



Rolling R Ranch Monitoring Summary

Overview

The Rolling R Ranch Project (Rolling R) was a small 30-acre forest management project led by the Colorado State Forest Service, in which mechanical thinning was implemented on private land in 2020 near Conifer, Colorado (Table 1, Figure 1). Rolling R was part of a larger landscape and cross-boundary forest management strategy led by the Upper South Platte Partnership (USPP), and was located adjacent to previous USPP projects (Newton Park, [Hunter and Slack 2023](#) and Beaver Ranch, [Slack et al. 2021](#) and [Hunter et al. 2022](#)). This monitoring summary presents results from field data collected before and one year after implementation to evaluate forest thinning outcomes.

Goals and Objectives

The USPP follows the [National Cohesive Wildland Fire Management Strategy](#) to guide collaborative efforts that promote: 1) Resilient Landscapes, 2) Fire-Adapted Communities, and 3) Safe and Effective Wildfire Response. The Resilient Landscapes strategy generally aims to promote forest health and mitigate wildfire risk through active forest management (e.g. mechanical thinning and prescribed fire). In 2015, the USPP established Landscape Resilience

goals (Table 2) that were informed by the historical range of variability information gathered by the Front Range Forest Reconstruction Network ([Battaglia et al. 2018](#), [Brown et al. 2015](#)). In addition to following USPP goals, Rolling R set specific prescription targets (Table 3), and was designed to promote aspen.

Highlights

The Rolling R project mostly met management goals and objectives. Forest thinning reduced stand density, basal area, and canopy cover, but more trees needed to be removed to achieve prescription targets. Post-thinning canopy cover was below 40%, but individual trees were not represented in canopy cover at any monitoring plot. The ratio of ponderosa pine in the overstory did increase, and ponderosa pine and aspen seedlings also increased, potentially promoting these species in the future. Increases in surface fuels were limited and lower-intensity fire behavior was predicted following thinning; forest conditions likely support the future use of prescribed fire.

Forest thinning mostly removed lodgepole pine across all size classes, and additional cutting of Douglas-fir may have further met prescription targets and canopy cover goals.

Dendrochronology data revealed that the largest lodgepole pine were established simultaneously with if not earlier than the largest ponderosa pine and Douglas-fir. Rolling R contained a unique mixed conifer forest that adds diversity value to the landscape, and lodgepole pine could have been maintained while meeting other project goals such as promoting ponderosa pine and aspen, reducing wildfire hazard, and increasing variability in canopy cover.

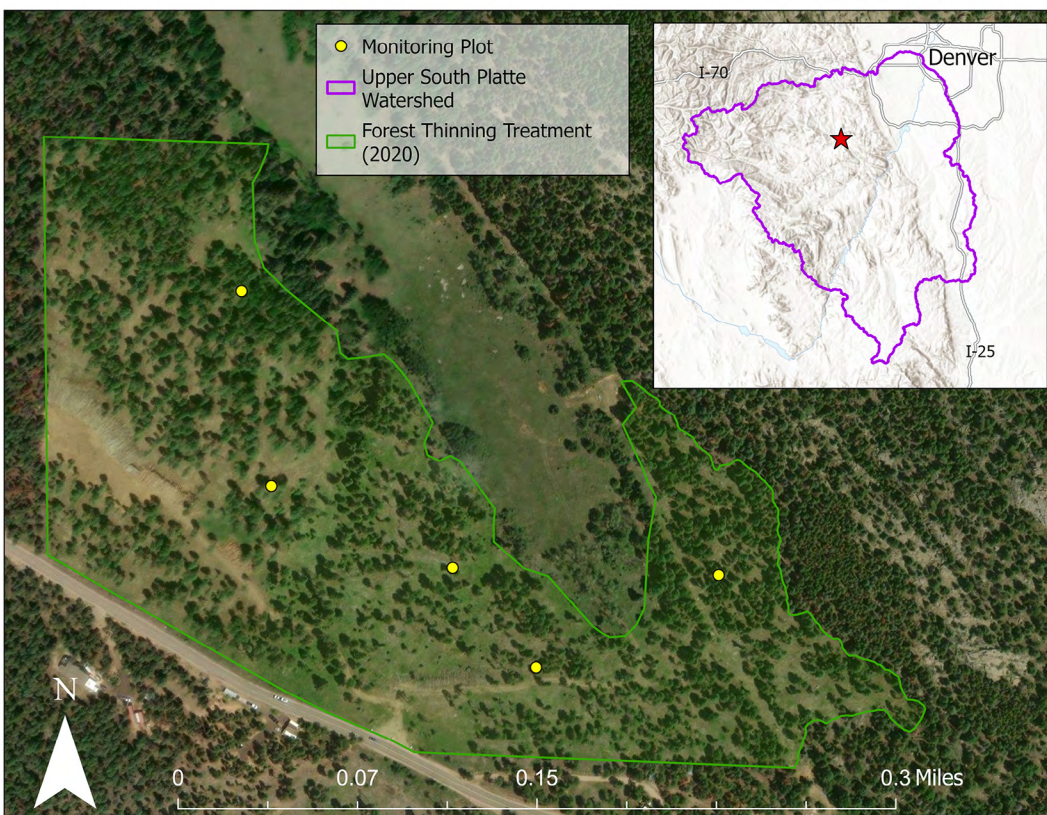


Figure 1. Map of Rolling R project area showing the forest thinning boundary, monitoring plots, and the project location within the Upper South Platte watershed.

Table 1. Project Information

Implementation Agency	Colorado State Forest Service – Golden
Ownership	Private
Funding	Upper South Platte Partnership
Forest Type	Mixed conifer
Year Completed	2020
Implementation Method	Mechanical thinning
Slash Treatment	Whole tree harvest, grind and haul off site
Acres Treated	30
Acres Monitored	30
Years Monitored	2019 (pre-thin), 2020 (post-thin)

Methods

The Colorado Forest Restoration Institute (CFRI) partners with the Upper South Platte Partnership to collect monitoring data at permanently established plots. Field data was collected at five plots (Figure 1) pre- and post-thinning (Figure 2) to monitor changes in forest overstory, saplings, seedlings, and surface fuels. For more information on CFRI data collection methods see the Mothership Protocol (CFRI, 2023). This monitoring summary used field data to calculate forest structure and composition metrics (Table 4) that evaluate USPP project scale goals 2-5 (Table 2) and prescription targets (Table 3). Field data was used to assess fire hazard and progress towards USPP Goal 5 (Table 3). Metrics describe surface fuel conditions (Table 5) and potential fire behavior (Table 6). Potential fire behavior was predicted using the Fire and Fuels Extension of the Forest Vegetation Simulator (FFE-FVS, [Rebain et al. 2022](#)). The nonparametric Wilcoxon signed rank test was used to test



Figure 2. Photo time series of a CFRI monitoring plot showing conditions pre-thinning (A, 2019) and post-thinning (B, 2021). Most of the lodgepole pine were removed and the overstory was dominated by ponderosa pine and Douglas-fir following thinning.

Table 2. Upper South Platte Partnership Landscape Resilience goals.

USPP Goal	Measure	Desired Condition	Scale
1	Mean canopy cover over the sub watershed	Average of 30%, while maintaining a range of 0-100% within forested areas	Landscape
2	Mean canopy cover	Average of 30% with an acceptable range of 10-40% within treated areas	Project
3	Arrangement of conifer canopy cover	25% of canopy cover is comprised of individual trees	Project
4	Conifer species composition	Increase the ratio of ponderosa pine	Project
5	Forest conditions that support the future use of prescribed fire	Limit accumulation of fine woody fuel and isolate large areas of contiguous canopy	Project
6	Crown fire activity	Limit the area of active crown fire activity to an average of 10 acres, with an acceptable range of 0-25 acres	Landscape

for statistical differences between pre- and post-thinning metrics. However, high variability in the data and a small sample size (n=5) likely resulted in low statistical power, and differences between pre- and post-thinning metrics were not statistically significant.

This site had a mix of species and evidence of past fire; thus we thought it was important for this monitoring report to understand tree establishment dates and and fire history. This information can be used to determine if and how these forests have changed in the past 150 years to more properly mimic

Table 3. Rolling R forest thinning prescription targets.

Measure	Target
Basal Area (ft ² /acre)	25
Stand Density (Trees/acre)	38
Canopy Base Height (ft)	10
Canopy Cover (%)	18

forest conditions prior to fire suppression and European settlement. Increment cores were extracted from the largest ponderosa pine (n=4) and Douglas-fir (n=4), and cross sections of fire-scarred lodgepole pine (n=10) were extracted to determine stand age and fire history. More information on dendrochronology methods for processing and measuring tree ring samples can be found at Rocky Mountain Tree-Ring Research ([Brown, 2024](#)).

Forest Structure and Composition

Forest thinning at Rolling R resulted in nearly a 40% reduction in stand density and basal area (Table 4). Mostly lodgepole pine and overstory trees in the 5-10 inch diameter class were removed (Figure 3). Basal area for most species was only slightly lower following thinning, except for

lodgepole pine which decreased by 88% ($p = 0.06$, Figure 4). Canopy cover decreased by 30% to the acceptable range of 10-40% as determined by USPP Goal 2. However, there were no isolated trees observed in the monitoring plots post-treatment, and over 85% of the canopy cover was continuous canopy of tree groups with more than 16 trees (USPP Goal 3). The proportion of ponderosa pine in the overstory slightly increased, but an increase in ponderosa pine seedlings following thinning indicated that the ratio of ponderosa pine may continue to increase in the overstory (USPP Goal 4). Furthermore, aspen seedlings also increased following thinning, and with limited herbivory aspen could continue to be promoted in the overstory (Figure 5).

Table 4. Stand structure and composition metrics (mean \pm standard deviation) pre- and post-thinning.

Phase	Stand Density (trees/acre)	Basal Area (ft ² /acre)	Ponderosa by BA (%)	Canopy cover (%)	Quadratic Mean Diameter (in)	Canopy Base Height (ft)
Pre	402 \pm 198	124 \pm 30	13.16	64.20 \pm 10.73	8.43 \pm 3.14	17.00 \pm 6.54
Post	251 \pm 195	76 \pm 24	15.71	34.8 \pm 19.23	8.99 \pm 3.83	16.01 \pm 7.53

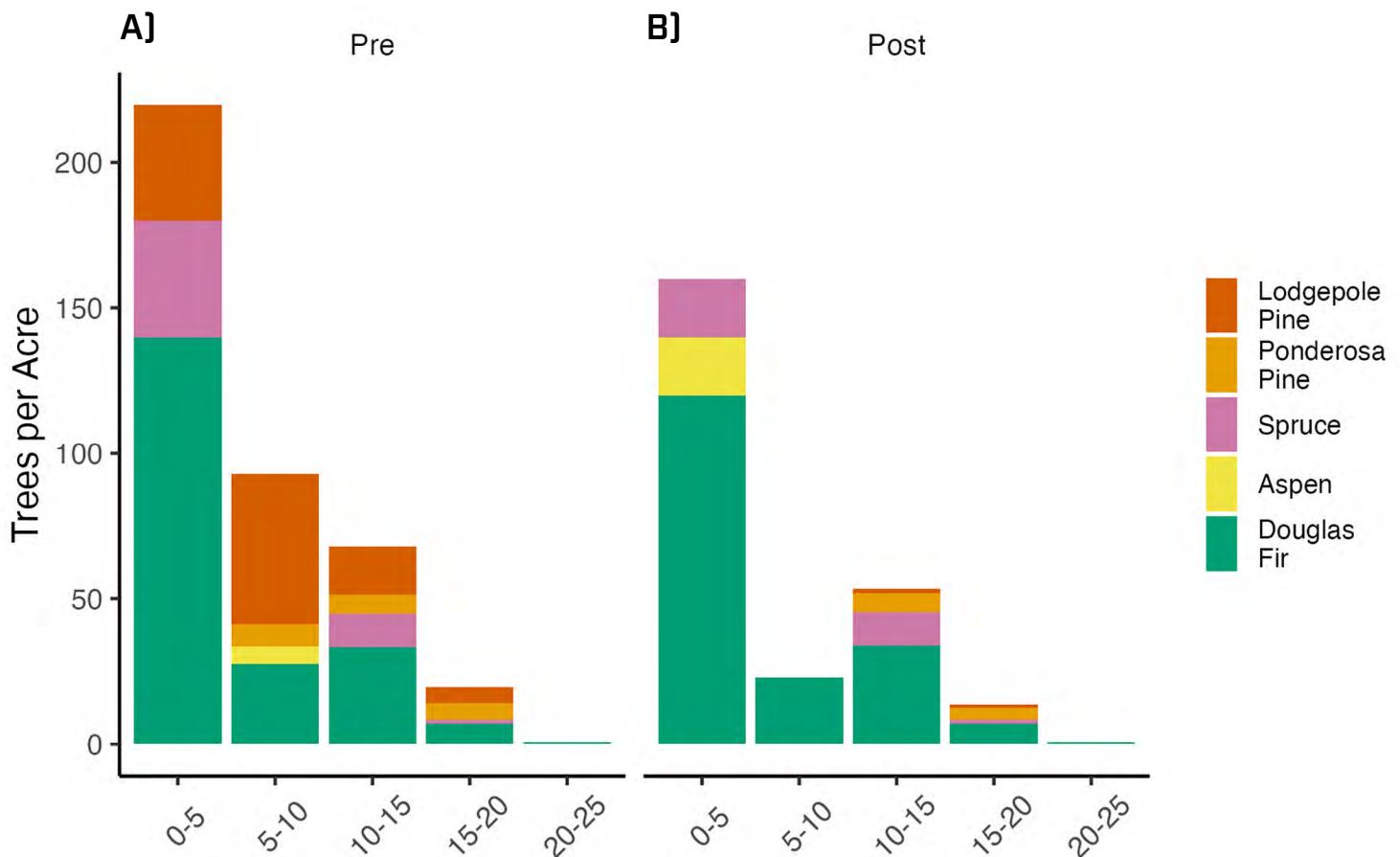


Figure 3. Diameter distribution of overstory trees and saplings by species before (A) and after (B) forest thinning. Forest thinning mostly removed lodgepole pine and aspen saplings emerged 1-year following thinning.

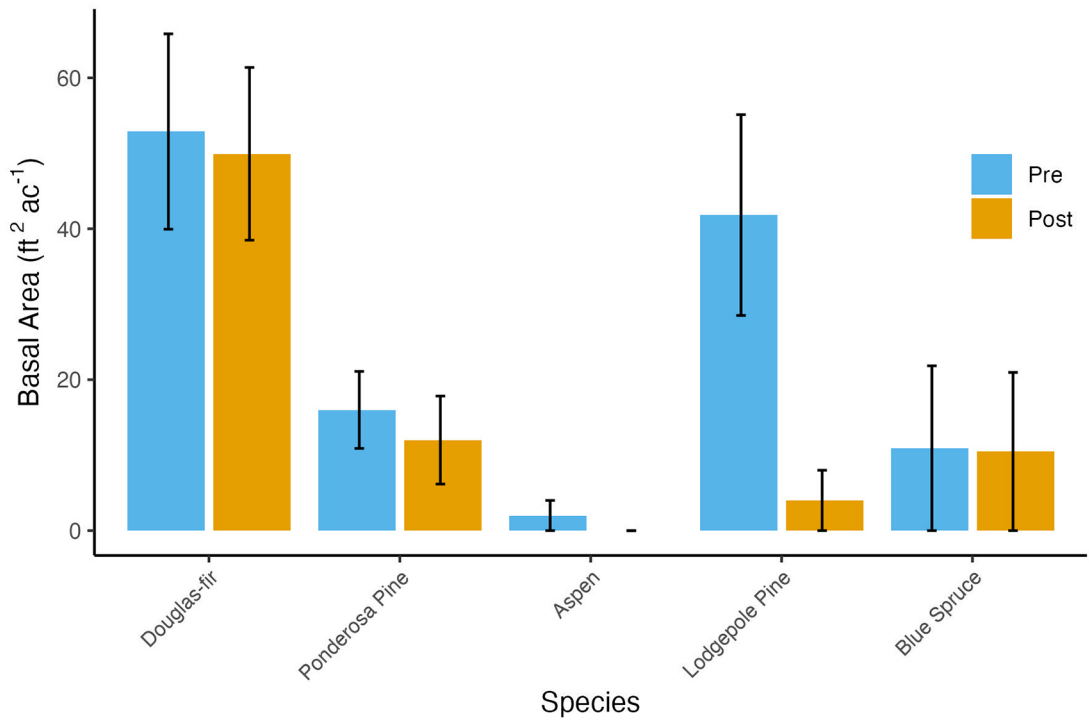


Figure 4. Species composition by basal area before (blue) and after (orange) forest thinning. Douglas-fir had the highest basal area before and after thinning, and lodgepole pine basal area decreased the most.

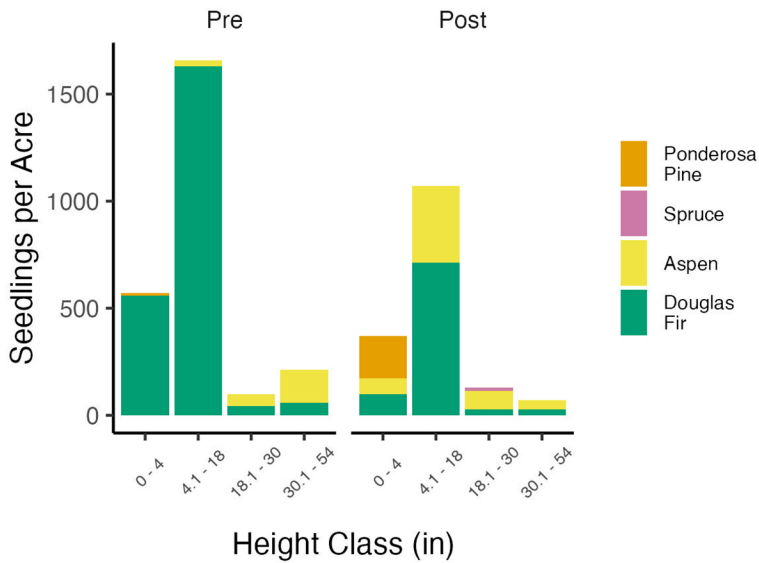


Figure 5. Seedlings per acre divided by species and height class. Ponderosa pine and aspen seedlings increased following thinning potentially promoting these species in the future.



Wildfire Hazard

Surface fuels somewhat increased following thinning, but this was expected and fine woody fuel loading and shrub cover remained relatively low (Table 5). Under severe weather conditions modeled fire behavior predicted a 53% decrease in total flame length, and the probability of torching fell by 0.36 (Table 6). While pre-treatment forest conditions predicted active and conditional crown fire types in some plots, only passive and surface fire types were predicted after thinning

(Figure 6). Similar trends were observed under moderate fire weather conditions, suggesting that forest conditions could support the future use of prescribed fire at Rolling R (USPP Goal 5). The torching index (an estimate of the windspeed needed to initiate torching fire behavior) increased from 0 to 5.6 miles per hour, and torching fire behavior would still likely occur after thinning. The crowning index predicted a 41% increase in the windspeed needed to initiate crown fire activity, and an extreme wind event would likely be needed for the project area to experience crown fire behavior.

Table 5. Surface fuel conditions (mean \pm standard deviation) before and after forest thinning.

Phase	Fine Woody Fuel Loading (tons/acre)	Coarse Woody Fuel Loading (tons/acre)	Litter Depth (in)	Duff Depth (in)	Shrub Cover (%)
Pre	2.09 \pm 0.40	10.61 \pm 5.22	0.95 \pm 0.15	1.04 \pm 0.10	5.70 \pm 3.01
Post	1.98 \pm 0.27	7.45 \pm 4.43	0.99 \pm 0.06	0.48 \pm 0.14	9.40 \pm 3.23

Table 6. Predicted fire behavior under moderate and severe fire weather conditions.

Measure	Pre		Post	
	Severe Fire Weather	Moderate Fire Weather	Severe Fire Weather	Moderate Fire Weather
Total Flame Length (ft)	33.3	2.8	15.6	2.3
Probability of Torching	0.94	0.93	0.58	0.56

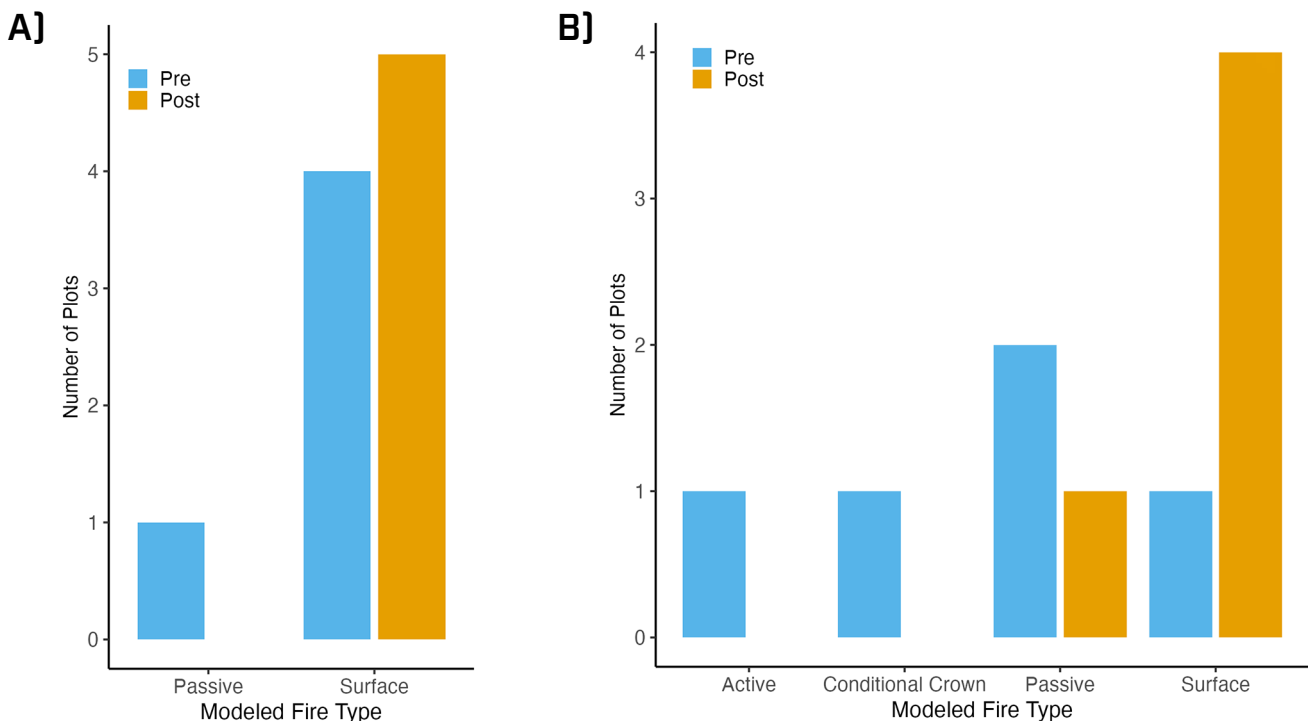


Figure 6. Predicted fire type for each plot under moderate (A) and severe (B) weather conditions.

Stand Age and Fire History

Sampled trees at Rolling R were established between 1863 and 1890 (Figure 7). On average sampled lodgepole pine (average DBH = 12.8) were smaller than ponderosa pine (average DBH = 15.9) and Douglas-fir (average DBH = 18.5). However, lodgepole pine had an average age of 146 years and most were established before sampled ponderosa pine and Douglas-fir. All ten lodgepole pine recorded a fire in 1896, and two lodgepole pine recorded a second fire in 1902 and a third fire in 1923. The tree-ring data collected from Rolling R suggests that lodgepole pine, ponderosa pine, and Douglas-fir were co-dominant and experienced some surface fire. However, none of the trees we cored were older than 1863, so understanding true reference forest structure is difficult; it is unclear if settlement and management in the late 19th century altered forest conditions.

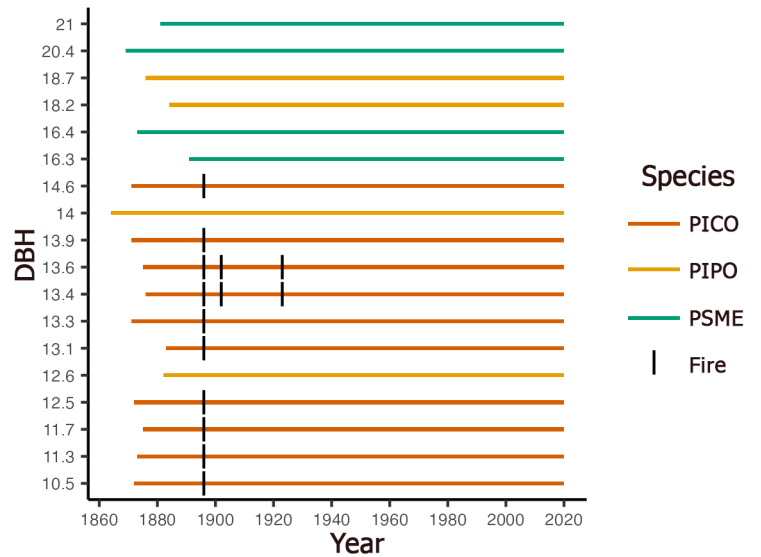


Figure 7. Tree age for ponderosa pine, Douglas-fir and lodgepole pine ordered by diameter at breast height where the largest trees are on top.

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