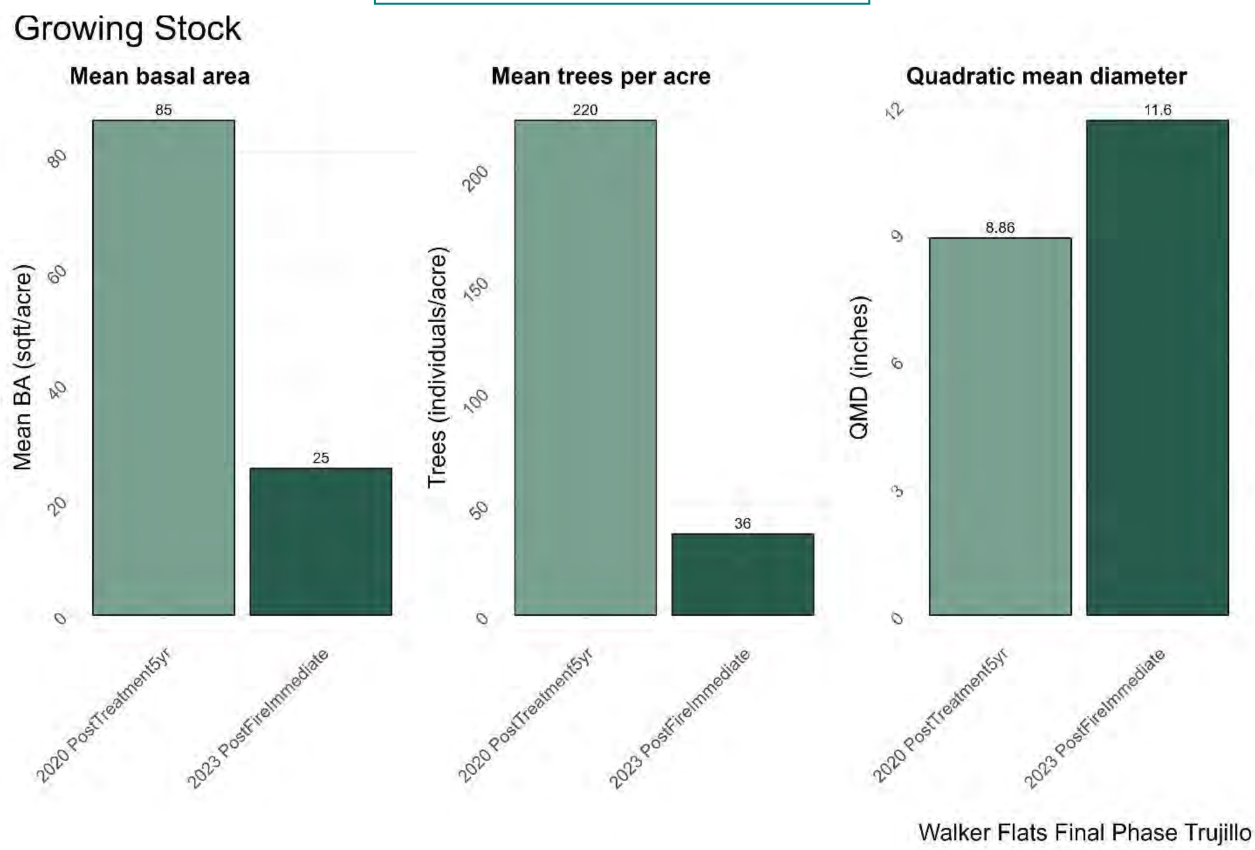


Figure 8. Mean basal area, mean trees per acre, and quadratic mean diameter for growing stock trees across both measurement periods (>1" DBH, live + sick status). Mean values represent averages of plot means for each monitoring status

Snags

Snag mean basal area increased from 18 sqft/acre 5 years post-treatment to 54 sqft/acre immediately post-wildfire. Mean snag density increased from 35 trees per acre 5 years post-treatment to 180 trees per acre immediately post-wildfire. These jumps show the large amounts of tree fatalities immediately post-fire. Quadratic mean snag diameter, conversely, decreased from 11.4 inches 5 years post-treatment to 7.64 inches immediately post-wildfire. This may indicate a survival bias – more small trees were killed than larger trees.

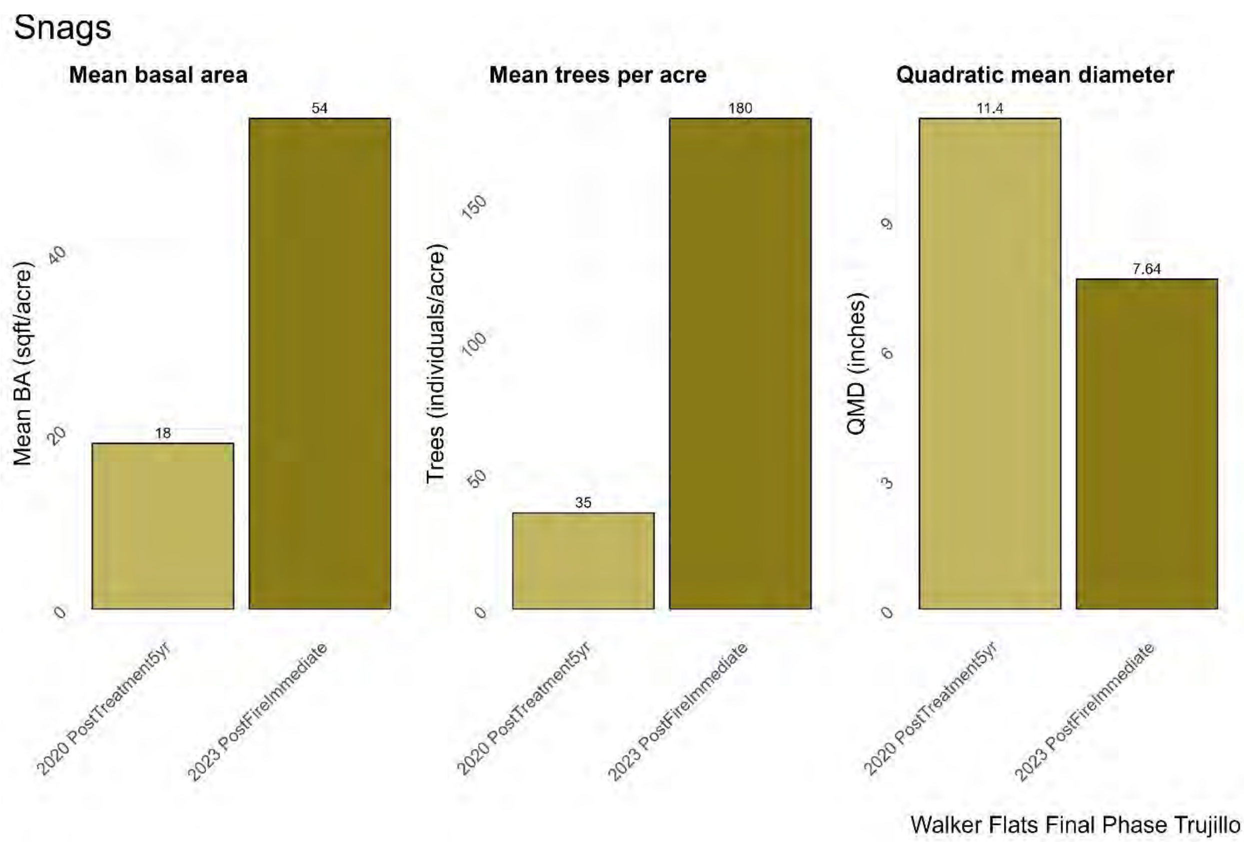


Figure 9. Mean basal area, mean trees per acre, and quadratic mean diameter for snags across both measurement periods (>1” DBH). Mean values represent averages of plot means for each monitoring status

Tree Stand Size Distribution

The figures below show histograms of the size distribution of growing stock trees and snags by DBH class. The inset tables display mean DBH in inches. Mean DBH of growing stock trees increased from 2020 to 2023, while mean DBH of snags decreased. This shows that smaller trees were more likely to be killed by the fire, and larger trees were more likely to survive.

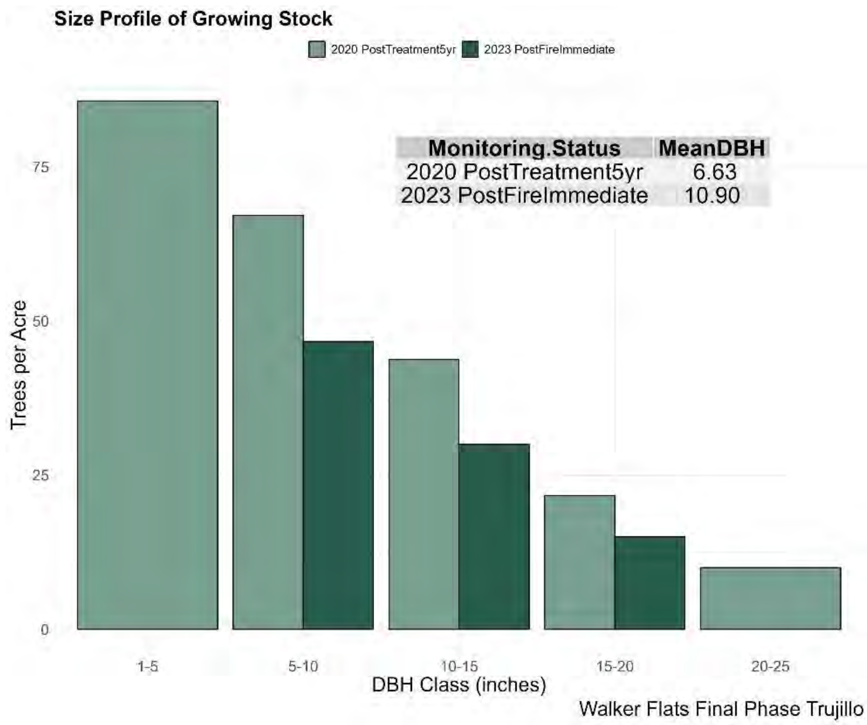


Figure 10. *Histogram showing distribution of growing stock trees by DBH class. The inset table shows mean DBH by monitoring period in inches.*

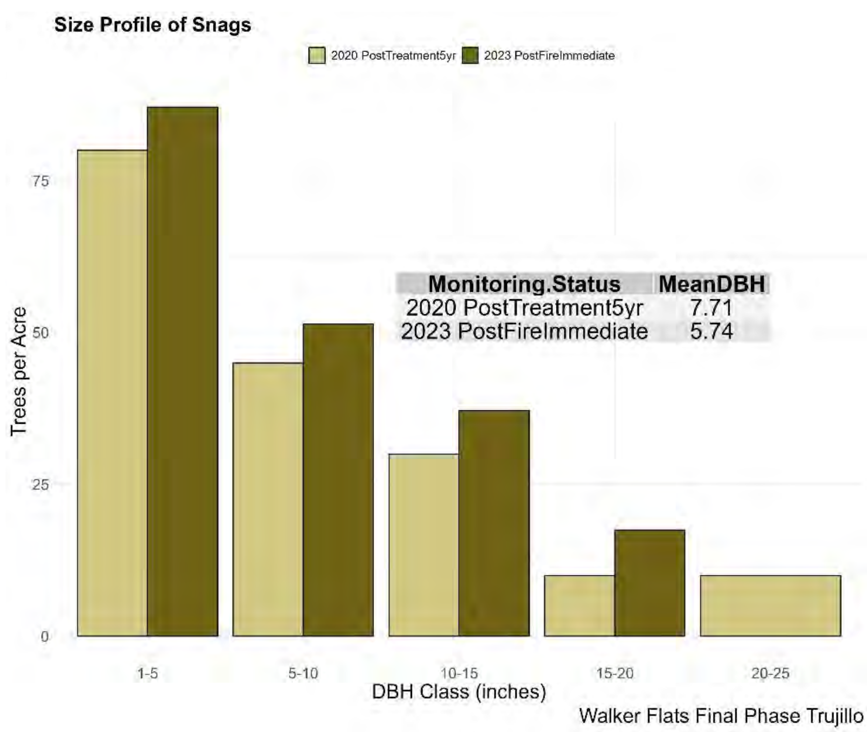


Figure 11. *Histogram showing distribution of snags by DBH class. The inset table shows mean DBH by monitoring period in inches.*

Damages

In 2020, broom rust was the most common damage recorded for growing stock trees, with 17 observations; no observations were recorded for growing stock trees in 2023. There were 5 observations of trees with bark beetle damage in 2020, and the same amount were recorded in 2023, although at a different plot. Seven trees were observed with bird damage in 2023, which indicates insect infestation in growing stock trees.

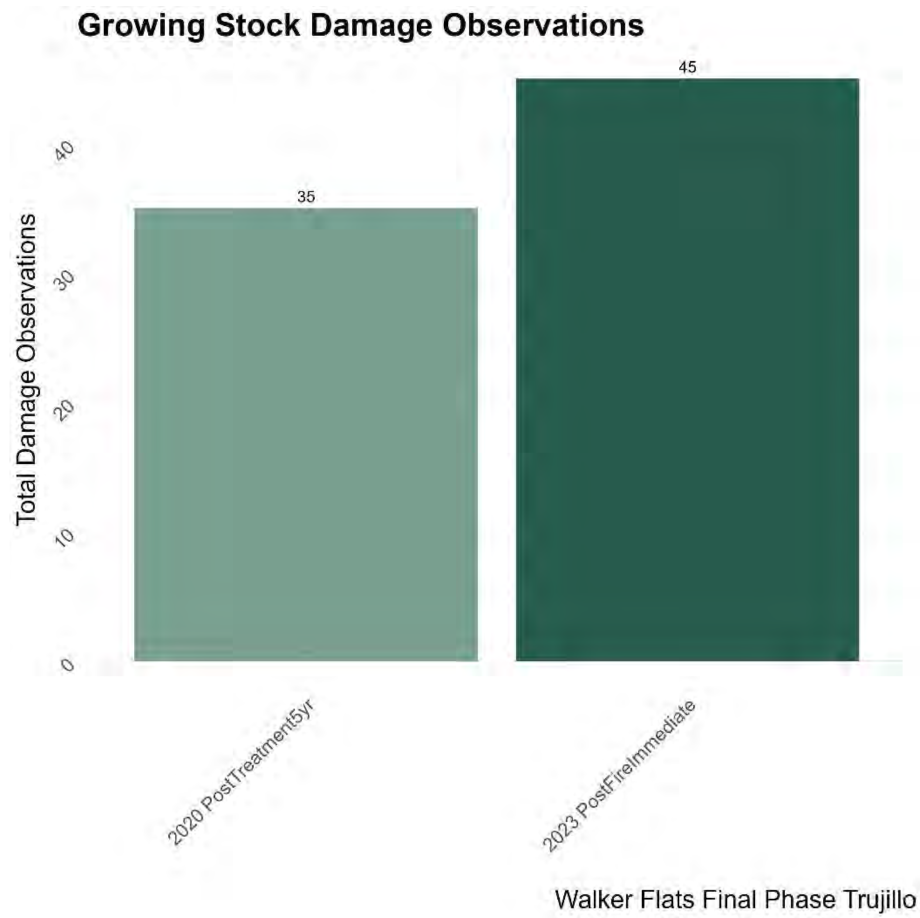


Figure 12. *Counts of damages recorded to growing stock trees in each monitoring year.*

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.*

Walker Flats Final Phase Trujillo : Growing Stock Trees by Damage Code			
Monitoring.Status	**Damage**	**Count**	**Description**
2020 PostTreatment5yr	27,000	17	Broom rust
	11,000	5	Bark beetles
	23,001	5	Mistletoe
	25,000	2	Witches' broom
	99,001	2	Broken top
	99,004	2	Uncharacteristic forked top, above or below DBH
	22,000	1	Conk fungus
	99,026	1	Wounds or cracks
2023 PostFireImmediate	30,000	26	Fire scar, char and/or scorch
	41,010	7	Bird damage
	11,000	5	Bark beetles
	25,000	2	Witches' broom
	99,004	2	Uncharacteristic forked top, above or below DBH
	22,000	1	Conk fungus
	90,000	1	Unknown cause
	99,026	1	Wounds or cracks

The most common damage recorded for snags in 2020 was a broken top. In 2023, immediately post wildfire, the most common damages were fire scars, followed by an uncharacteristic forked top and damage by birds. Five snags were observed to have evidence of bark beetle infestation in 2023. These beetles only infest living trees, so this metric indicates possible cause of death, rather than a current infestation.

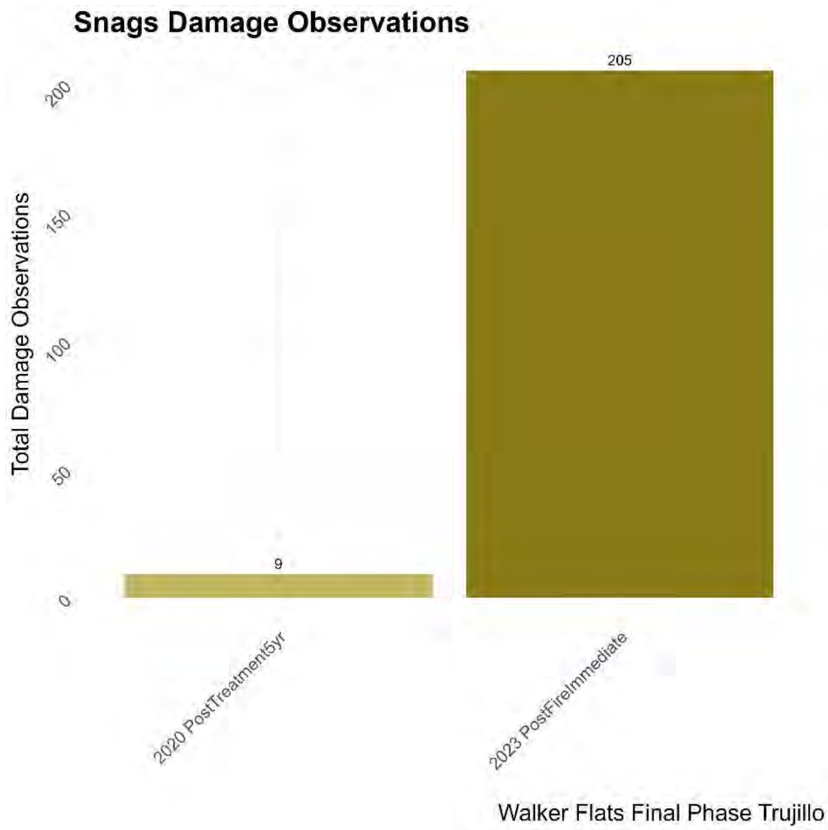


Figure 13*.Count of damages recorded to dead trees across monitoring periods.*

__Table 3__. Counts of damages recorded to dead trees across monitoring periods.

Walker Flats Final Phase Trujillo : Snags by Damage Code			
Monitoring.Status	**Damage**	**Count**	**Description**
2020 PostTreatment5yr	99,001	7	Broken top
	22,000	1	Conk fungus
	99,004	1	Uncharacteristic forked top, above or below DBH
2023 PostFireImmediate	30,000	136	Fire scar, char and/or scorch
	99,004	17	Uncharacteristic forked top, above or below DBH
	41,010	14	Bird damage
	99,001	13	Broken top
	11,000	5	Bark beetles
	22,000	5	Conk fungus
	10,000	2	General insects
	25,000	2	Witches' broom
	27,000	2	Broom rust
	40,000	2	Mammal damage
	90,000	2	Unknown cause
	99,026	2	Wounds or cracks
	99,036	2	Fire scar (catface)
	17,000	1	Gall formed by pathogen/parasitic infection

Char & Scorch

Immediately post-wildfire, char height (highest point of blackened bark) averaged 17 ft and scorch height (highest point of heat-killed needles) averaged 35 ft.

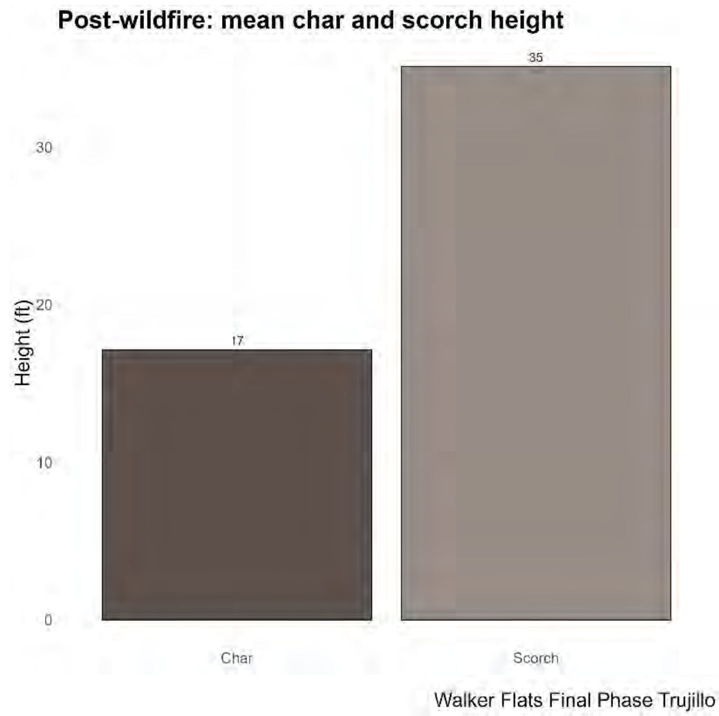


Figure 14*. Mean char and scorch heights for trees measured immediately post-wildfire. Mean values represent averages of plot means for each monitoring status*

Regeneration: Trees & Shrubs

Mean live tree seedling density decreased from approximately 3,000 individuals/acre 5 years post-treatment to 5,000 individuals/acre immediately post-wildfire. Mean live tree sapling density decreased from 220 individuals/acre 5 years post-treatment to 75 individuals/acre immediately post-wildfire. Mean live shrub seedling density decreased from 11,000 individuals per acre 5 years post-treatment to 3600 individuals/acre immediately post-wildfire. Mean shrub sapling density was 38 individuals per acre 5 years post-treatment; none were recorded immediately post-wildfire.

Dead tree seedling density increased from 25 individuals/acre 5 years post-treatment to 250 individuals/acre immediately post-wildfire. Mean dead tree sapling density increased from 0 individuals/acre 5 years post-treatment to 62 individuals/acre immediately post-wildfire. Mean dead shrub seedling density increased from 12 individuals/acre 5 years post-treatment to 100 individuals per acre immediately post-wildfire. No dead shrubs of sapling stature were detected across any measurement period.

See Supplementary Figures for a breakdown of regeneration densities by species.

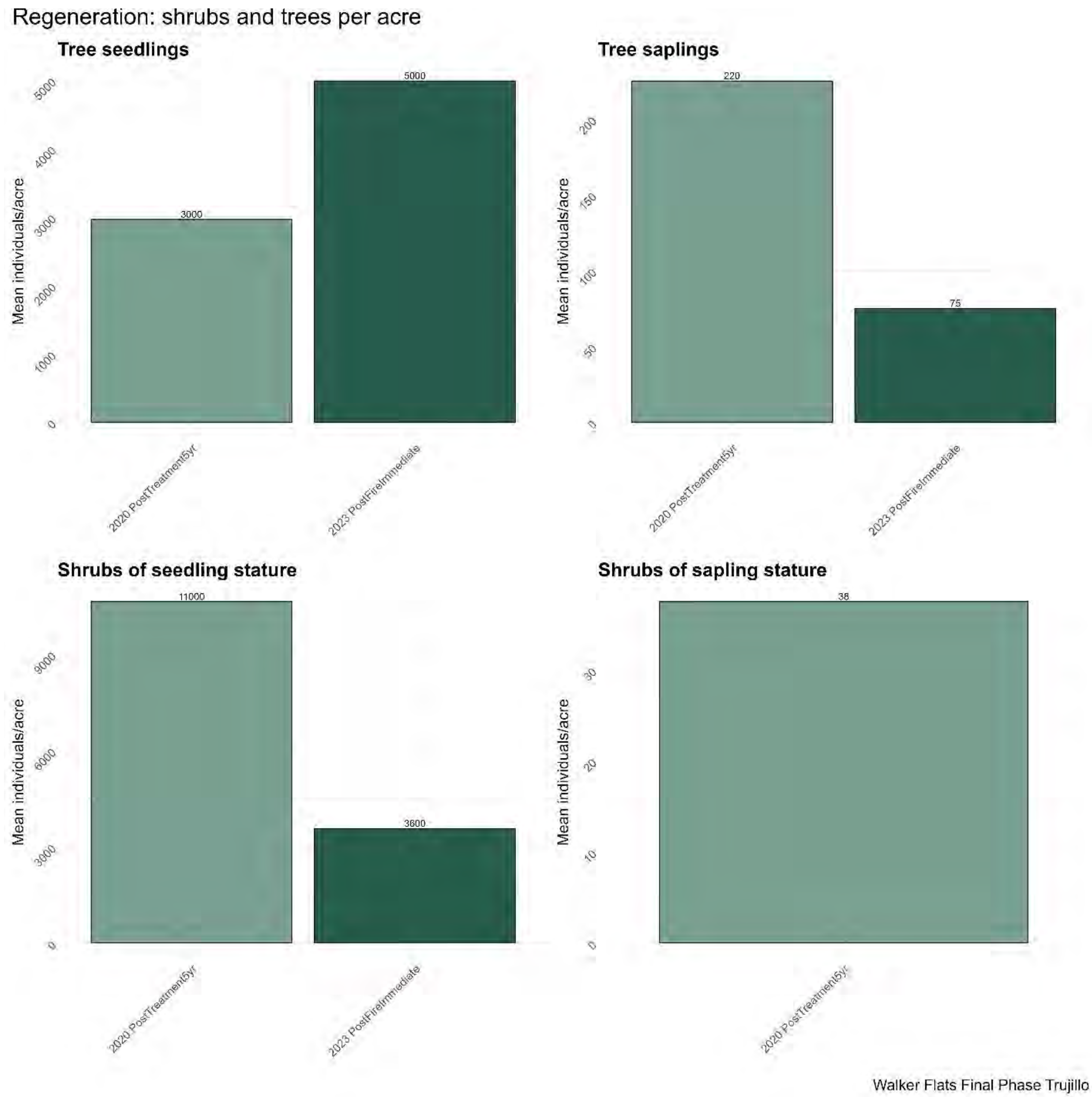


***Figure 15**. Regeneration densities of trees and shrubs in the seedling and saplings classes across all measurement periods. No shrubs of sapling stature were observed 2023.*

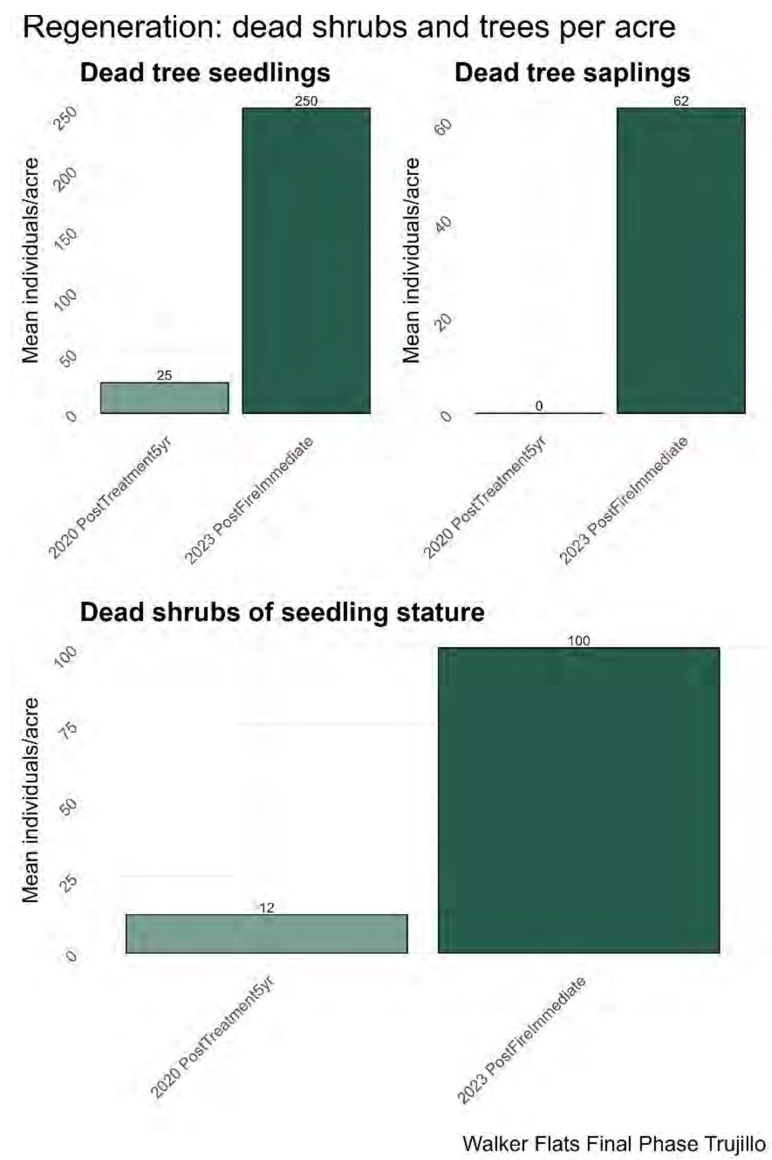


Figure 16. *Regeneration densities of trees and shrubs in the seedling and sapling classes across all measurement periods. No dead shrubs of sapling stature were observed either year.*

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.

2020 Post-treatment 5yr

Table 4. Stand table of forestland species metrics for the 2020 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	5	0	0	4	1	3	4	4	2	0	0	0	0	0	0	0	***23***	
	TPA	0	6.25	0	0	5.00	1.25	3.75	5.00	5.00	2.50	0	0	0	0	0	0	0	***29***	***16%***
	BA/AC	0	0.07	0	0	1.77	0.62	2.76	5.45	7.10	4.69	0	0	0	0	0	0	0	***22***	***26%***
	AVE HT. (HL)	0	10.35	0	0	43.30	36.00	55.95	59.57	63.41	78.49	0	0	0	0	0	0	0		
PIPO Ponderosa pine	COUNT	0	0	0	3	6	10	6	2	4	1	0	1	0	0	0	0	0	***33***	
	TPA	0	0	0	3.75	7.50	12.50	7.50	2.50	5.00	1.25	0.0	1.25	0	0	0	0	0	***41***	***22%***
	BA/AC	0	0	0	0.79	2.63	6.54	6.03	2.70	6.71	2.02	0.0	3.39	0	0	0	0	0	***31***	***36%***
	AVE HT. (HL)	0	0	0	29.21	36.78	49.18	50.45	66.37	55.48	64.00	0	57.00	0	0	0	0	0		
PSME Douglas-fir	COUNT	0	3	0	7	5	11	6	1	0	0	1	0	0	0	0	0	0	***34***	
	TPA	0.0	3.75	0.0	8.75	6.25	13.75	7.50	1.25	0	0	1.25	0	0	0	0	0	0	***43***	***23%***
	BA/AC	0.0	0.08	0.0	1.80	2.27	6.98	5.23	1.26	0	0	2.62	0	0	0	0	0	0	***20***	***24%***
	AVE HT. (HL)	0	13.76	0	33.76	47.14	47.20	56.67	60.00	0	0	80.00	0	0	0	0	0	0		
PIFL2 Limber pine	COUNT	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	***2.0***	
	TPA	0	0	0	0	0	0	2.50	0	0	0	0	0	0	0	0	0	0	***2.5***	***1.4%***
	BA/AC	0	0	0	0	0	0	1.98	0	0	0	0	0	0	0	0	0	0	***2.0***	***2.3%***
	AVE HT. (HL)	0	0	0	0	0	0	50.09	0	0	0	0	0	0	0	0	0	0		
POTR5 Aspen	COUNT	1	32	11	5	2	1	1	2	1	0	0	0	0	0	0	0	0	***56***	
	TPA	1.25	40.00	13.75	6.25	2.50	1.25	1.25	2.50	1.25	0	0	0	0	0	0	0	0	***70***	***38%***
	BA/AC	0.01	0.55	0.93	1.27	0.69	0.70	1.12	2.49	1.53	0	0	0	0	0	0	0	0	***9.3***	***11%***
	AVE HT. (HL)	28.00	16.66	27.52	53.22	48.17	40.00	63.00	58.17	78.00	0	0	0	0	0	0	0	0		
Forestland Species Sub-total	***COUNT***	***1***	***40***	***11***	***15***	***17***	***23***	***18***	***9***	***9***	***3***	***1***	***1***	***0***	***0***	***0***	***0***	***0***	***148***	
	TPA	***1.25***	***50.00***	***13.75***	***18.75***	***21.25***	***28.75***	***22.50***	***11.25***	***11.25***	***3.75***	***1.25***	***1.25***	***0***	***0***	***0***	***0***	***0***	***185***	***100%***
	BA/AC	***0.01***	***0.70***	***0.93***	***3.85***	***7.37***	***14.82***	***17.12***	***11.90***	***15.34***	***6.71***	***2.62***	***3.39***	***0***	***0***	***0***	***0***	***0***	***85***	***100%***
	AVE HT. (HL)	***28***	***19***	***29***	***39***	***43***	***47***	***54***	***61***	***61***	***74***	***80***	***57***	***0***	***0***	***0***	***0***	***0***		
Summary by Size Class for Forestland Species	***TPA***		***65***			***69***							***51***						***185***	
	TPA %		***35%***			***37%***							***28%***						***100%***	
	BA/AC		***1.6***			***26***							***57***						***85***	
	BA/AC %		***1.9%***			***31%***							***67%***						***100%***	
	QUADRATIC MEAN DIA.		***2.2***			***8.3***							***14***						***9.2***	
	AVE HT. (HL)		***24***			***45***							***61***						***55***	

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 &	**COUNT**	1	40	11	15	17	23	18	9	9	3	1	1	0	0	0	0	0	***148***	
	TPA	1.25	50.00	13.75	18.75	21.25	28.75	22.50	11.25	11.25	3.75	1.25	1.25	0	0	0	0	0	***185***	***84%***
	BA/AC	0.01	0.70	0.93	3.85	7.37	14.82	17.12	11.90	15.34	6.71	2.62	3.39	0	0	0	0	0	***85***	***82%***
	AVE HT, HL	28	19	29	39	43	47	54	61	61	74	80	57	0	0	0	0	0		
Summary by Size Class (All living trees in woodland & forestland)	**TPA**		65			69							51						***185***	
	TPA %		35%			37%							28%						***100%***	
	BA/AC		1.6			26							57						***85***	
	BA/AC %		1.9%			31%							67%						***100%***	
	QMD MEAN DIA.		2.2			8.3							14						***9.2***	
	AVE HT, HL		24			45							61						***55***	
Dead (All dead trees in woodland & forestland)	**COUNT**	0	11	0	2	5	2	1	2	3	0	1	0	1	0	0	0	0	***28***	
	TPA	0	13.75	0	2.50	6.25	2.50	1.25	2.50	3.75	0	1.25	0	1.25	0	0	0	0	***35***	***16%***
	BA/AC	0	0.27	0	0.44	2.02	1.19	0.82	2.50	4.77	0	2.65	0	3.70	0	0	0	0	***18***	***18%***
	AVE HT, HL	0	20	0	10	37	47	53	44	20	0	105	0	15	0	0	0	0	***40***	
Total for all sample trees including	**COUNT**	1	51	11	17	22	25	19	11	12	3	2	1	1	0	0	0	0	***176***	
	TPA	1.25	63.75	13.75	21.25	27.50	31.25	23.75	13.75	15.00	3.75	2.50	1.25	1.25	0	0	0	0	***220***	***100%***
	BA/AC	0.01	0.98	0.93	4.30	9.39	16.02	17.94	14.40	20.11	6.71	5.26	3.39	3.70	0	0	0	0	***103***	***100%***

*NOTE1: Average Diameter calculated using the Quadratic Mean Diameter (QDM), equivalent equation: (SQRT((BA/AC)/TPA) /.005454)) ; NOTE2: Average Height (HL), calculated using Lorey's height equation for a weighted mean, HL=SUM(bi * hi)/SUM(bi) , where bi is basal area of individual tree & hi is height of an individual tree.*

2023 Post-wildfire immediate

Table 5. *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	COUNT	0	0	0	0	0	0	0	2	0	1	0	0	0	0	0	0	0	***3.0***	
White fir	TPA	0	0	0	0	0	0	0	2.50	0	1.25	0	0	0	0	0	0	0	***3.8***	***10%***
	BA/AC	0	0	0	0	0	0	0	2.79	0	2.33	0	0	0	0	0	0	0	***5.1***	***20%***
	AVE HT. (HL)	0	0	0	0	0	0	0	45.75	0	61.40	0	0	0	0	0	0	0		
PIPO	COUNT	0	0	0	0	3	5	0	2	2	0	0	0	0	0	0	0	0	***12***	
Ponderosa pine	TPA	0	0	0	0	3.75	6.25	0	2.50	2.50	0	0	0	0	0	0	0	0	***15***	***41%***
	BA/AC	0	0	0	0	1.53	3.33	0	2.77	3.48	0	0	0	0	0	0	0	0	***11***	***44%***
	AVE HT. (HL)	0	0	0	0	32.07	41.45	0	49.44	52.28	0	0	0	0	0	0	0	0		
PSME	COUNT	0	0	0	2	2	5	2	1	0	0	0	0	0	0	0	0	0	***12***	
Douglas-fir	TPA	0	0	0	2.50	2.50	6.25	2.50	1.25	0	0	0	0	0	0	0	0	0	***15***	***41%***
	BA/AC	0	0	0	0.58	0.96	3.33	1.82	1.30	0	0	0	0	0	0	0	0	0	***8.0***	***32%***
	AVE HT. (HL)	0	0	0	31.67	37.85	42.06	44.89	49.50	0	0	0	0	0	0	0	0	0		
POTR5	COUNT	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	***2.0***	
Aspen	TPA	0	0	0	1.25	0	1.25	0	0	0	0	0	0	0	0	0	0	0	***2.5***	***6.9%***
	BA/AC	0	0	0	0.32	0	0.75	0	0	0	0	0	0	0	0	0	0	0	***1.1***	***4.3%***
	AVE HT. (HL)	0	0	0	42.60	0	49.80	0	0	0	0	0	0	0	0	0	0	0		
Forestland Species Sub-total	***COUNT***	***0***	***0***	***0***	***3***	***5***	***11***	***2***	***5***	***2***	***1***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***29***	
	TPA	***0***	***0***	***0***	***3.75***	***6.25***	***13.75***	***2.50***	***6.25***	***2.50***	***1.25***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***36***	***100%***
	BA/AC	***0***	***0***	***0***	***0.90***	***2.49***	***7.41***	***1.82***	***6.86***	***3.48***	***2.33***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***25***	***100%***
	AVE HT. (HL)	***0***	***0***	***0***	***36***	***34***	***43***	***45***	***48***	***52***	***61***	***0***	***0***	***0***	***0***	***0***	***0***	***0***		
Summary by Size Class for Forestland Species	***TPA***	***0***			***24***			***13***											***36***	
	TPA %	***0%***			***66%***			***34%***											***100%***	
	BA/AC	***0***			***11***			***14***											***25***	
	BA/AC %	***0%***			***43%***			***57%***											***100%***	
	QUADRATIC MEAN DIA.	***0***			***9.1***			***15***											***11***	
	AVE HT. (HL)	***0***			***40***			***51***											***46***	

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	3	5	11	2	5	2	1	0	0	0	0	0	0	0	***29***	
	TPA	0	0	0	3.75	6.25	13.75	2.50	6.25	2.50	1.25	0	0	0	0	0	0	0	***36***	***17%***
	BA/AC	0	0	0	0.90	2.49	7.41	1.82	6.86	3.48	2.33	0	0	0	0	0	0	0	***25***	***32%***
	AVE HT, HL	0	0	0	36	34	43	45	48	52	61	0	0	0	0	0	0	0		
Summary by Size Class (All living trees in woodland & forestland)	**TPA**		0			24							13						***36***	
	TPA %		0%			66%							34%						***100%***	
	BA/AC		0			11							14						***25***	
	BA/AC %		0%			43%							57%						***100%***	
	QMD MEAN DIA.		0			9.1							15						***11***	
	AVE HT, HL		0			40							51						***46***	
Dead (All dead trees in woodland & forestland)	**COUNT**	5	59	10	16	15	10	17	4	5	1	1	0	0	0	0	0	0	***143***	
	TPA	6.25	73.75	12.50	20.00	18.75	12.50	21.25	5.00	6.25	1.25	1.25	0	0	0	0	0	0	***179***	***83%***
	BA/AC	0.02	1.09	0.90	4.07	6.55	6.77	16.17	5.28	8.72	2.26	2.57	0	0	0	0	0	0	***54***	***68%***
	AVE HT, HL	7	14	21	28	30	36	37	50	50	60	64	0	0	0	0	0	0	***40***	
Total for all sample trees including	**COUNT**	5	59	10	19	20	21	19	9	7	2	1	0	0	0	0	0	0	***172***	
	TPA	6.25	73.75	12.50	23.75	25.00	26.25	23.75	11.25	8.75	2.50	1.25	0	0	0	0	0	0	***215***	***100%***
	BA/AC	0.02	1.09	0.90	4.97	9.04	14.18	17.99	12.14	12.20	4.59	2.57	0	0	0	0	0	0	***80***	***100%***

*NOTE1. Average Diameter calculated using the Quadratic Mean Diameter (QDM), equvalent equation (SQRT((BA/AC)/TPA) / 005454)) , NOTE2. Average Height (HL), calculated using Lorey's height equation for a weighted mean, HL=SUM(bi * hi)/SUM(bi) , where bi is basal area of individual tree & hi is height of an individual tree.*

Understory & Forest Floor Component

Ground & Aerial Cover

Measurements of ground cover for plant basal, bole, and litter decreased from 5 years post-treatment to immediately post-wildfire. Concurrently, proportional cover of bare soil, gravel, and rock increased between these monitoring periods. This shows how the wildfire consumed living and dead plant material, exposing mineral soil.

Mean aerial cover of plots stayed relatively steady between 2020 and 2023, whereas shrub cover decreased from 44% 5 years post-treatment to 10% immediately post-fire.

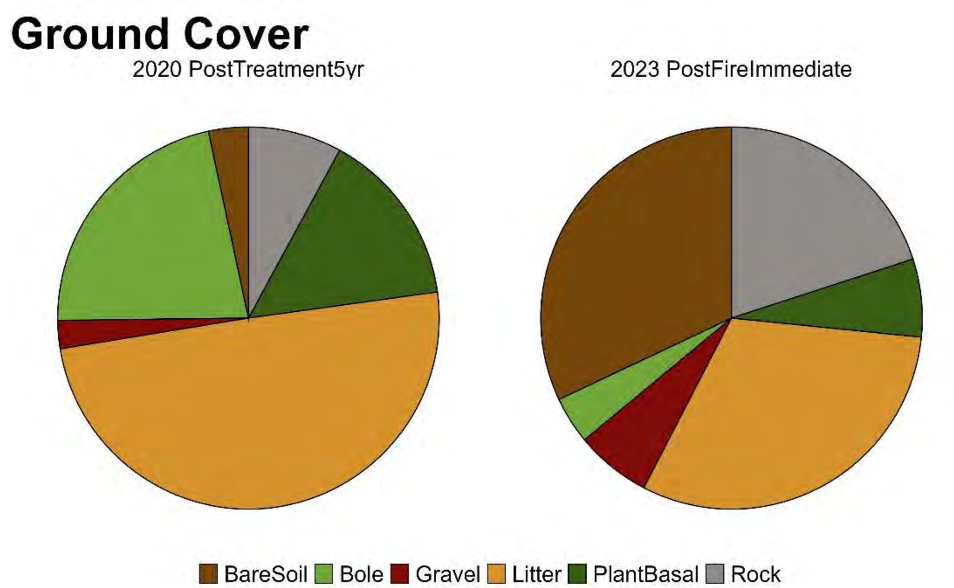


Figure 17. *Mean percent ground cover by monitoring status.*

Table 6. *Mean percent ground cover by monitoring status.*

Walker Flats Final Phase Trujillo		
Monitoring Status	**Cover Class**	**% Cover**
2020 PostTreatment5yr	PlantBasal	15.0
	Bole	22.0
	Litter	50.0
	BareSoil	3.4
	Rock	8.0
	Gravel	2.4
2023 PostFireImmediate	PlantBasal	6.6
	Bole	4.0
	Litter	31.0
	BareSoil	32.0
	Rock	20.0
	Gravel	6.4

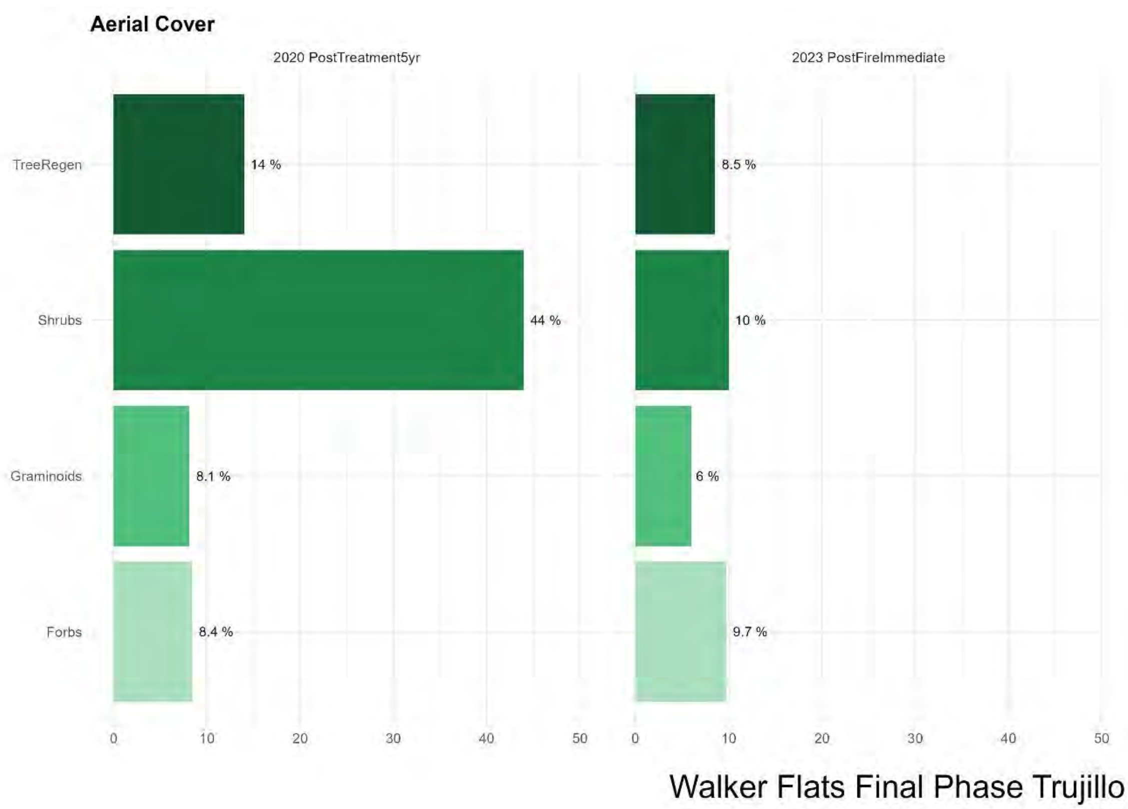


Figure 18. *Mean percent aerial cover by monitoring status.*

Tree Canopy

The mean percentage of closed canopy as measured by a denisometer decreased slightly from 50% 5 years post-treatment to 43% immediately post-wildfire. This is consistent with measured tree mortality.

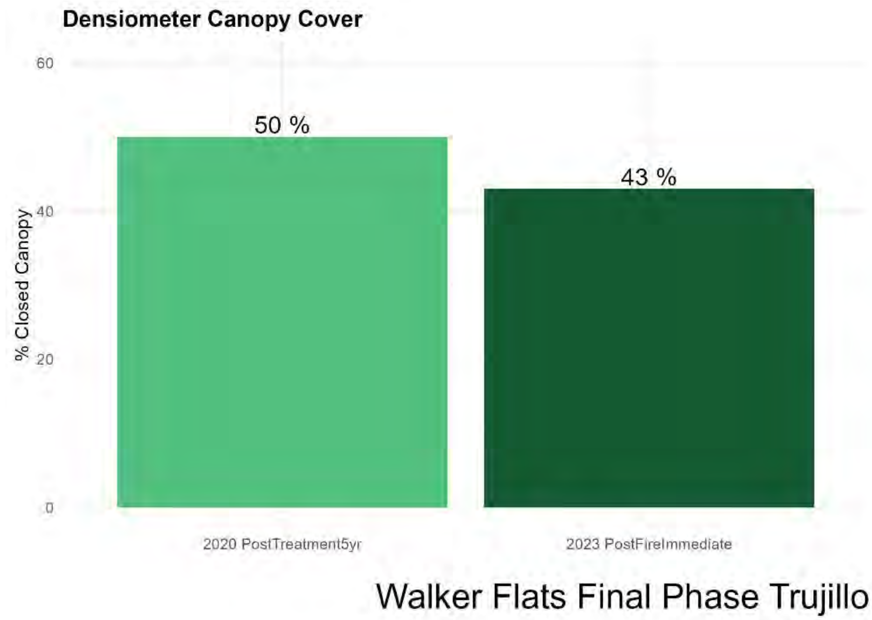


Figure 19. *Mean percent closed tree canopy by monitoring status.*

Ladder Fuels

Average biomass of ladder fuels decreased from 92 tons per acre 5 years post-treatment to 46 tons per acre immediately post-wildfire. For both monitoring periods, the dominant component of ladder fuel biomass was live woody fuels at 89 tons per acre, but this was reduced to 19 tons per acre immediately post-wildfire.

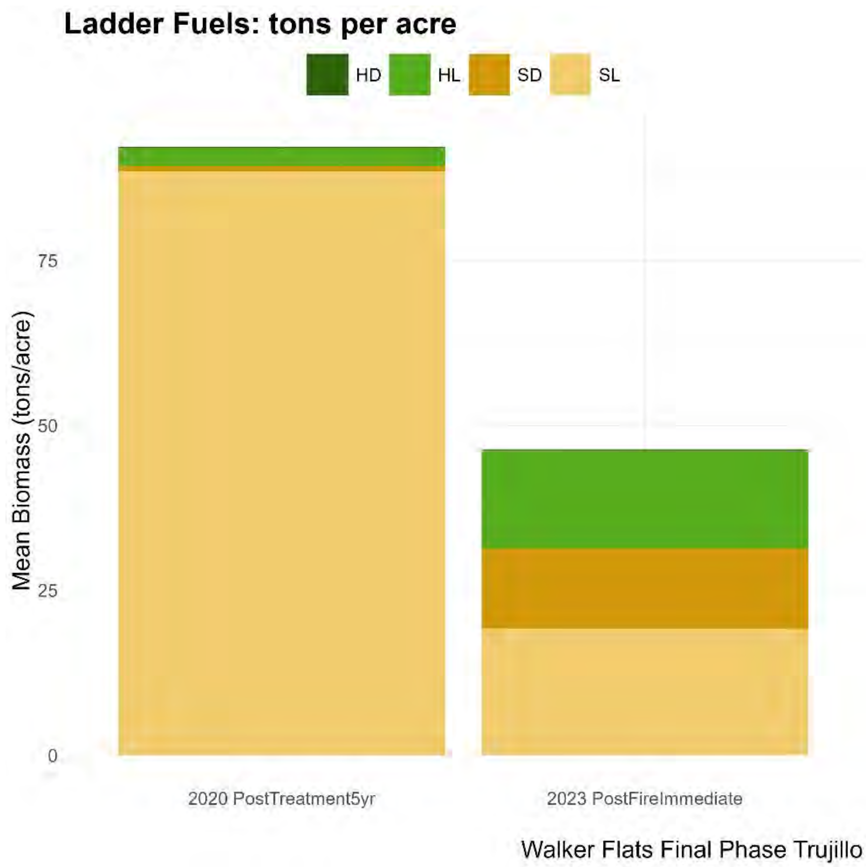


Figure 20*. Ladder fuels in mean tons per acre by monitoring status.*

Table 7*. Ladder fuel average percent cover, height, and biomass for each category and monitoring status*

Walker Flats Final Phase Trujillo					
Monitoring & Treatment Status	**Vegetation**	**Mean % Cover**	**Mean Height (ft)**	**Mean Biomass (tons/acre)**	**Total Biomass (tons/acre)**
2020 PostTreatment5yr	HD	0.44	0.13	0.18	
	HL	14	0.23	2.8	
	SD	0.062	0.62	0.76	
	SL	6.9	2.3	89	
					92
2023 PostFireImmediate	HD	0.12	0.21	0.12	
	HL	15	0.68	15	
	SD	0.47	3.4	12	
	SL	6.4	0.98	19	
					46

Surface Fuels

Total fine fuels, total wood fuels, and total surface fuels all decreased from the first monitoring period to the next. Total surface fuels dropped substantially from 28 tons per acre 5 years post-treatment, to 6.2 tons per acre immediately post-wildfire.

Table 8*. Fuel loads by type and monitoring status*

Walker Flats Final Phase Trujillo										
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)**
2020 PostTreatment5yr	0.096	1.2	2.5	7.3	4.6	7.9	4.1	3.8	16	28
2023 PostFireImmediate	0.07	0.38	0.36		0.97	1.8	2.6	0.81	1.8	6.2

Litter and Duff

Litter and duff fuel loads decreased from the first measurement period to the next. Litter fuel loads dropped from 7.9 tons per acre 5 years post-treatment, to 1.8 tons per acre immediately post-wildfire. Likewise, duff fuel loads dropped from 4.1 tons per acre 5 years post-treatment, to 2.6. tons per acre immediately post-wildfire. Mean litter and duff depth in inches also decreased – this is all consistent with the knowledge that fire consumes surface fuels.

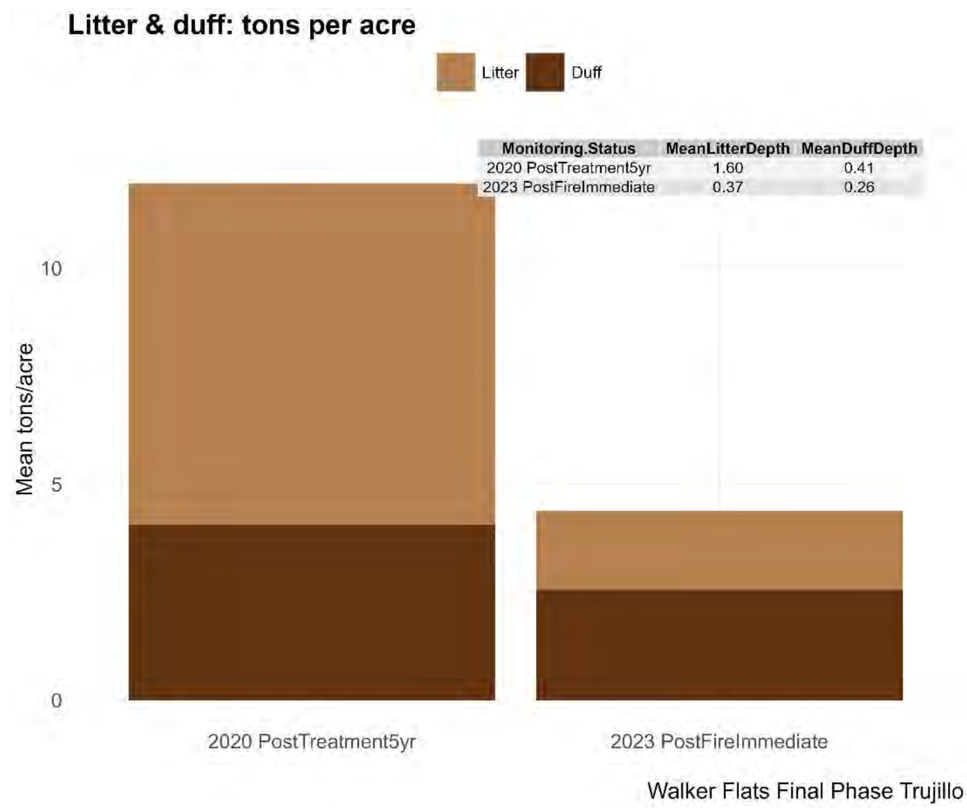


Figure 21. *Mean litter and duff loads by monitoring status*

Fine Fuels

Total fine fuels decreased from the first measurement period to the next. 1-hr fuels decreased from 0.096 tons per acre 5 years post-treatment to 0.07 tons per acre immediately post-wildfire. 10-hr fuels decreased from 1.2 tons per acre 5 years post-treatment to 0.38 tons per acre immediately post-wildfire. 100-hr fuels decreased from 2.5 tons per acre 5 years post-treatment to 0.36 tons per acre immediately post-wildfire.

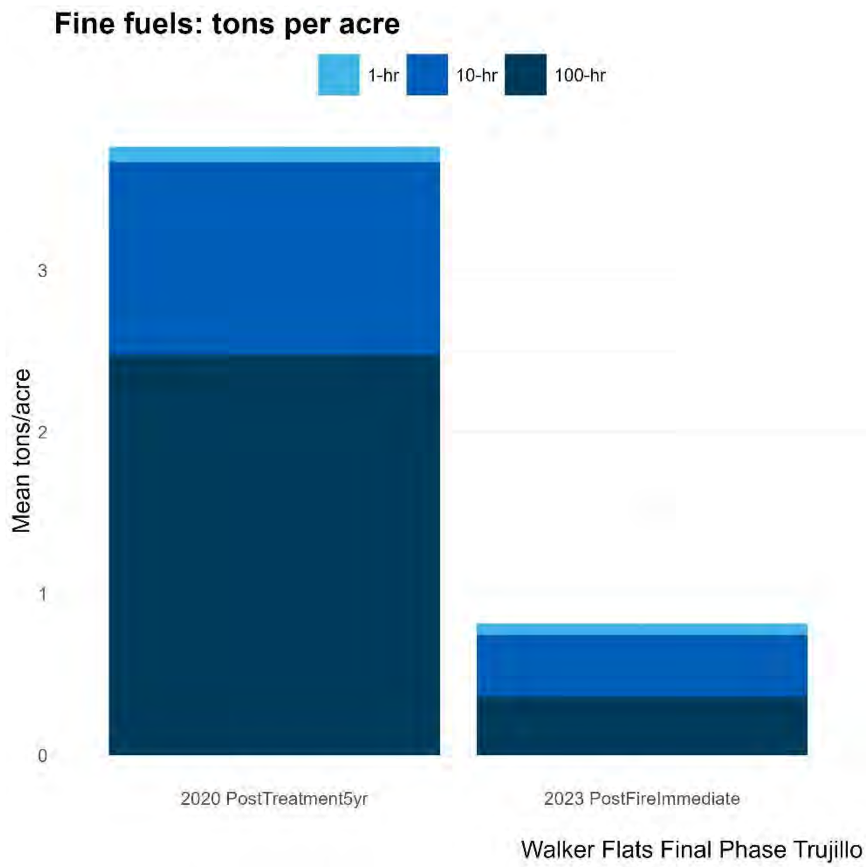


Figure 22. *Mean litter and duff loads by monitoring status*

Thousand-Hour Fuels

Rotten 1000-hr fuels decreased from 4.6 tons per acre 5 years post-treatment to 0.97 tons per acre immediately post-wildfire. Sound 1000-hour fuels loads were measured at 7.3 tons per acre 5 years post-treatment, but were absent immediately post-fire.

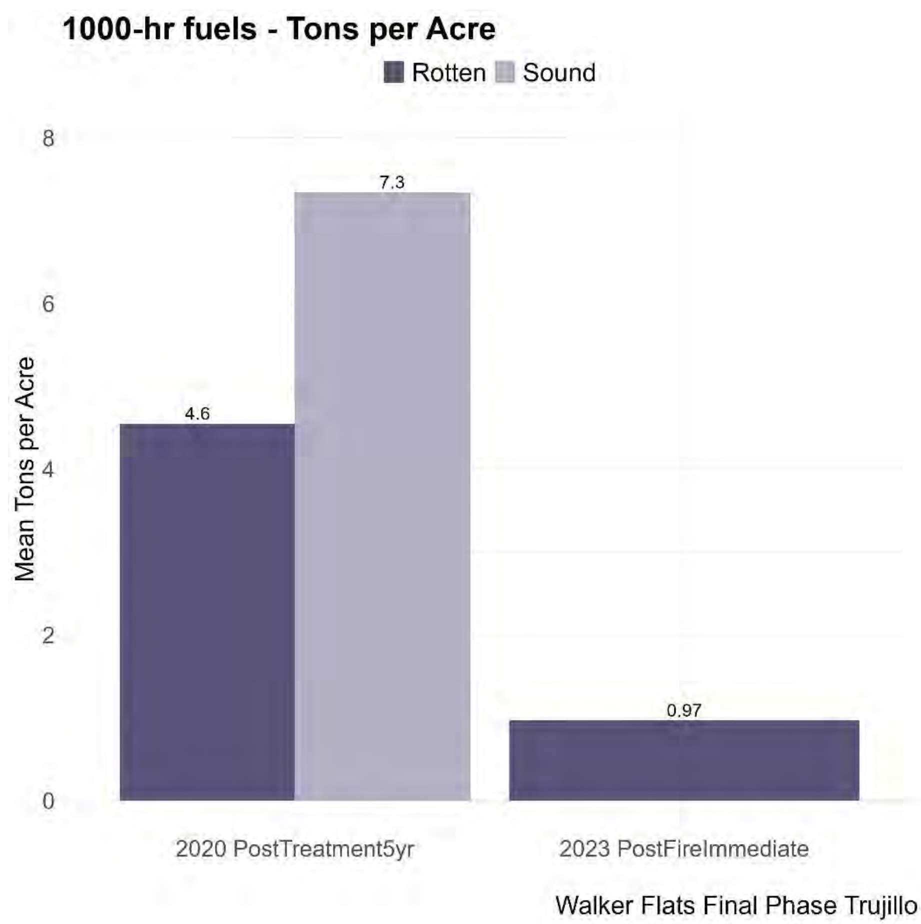


Figure 23*. Mean thousand-hour fuel loads by monitoring status*

While 1000-hour fuels 5 years post-treatment were made up of decay classes 2, 3, and 4; 100% of 1000-hour fuels immediately post fire belonged to decay class 5. Decay class 1 represents freshly downed 1000-hour fuels with minimal decay. Progressing to decay class 5, this represents the most decayed a woody fuel can become before it is considered duff. This natural progression of decay is evident post-fire, where many rotten fuels have decayed past class 5. For now, this habitat element is reduced, but this project has many snags that will eventually fall and become thousand-hour fuels.

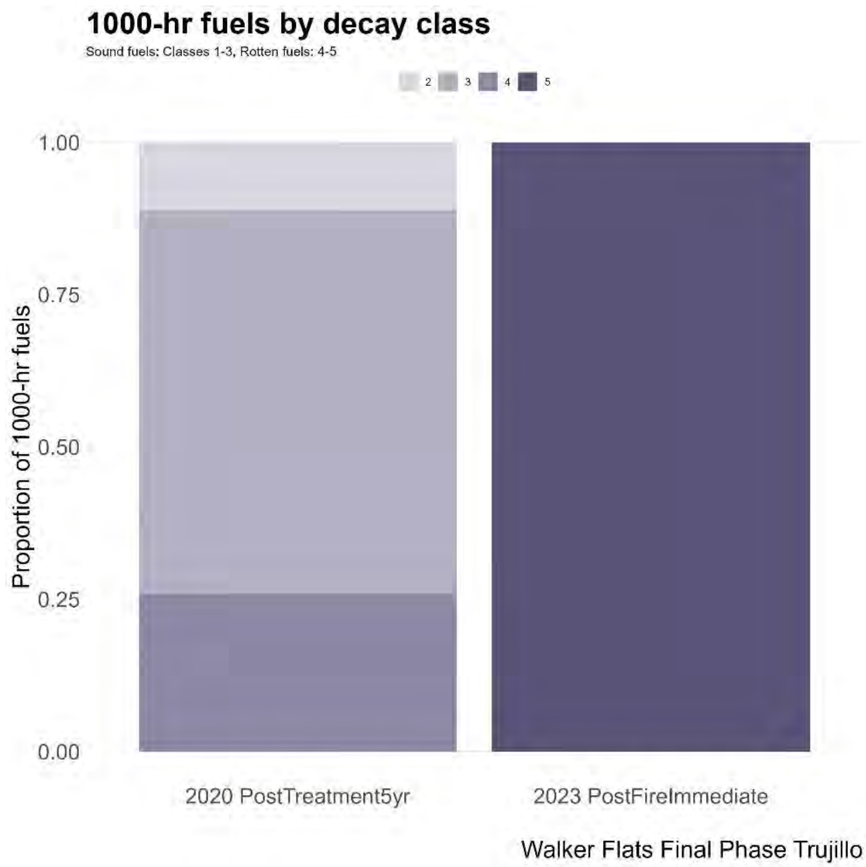
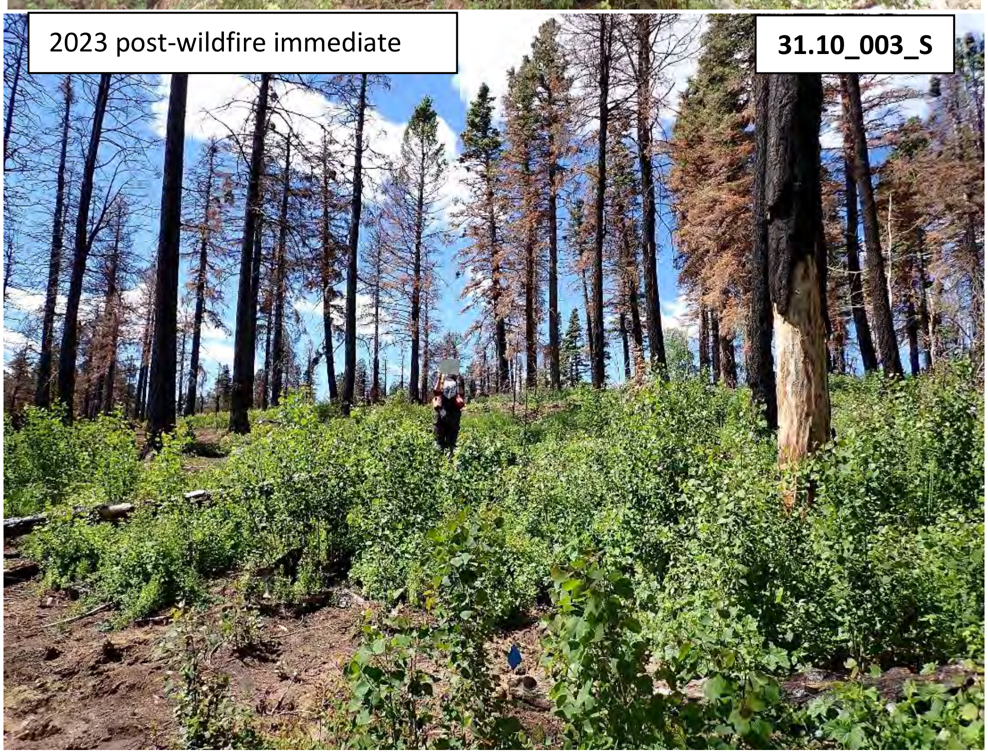


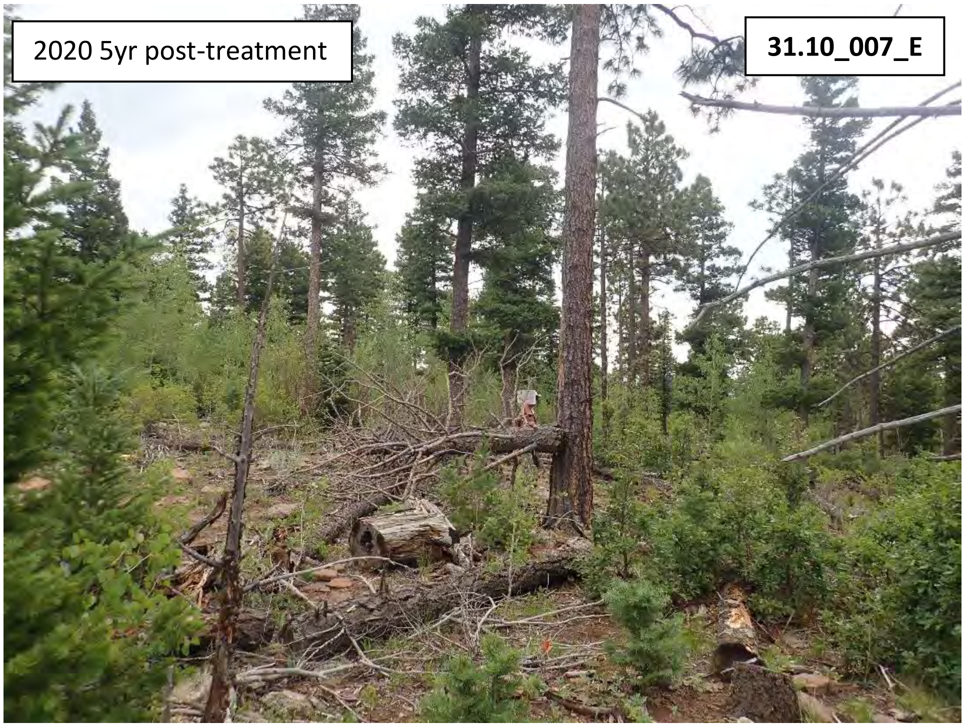
Figure 24. *Proportion of total thousand-hour fuels by decay class and monitoring status*

Photo Comparisons:




2020 5yr post-treatment
31.10_004_N


2023 post-wildfire immediate
31.10_004_N


2020 5yr post-treatment
31.10_007_E


2023 post-wildfire immediate
31.10_007_E

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

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. (2024). *Guidelines and Protocols for Monitoring Upland Forests Field Manual, First Edition.*

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 S9. *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
ACGL	*Acer glabrum*	Rocky Mountain maple
PIFL2	*Pinus flexilis*	Limber pine
PIPO	*Pinus ponderosa*	ponderosa pine
POTR5	*Populus tremuloides*	Quaking aspen
PSME	*Psuedotsuga menziesii*	Douglas-fir
QUGA	*Quercus gambelii*	Gambel oak
SABE2	*Salix bebbiana*	Bebb willow

Shrub Species

Species Symbol	Scientific Name	Common Name
ARUV	*Arctostaphylos uva-ursi*	kinnickinnick
CEFE	*Ceanothus fendleri*	Fendler's ceanothus
JUCO6	*Juniperus communis*	common juniper
MARE11	*Mahonia repens*	creeping barberry
PHMO4	*Physocarpus monogynus*	Mountain ninebark
PAMY	*Paxistima myrsinites*	Oregon boxleaf
RIBES	*Ribes sp.*	Currant species
ROWO	*Rosa woodsii*	Woods' rose
RUID	*Rubus idaeus*	American red raspberry
RUPA	*Rubus parviflorus*	thimbleberry

Species Symbol	Scientific Name	Common Name
SYRO	*Symphoricarpos rotundifolius*	Roundleaf snowberry

Table S10. *List of plots coordinates by plot name, latitude, and longitude*

Plot Center Coordinates

Plot Name*	Latitude	Longitude
31.10_001	36.016802	-105.454622
31.10_002	36.018567	-105.459671
31.10_003	36.019927	-105.459909
31.10_004	36.021913	-105.460354
31.10_005	36.022413	-105.457547
31.10_006	36.023162	-105.459908
31.10_007	36.023189	-105.457889
31.10_008	36.024709	-105.45778

*Previous iterations and records of this project use the non-standardized plot names “CF_01”, etc.

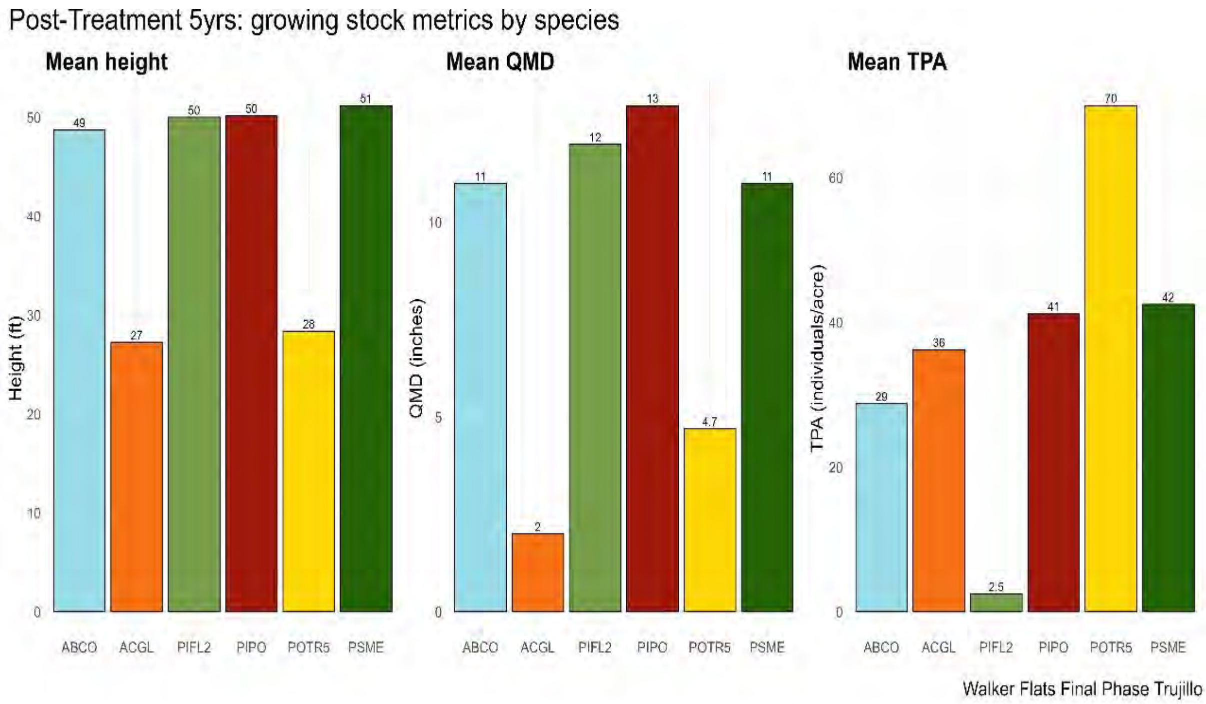
Table S11. *List of abbreviated terms by abbreviation and definition*

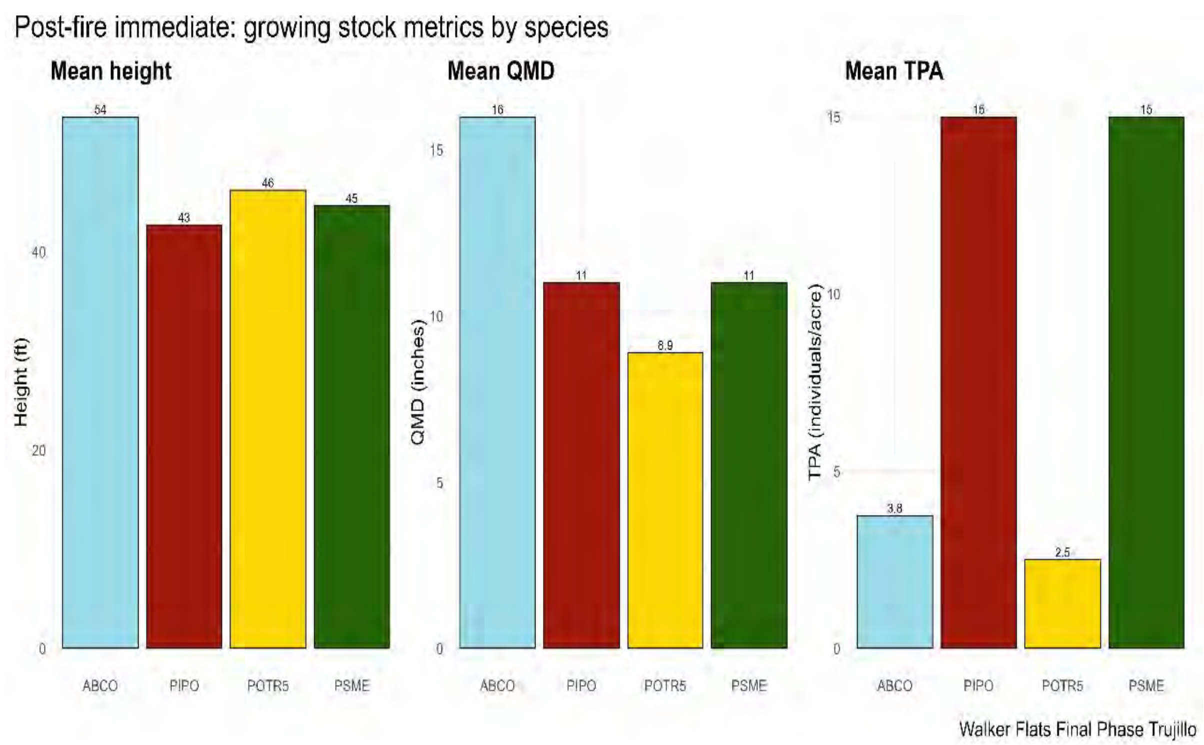
Abbreviations & Acronyms

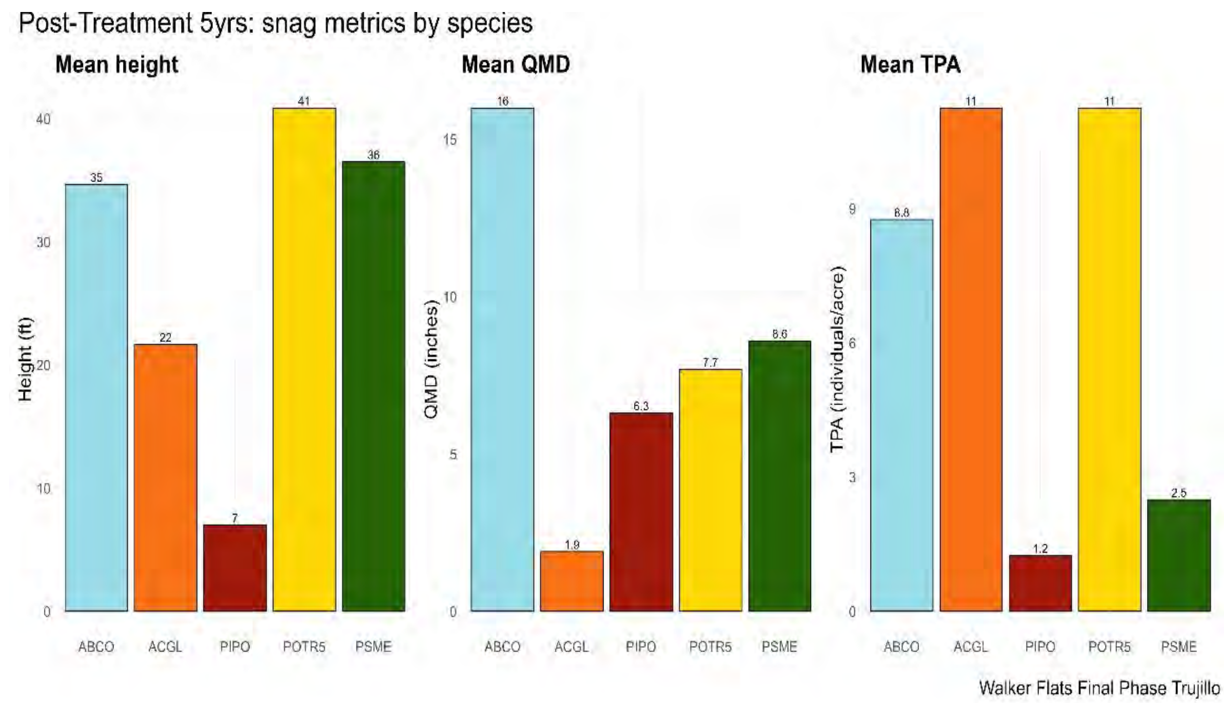
Acronym/Abbreviation/Term	Definition as used by NMFWRI
1-hr fuel	Woody surface debris < 0.25 inches in diameter
10-hr fuel	Woody surface debris 0.25 – 1 inch in diameter
100-hr fuel	Woody surface debris 1.0 – 3.0 inches in diameter
1000-hr fuel	Woody surface debris > 3.0 inches in diameter
CFRP	Collaborative 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 S25. *The following figures show tree (>1" DBH) metrics at the species level by status and measurement period*






Post-Treatment 5yrs: snag metrics by species
Mean height
Height (ft)
35
22
7
41
36
ABCO
ACGL
PIPO
POTR5
PSME
Mean QMD
QMD (inches)
16
1.9
6.3
7.7
8.6
ABCO
ACGL
PIPO
POTR5
PSME
Mean TPA
TPA (individuals/acre)
8.8
11
1.2
11
2.5
ABCO
ACGL
PIPO
POTR5
PSME
Walker Flats Final Phase Trujillo

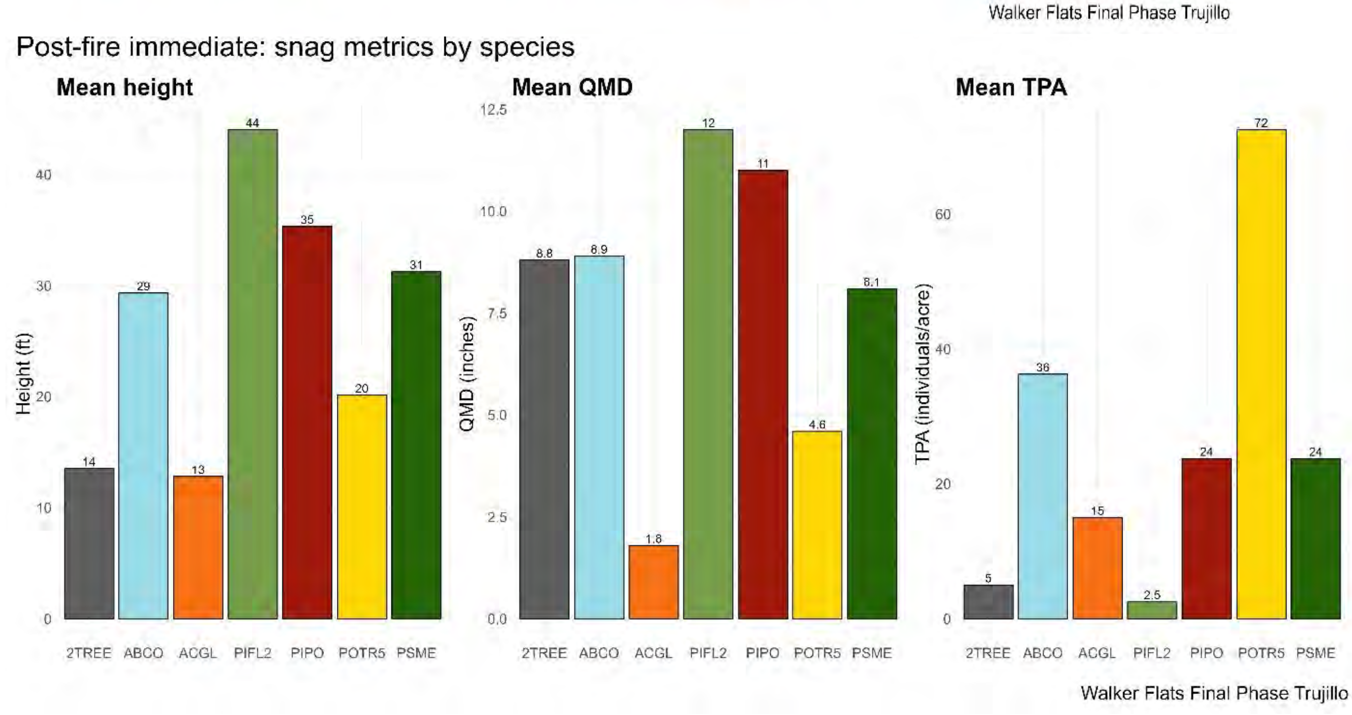
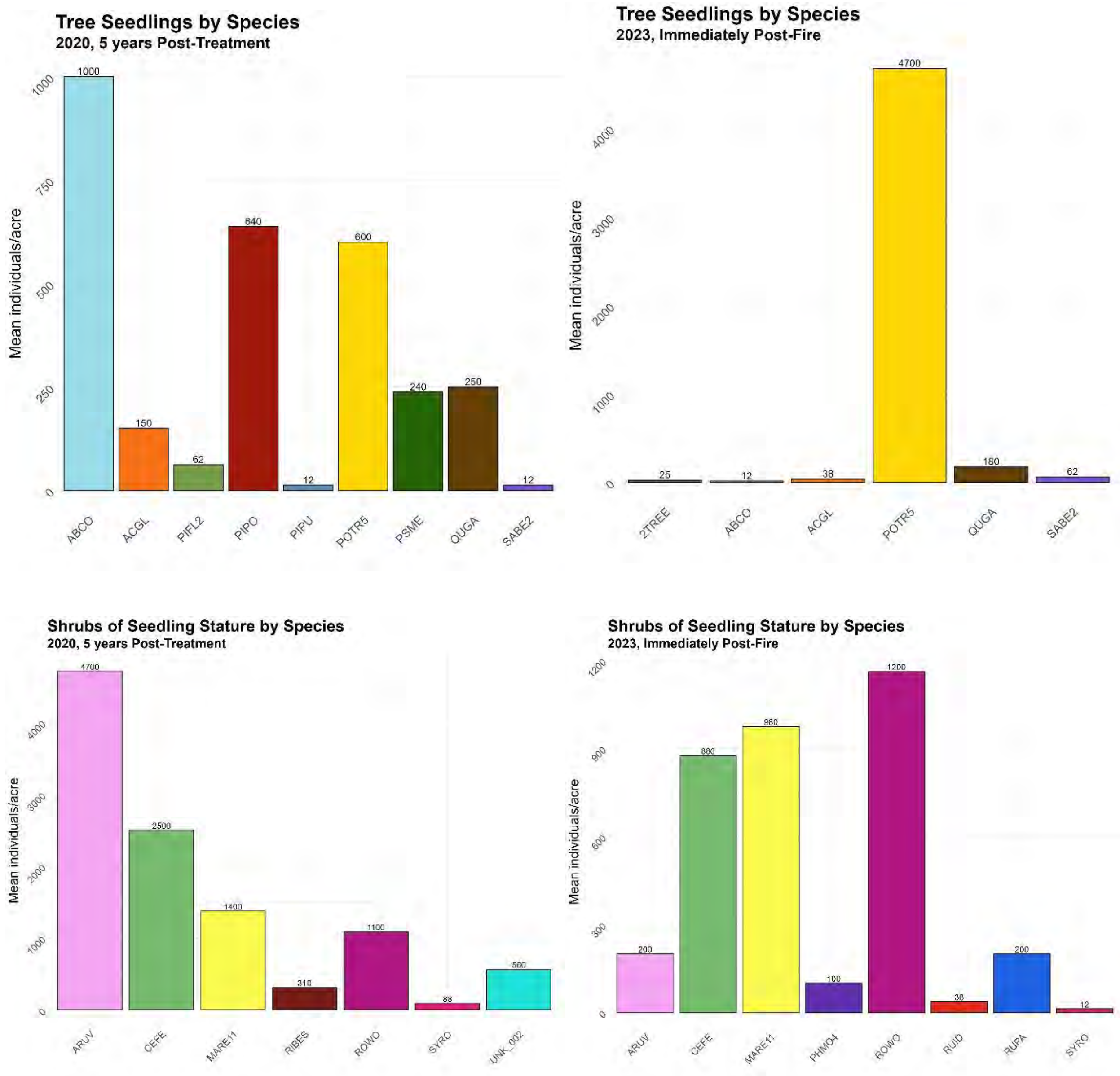
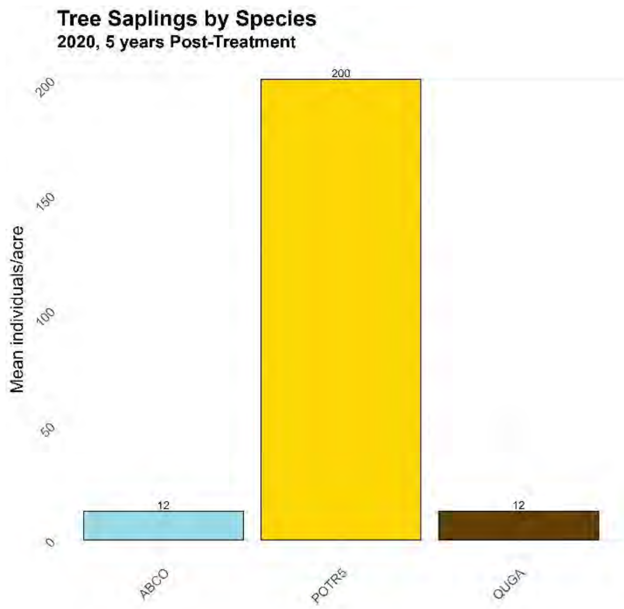
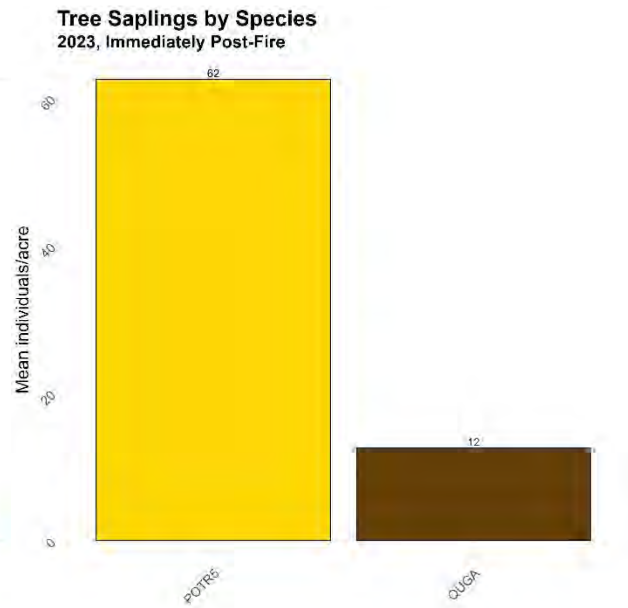
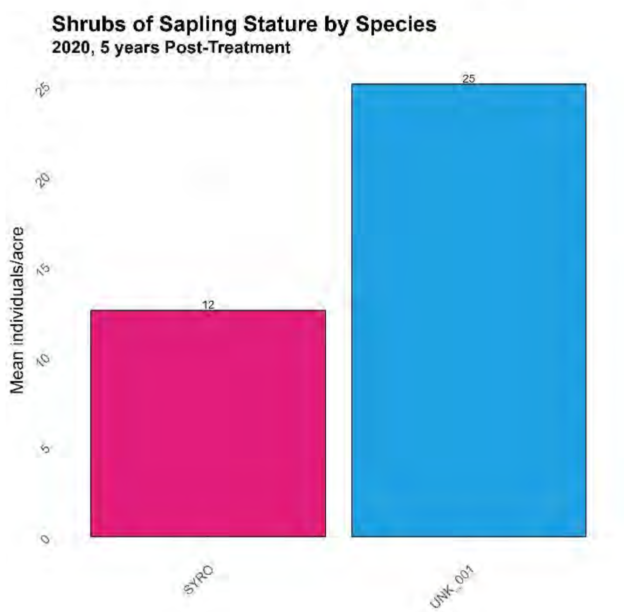

Post-fire immediate: snag metrics by species
Mean height
Height (ft)
14
29
13
44
35
20
31
2TREE
ABCO
ACGL
PIFL2
PIPO
POTR5
PSME
Mean QMD
QMD (inches)
8.8
8.9
1.8
12
11
4.6
8.1
2TREE
ABCO
ACGL
PIFL2
PIPO
POTR5
PSME
Mean TPA
TPA (individuals/acre)
5
36
15
2.5
24
72
24
2TREE
ABCO
ACGL
PIFL2
PIPO
POTR5
PSME
Walker Flats Final Phase Trujillo

Figure S26*. The following figures show seedling and sapling densities by status and measurement period*




Tree Saplings by Species
2020, 5 years Post-Treatment
Mean individuals/acre
0
50
100
150
200
12
200
12
ABCO
POTR5
QUGA


Tree Saplings by Species
2023, Immediately Post-Fire
Mean individuals/acre
0
20
40
60
62
12
POTR5
QUGA


Shrubs of Sapling Stature by Species
2020, 5 years Post-Treatment
Mean individuals/acre
0
5
10
15
20
25
12
25
SYRO
UNK_001