Baseline Monitoring Prior to Fuels Treatments in Whitebark Pine Stands within the Upper North Fork Project Area

Prepared by Salmon Valley Stewardship and Salmon Environmental Services

for

Idaho Fish and Game and Salmon-Challis National Forest

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INTRODUCTION

A century of fire exclusion in the Upper North Fork (UNF) project area on the North Fork Ranger District of the Salmon-Challis National Forest (SCNF) has resulted in ecological conditions that threaten the resilience of plant and wildlife species and natural functions. Native species are declining and unnatural fuel accumulations increase the risk for extreme fire behavior and associated stand replacement, vegetation composition changes, and habitat loss.

Therefore the Lemhi Forest Restoration Collaborative intends to implement planned mechanical thinning and prescribed fire treatments across multiple stands within the project area. The area is characterized as a higher elevation cold forest with a mixed severity historical fire regime.

Whitebark pine (*Pinus albicaulis*) is known to occur in the higher elevations of the project area, together with lodgepole pine (*Pinus contorta*), subalpine fir (*Abies lasiocarpa*), Engelmann spruce (*Picea engelmannii*), and Douglas-fir (*Pseudotsuga menziesii*). Whitebark pine is a keystone and foundation subalpine species known to be in decline across its range, and is therefore a candidate species for listing under the Endangered Species Act (Federal Register 2011). Whitebark pine is relatively slow-growing, relatively shade intolerant, and weakly competitive with other conifers, occurring in pure stands only in the highest and least productive subalpine areas. Threats to whitebark pine include mountain pine beetle, white pine blister rust, altered fire regimes, and effects of climate change (Perkins et al. 2016). Whitebark pine is predominantly dependent on the Clark's nutcracker (*Nucifraga columbiana*) as a seed dispersal agent; the nutcracker creates caches containing multiple seeds in non-forested openings.

Various restorative treatments are planned within stands containing whitebark pine; however treatments have not been specifically designed to benefit whitebark pine. Nevertheless, daylighting – the targeted reduction in densities of competing species in the immediate vicinity of whitebark pine has been shown to improve vigor (Hansen et al. 2016). It is therefore possible that thinning and prescribed fire treatments may promote vigor and survival rates of whitebark pine within treated stands.

Currently there is little information about whitebark pine response to forest restoration treatments in mixed severity cold forests on the SCNF or other forests within USFS Region 4 outside of predictive models. This project offers the Lemhi Forest Restoration Collaborative a unique opportunity to monitor and assess whitebark pine response to planned thinning and prescribed fire treatments at a meaningful spatial scale.

OBJECTIVES

- Establish baseline monitoring plots by stand, prior to treatments, to assess the effects of mechanical and prescribed fire treatment in the UNF project area.
- Determine current whitebark pine distribution and stand characteristics.
- Determine relative presence and severity of blister rust and pine beetle infestation.
- Document Clark's nutcracker's activity, presence, and opportunity for caching.

STUDY AREA

The Upper North Fork project area consists of approximately 41,400 acres in the upper reaches of the North Fork Salmon River. It lies at the northern end of Lemhi County, adjacent to the Montana border. Higher elevation areas ranging from 7,000 to just below 8,000 feet support varying densities of whitebark pine.

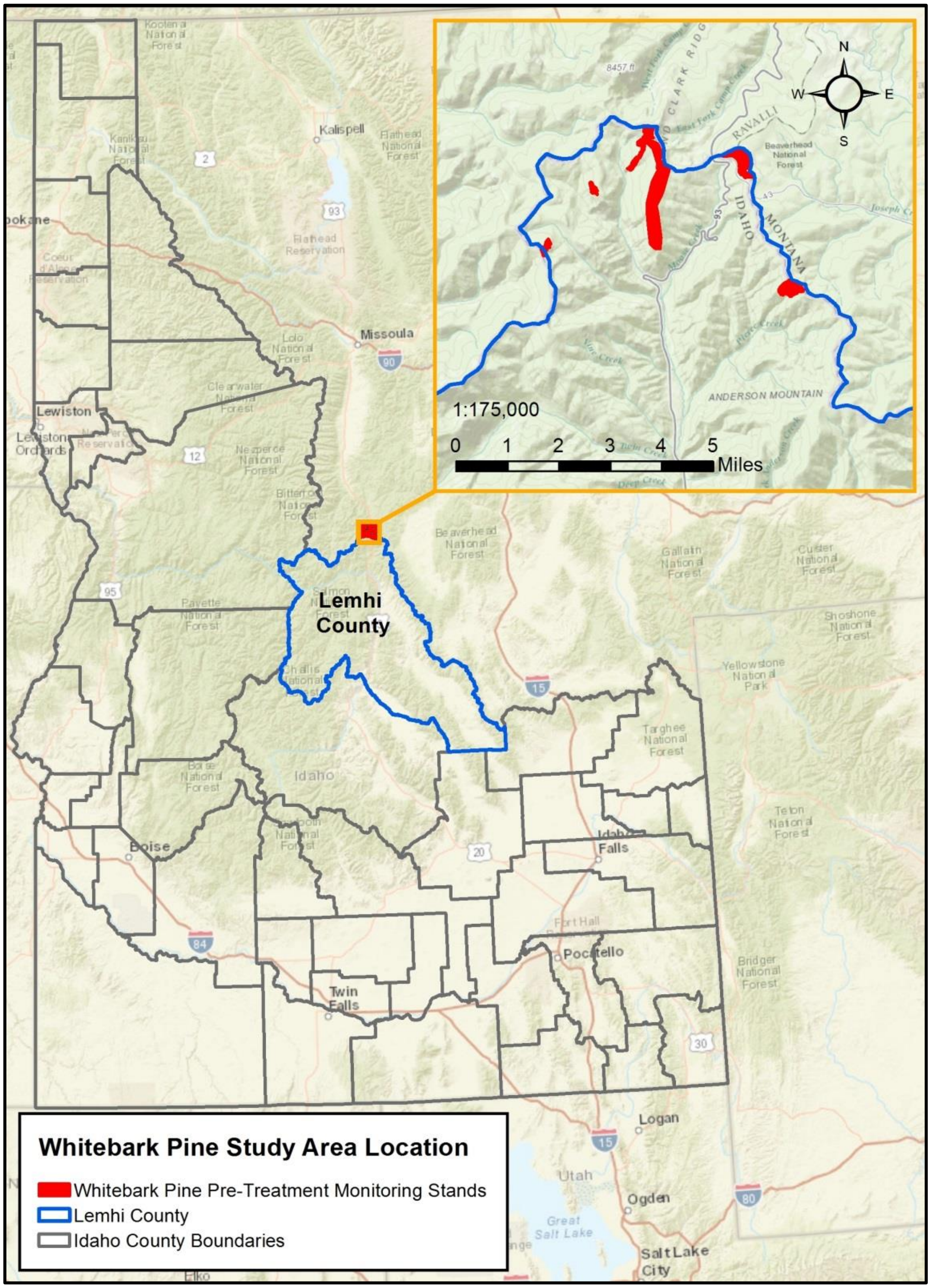


Figure 1. Study Area Location

METHODS

Fourteen treatment stands within the UNF project area were selected by the SCNF silviculturalist as most likely to contain whitebark pine. Criteria for selection of treatment stands were cover types ≥6,500 feet elevation (using the current USFS corporate vegetation layer), examination of aerial photos to detect mature whitebark pine, and ground-truthing of the USFS vegetation layer model. Inventory plots were located within each stand, with number of plots dependent on stand size. Stands were located in four distinct geographic areas – on the Anderson Mountain Road, at Chief Joseph and Lost Trail passes, and in the upper headwaters of the North Fork River (Figure 2).

All selected stands were located within proposed treatment stands. The SCNF silviculturalist did not consider it necessary to collect data in non-treatment control stands, due to the known positive effect of reducing competition for whitebark pine by daylighting treatments. The intent of pre- and post-treatment monitoring is to determine the extent of recruitment up through the seedling and sapling size classes.

Inventory data was collected by a field crew in October 2015 and June 2016, using USFS Common Stand Exam (CSE) Intensive methodology, as detailed in the CSE Field Guide for Region 4 (Appendix A).

A variable macro plot with a BAF (basal area factor) of 20 was used to tally trees with a dbh (diameter at breast height) of 5 inches and above, and a fixed micro plot of 1/100 of an acre was used to tally saplings of less than 5 inches dbh, and seedlings of less than 4.5 feet in height. Information was collected regarding species, mortality, diameter, height, crown ratio and class, and disease severity for mountain pine beetle and white pine blister rust. Five trees per stand, selected from representatives of the codominant species, were aged by coring with an increment borer.

Plot data included existing vegetation cover type, habitat, elevation, aspect and slope. Photographs were taken at each plot, facing each of the cardinal directions. Additionally, wildlife comments were recorded, with emphasis on noting any sign of Clark's nutcracker, wolverine (*Gulo gulo*), fisher (*Pekania pennanti*), American marten (*Martes Americana*), American red squirrel (*Tamiasciurus hudsonicus*), and woodpeckers (Picidae family).

Detailed methodology can be found in Appendix A, to ensure that future data collection post-treatment will be conducted consistently with the original inventory.

Measuring dbh, and using a laser rangefinder to calculate tree heights.

Figure 2 displays the locations of the 14 stands originally selected for plot data collection. However, once fieldwork began, we determined that multiple stands along the Anderson Mountain Road did not contain whitebark pine– it was so vanishingly rare that no data could have been collected on this target species. The remaining Anderson Mountain stands contained very sparse levels of whitebark pine and were at a low enough elevation (below 7,000 feet) that their lower points intersected with the upper limit for ponderosa pine (*Pinus ponderosa*).

As a result, several stands were dropped from the monitoring inventory project, and the remaining stands (plus one of the two North Fork stands) were redelineated to exclude the lower elevation portions.

In total, 66 monitoring plots were established in 9 stands, as shown in Figure 3.

Field data entry into the Trimble Juno handheld, after tallying seedlings and saplings in the micro plot.

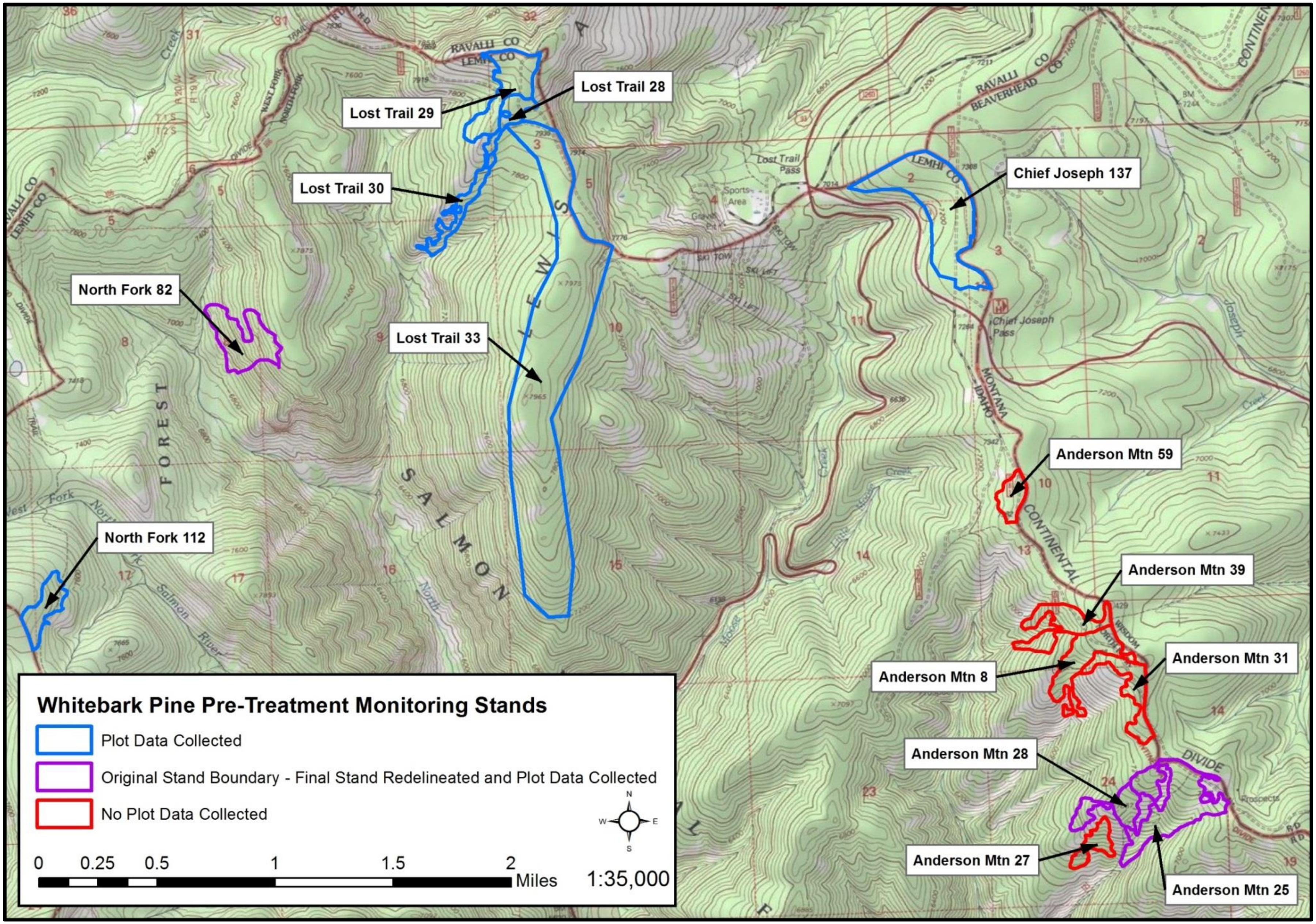


Figure 2. Original Monitoring Stands

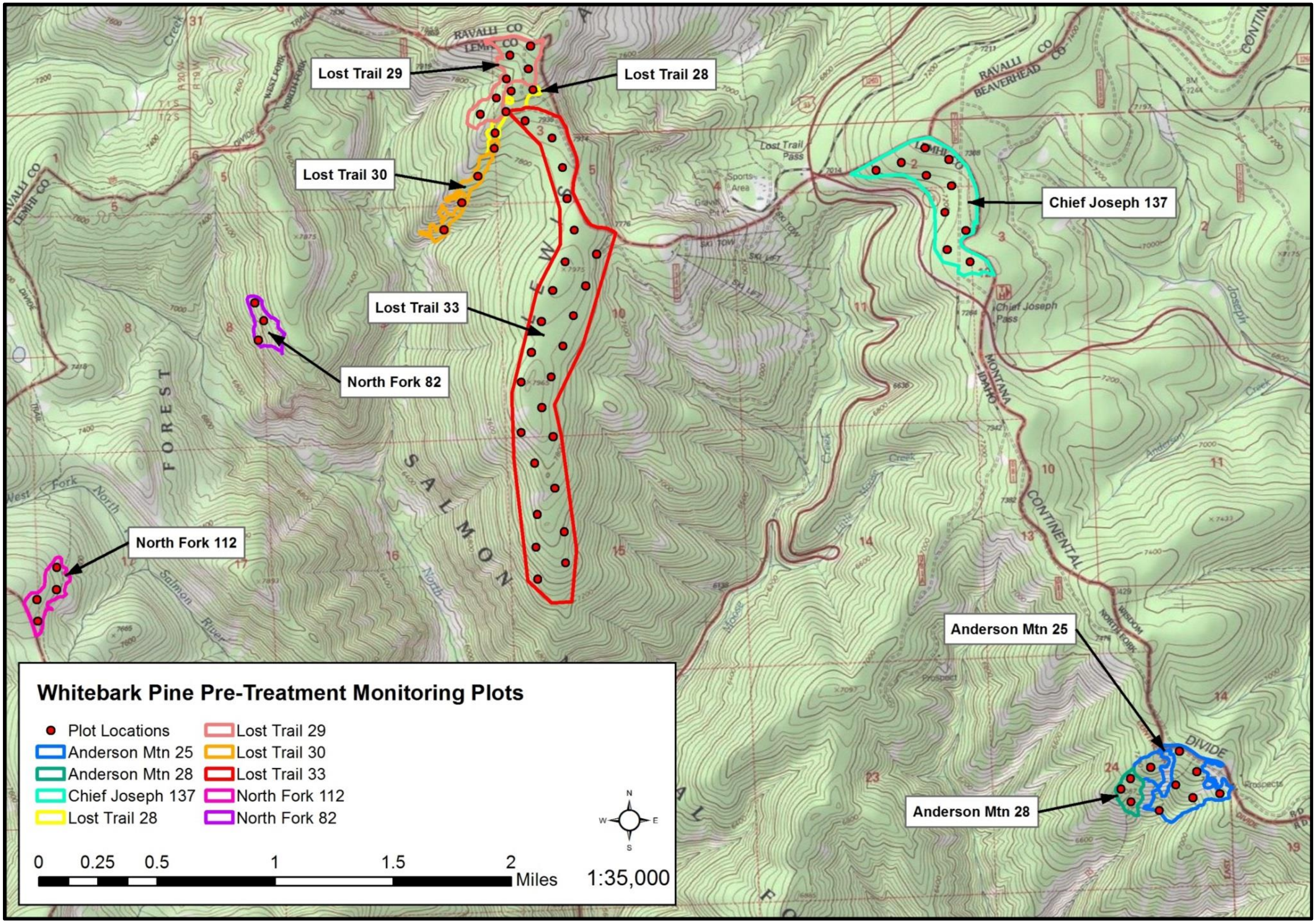
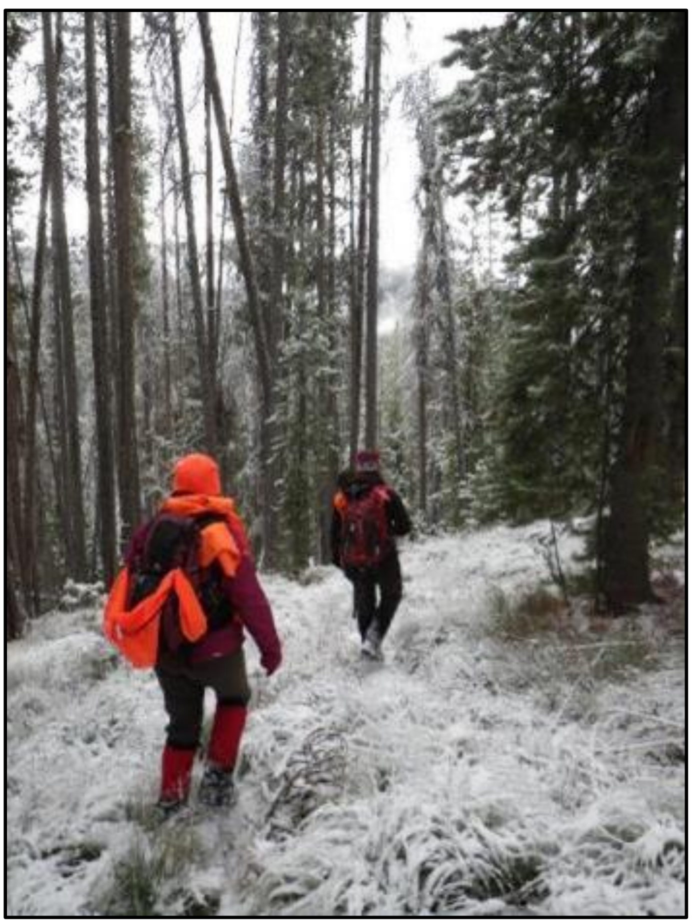


Figure 3. Final Monitoring stands and Plot Locations

Figure 3. Final Monitoring **S**tands and Plot Locations Table 1 displays the SCNF numerical identifier for the stands in which data was collected, together with the names assigned to them for this project, size, number of plots, and average elevation, aspect, and slope within each stand. Location information is provided in UTM Zone 11N, datum NAD83.

Table 1. Inventory Stands

Stand ID	Name	Acres	Plots	Northing	Easting	Elevation (ft)	Aspect	Slope %
72040025	Anderson Mtn 25	43	7	5060355	740047	7100	SSW	25
72040028	Anderson Mtn 28	9	3	5060315	739640	7000	S	35
72110137	Chief Joseph 137	78	10	5064401	738450	7200	SW	5
72220028	Lost Trail 28	11	4	5065023	735542	7900	SE	10
72220029	Lost Trail 29	31	6	5065221	735510	8000	W	20
72220030	Lost Trail 30	13	4	5064404	735202	7600	S	25
72220033	Lost Trail 33	263	25	5063225	735823	7900	0	15
72210112	North Fork 112	16	4	5061685	732371	7800	E	20
72210082	North Fork 82	12	3	5063517	733726	7500	WSW	60



Late October travel through a stand.

RESULTS

None of the stands selected for pre-treatment monitoring data collection, nor any other stands in the immediate vicinity, were pure whitebark pine stands. All stands were homogenous subalpine fir-beargrass habitat type (Steele and Fister, 1981).

Whitebark pine only approached codominance in one stand, North Fork 112; in all others it was a minor component of the mature size classes. It is unlikely that whitebark has ever been more than a minor component of most of these stands (with the exception of North Fork 112), due to the relatively productive habitat type and lack of evidence of 1930s dead trees (relics of the last major episode of pine beetle mortality in whitebark pine, preceding the current one).

Several Lost Trail stands, and the North Fork stands, contained substantial (43% to 85% composition) levels of whitebark pine saplings, however. Seedling compositions in these stands ranged from 4% to 42%. Due to extreme sparseness, no whitebark pine was tallied in any size class within the Anderson Mountain stands, and just a few seedlings and saplings were tallied in the Chief Joseph stand.

Two of the stands, Lost Trail 28 and 29, burned in a wildland fire in 2000, which should be taken into account when comparing density and mortality between stands.

White pine blister rust levels were generally low, possibly due to the relative scarcity of whitebark pine. No currant (*Ribes* spp.) species (alternate rust host) were observed. Mountain pine beetle-caused mortality was high in all stands on both lodgepole and whitebark pine; with the exception of whitebark pine within North Fork 82. Mortality levels varied from 20% in Chief Joseph 137 to 72% in Lost Trail 28.

We observed little evidence of Clark's nutcrackers; just one sighting and no calls heard. There was also no evidence of seed caching, which will result in whitebark growing in multistemmed clumps (other than multistemmed 1930s dead trees in North Fork 112). No wolverine, marten, or fisher were sighted. The main wildlife sign observed was elk (*Cervus elaphus*) and deer (*Odocoileus* spp.) scat.

Table 2. Plot Locations and Wildlife Comments

Stand Plot	Elevation	Aspect	Slope	Northing	Easting	Wildlife Comments
AM 25 1	7228	198	26	5060508	739887	recent elk bedding. visual on 2 spruce grouse
AM 25 2	7275	202	10	5060614	740084	
AM 25 3	7255	198	24	5060476	740204	
AM 25 4	7191	258	21	5060323	740364	woodpecker heard nearby
AM 25 5	6809	164	36	5060212	739952	deer scat, elk scat, ravens
AM 25 6	7052	158	24	5060079	739826	deer scat, elk scat
AM 25 7	7080	238	22	5060380	740067	deer scat
AM 28 1	7074	200	32	5060426	739758	
AM 28 2	6893	138	35	5060268	739754	
AM 28 3	7038	158	35	5060351	739484	
CJ 137 1	7161	220	14	5064573	738019	
CJ 137 2	7252	204	5	5064629	738194	

Stand Plot	Elevation	Aspect	Slope	Northing	Easting	Wildlife Comments
CJ 137 3	7299	174	5	5064724	738349	
CJ 137 4	7318	184	3	5064651	738517	
CJ 137 5	7228	192	15	5064542	738363	deer scat
CJ 137 6	7237	212	5	5064469	738535	deer scat
CJ 137 7	7230	282	8	5064291	738493	
CJ 137 8	7280	234	5	5064167	738628	
CJ 137 9	7237	298	3	5064034	738501	
CJ 137 10	7316	210	5	5063950	738664	deer and elk scat, gray jay flying from tree to tree
LT 28 1	7988	158	7	5065126	735686	burn area, elk and deer scat close to plot, 2 spruce grouse on rd
LT 28 2	7943	134	4	5064973	735497	
LT 28 3	7886	124	8	5064829	735424	
LT 28 4	8080	296	12	5065112	735534	burn area
LT 29 1	7858	262	25	5064960	735326	
LT 29 2	7912	182	12	5065066	735436	burn area
LT 29 3	7941	258	17	5065203	735506	burn area, plot on elk trail with fresh scat
LT 29 4	8051	238	18	5065268	735647	burn area
LT 29 5	8057	184	25	5065359	735526	burn area
LT 29 6	8115	244	12	5065419	735664	burn area
LT 30 1	7836	164	16	5064731	735420	
LT 30 2	7676	78	15	5064540	735314	
LT 30 3	7515	192	32	5064352	735200	elk and deer scat
LT 30 4	7287	180	35	5064170	735079	deer scat
LT 33 1	7938	202	5	5064930	735641	deer elk scat
LT 33 2	7897	224	3	5064809	735824	
LT 33 3	7850	249	7	5064597	735882	deer scat close to plot
LT 33 4	7834	264	10	5064380	735915	elk scat
LT 33 5	7872	292	4	5064165	735961	deer and elk scat
LT 33 6	7908	314	5	5063954	735902	deer scat on site
LT 33 7	7781	96	30	5064004	736110	2 vocal ravens in area, one Clark's nutcracker
LT 33 8	7899	296	2	5063751	735819	
LT 33 9	7878	106	18	5063790	736040	deer scat close to plot
LT 33 10	7860	96	13	5063581	735958	
LT 33 11	7876	219	8	5063545	735742	
LT 33 12	7856	103	13	5063373	735888	

Stand Plot	Elevation	Aspect	Slope	Northing	Easting	Wildlife Comments
LT 33 13	7844	320	15	5063337	735671	
LT 33 14	7901	90	25	5063168	735810	
LT 33 15	7892	300	28	5063130	735600	
LT 33 16	7898	90	25	5062960	735739	
LT 33 17	7822	105	20	5062757	735823	
LT 33 18	7790	246	31	5062786	735605	elk scat
LT 33 19	7713	244	21	5062579	735694	
LT 33 20	7708	114	10	5062410	735833	two ravens flying, deer scat
LT 33 21	7601	248	22	5062228	735710	
LT 33 22	7555	106	19	5062112	735896	deer scat
LT 33 23	7479	236	17	5062002	735706	elk scat
LT 33 24	7494	118	13	5061892	735903	
LT 33 25	7302	250	45	5061782	735713	deer scat and a visual on a spruce grouse
NF 82 1	7442	250	60	5063672	733787	
NF 82 2	7395	250	70	5063550	733849	
NF 82 3	7302	230	50	5063418	733811	
NF 112 1	7691	80	20	5061868	732439	
NF 112 2	7753	90	30	5061718	732436	
NF 112 3	7870	100	15	5061650	732303	
NF 112 4	7790	105	20	5061499	732307	

Spruce grouse (*Falcipennis canadensis*) in Lost Trail 33.

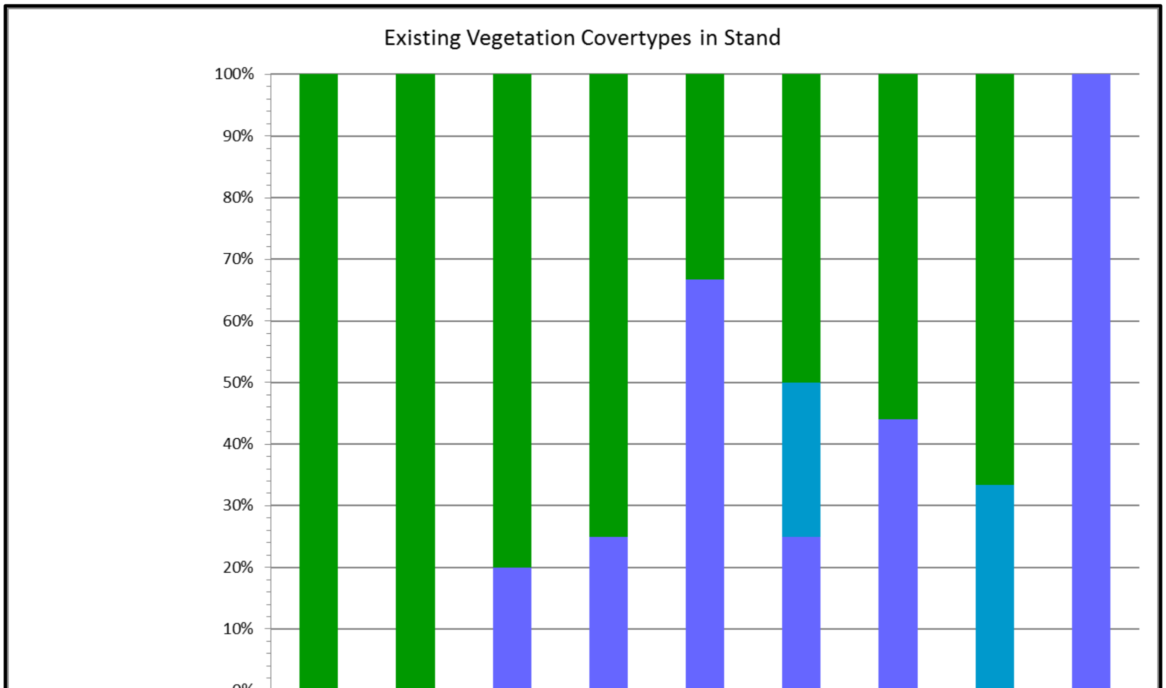
Snowshoe hare (*Lepus americanus*) tracks near Chief Joseph 137.

Appendix B contains cardinal direction photos taken at each plot, and Appendix C contains links to the complete inventory data, in two forms. The raw data is contained in a CSE file, readable by the USFS Exams-PC software, and suitable for collection of post-treatment monitoring data.

The original intention had been that data analysis would be conducted via queries once the data was uploaded to FSVeg, the nationwide database used by USFS to store vegetation inventory data. This proved not to be possible due to access issues, and so data was transferred to an Excel spreadsheet for analysis. This spreadsheet will also be suitable for future analysis of post-treatment data.

The following series of figures present relevant syntheses of data collected.

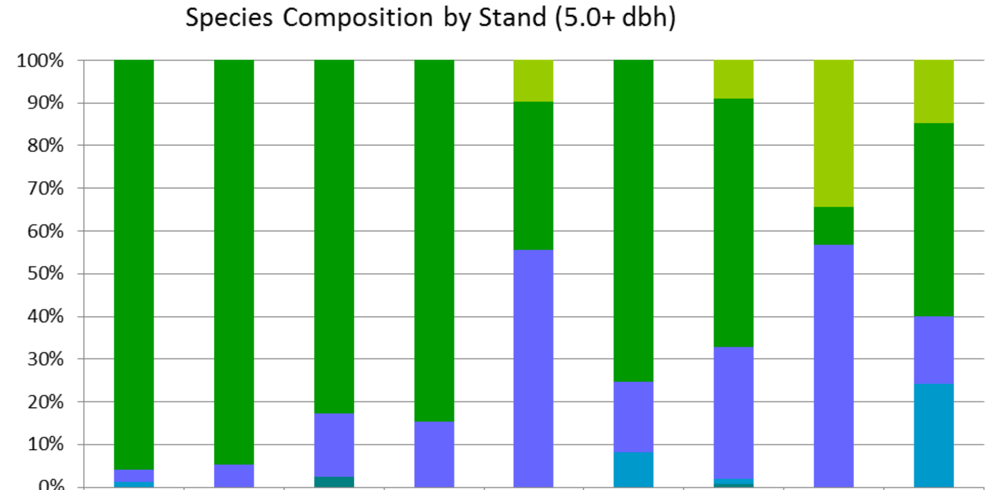
Figure 4 displays existing vegetation covertype, i.e., the dominant species within a stand. Only one covertype may be chosen per plot, so codominant species are not represented. Within the UNF area, the spruce-fir covertype generally indicates the presence of subalpine fir, with spruce as a minor component, other than in the drainage bottoms.



Number of Plots	Anderson Mtn 25	Anderson Mtn 28	Chief Joseph 137	Lost Trail 28	Lost Trail 29	Lost Trail 30	Lost Trail 33	North Fork 82	North Fork 112
Lodgepole Pine	7	3	8	3	2	2	14	2	0
Douglas-Fir	0	0	0	0	0	1	0	1	0
Engelmann Spruce-Subalpine Fir	0	0	2	1	4	1	11	0	4

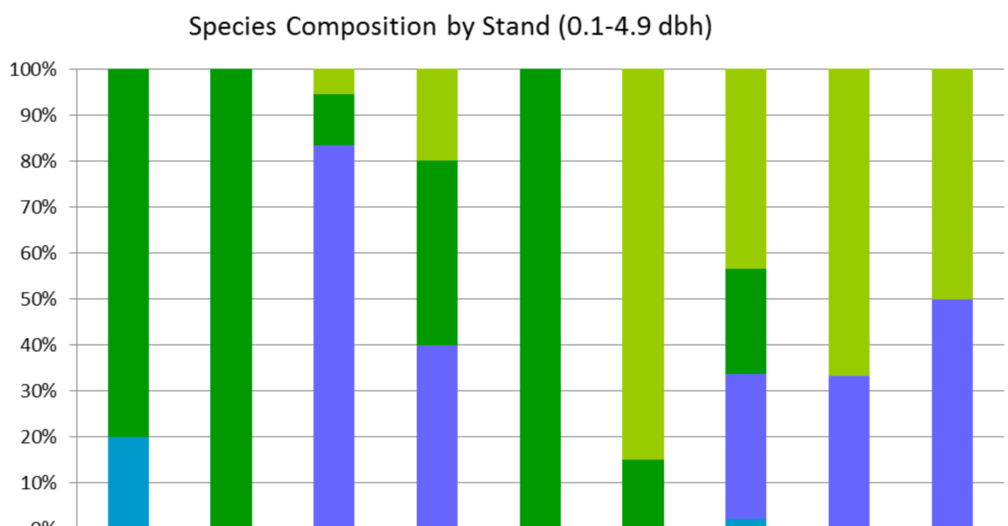
Figure 4. Existing Vegetation Covertype

Figures 5, 6, and 7 display species composition by stand and by size class, i.e., for mature trees, saplings, and seedlings. Species composition for mature trees is displayed for both live and dead trees; however data was only collected on live sapling and seedlings in the micro plot.



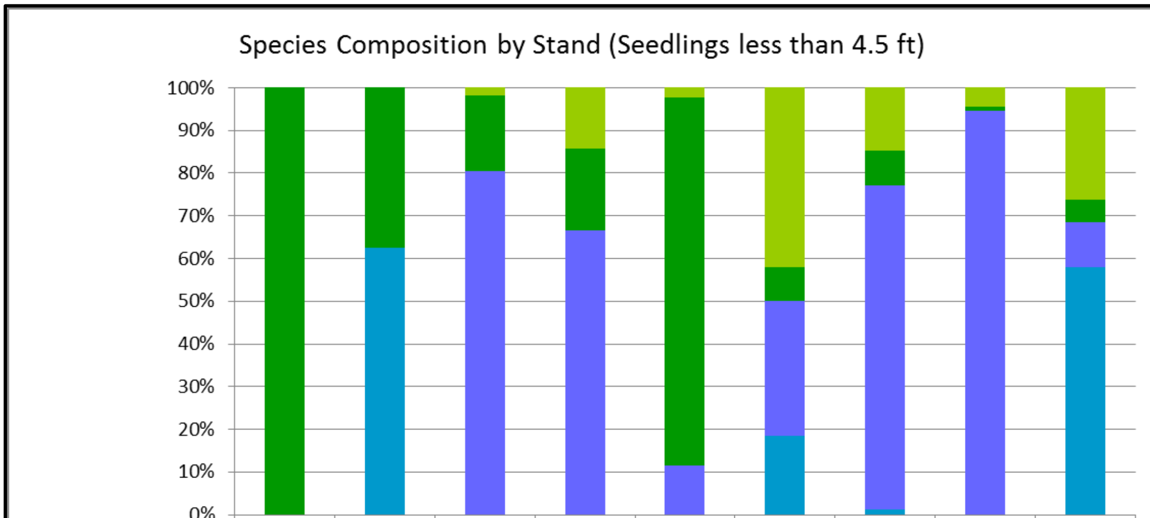
	Anderson Mtn 25	Anderson Mtn 28	Chief Joseph 137	Lost Trail 28	Lost Trail 29	Lost Trail 30	Lost Trail 33	North Fork 112	North Fork 82
Whitebark Pine	0.0%	0.0%	0.0%	0.0%	9.7%	0.0%	9.1%	34.3%	14.7%
Lodgepole Pine	95.9%	94.7%	82.7%	84.8%	34.7%	75.3%	58.2%	9.1%	45.2%
Subalpine Fir	2.9%	5.3%	14.8%	15.2%	55.6%	16.4%	30.8%	56.7%	15.9%
Douglas-Fir	1.2%	0.0%	0.0%	0.0%	0.0%	8.3%	1.3%	0.0%	24.2%
Engelmann Spruce	0.0%	0.0%	2.4%	0.0%	0.0%	0.0%	0.6%	0.0%	0.0%

Figure 5. Species Composition by Stand (dbh 5 inches and greater)



	Anderson Mtn 25	Anderson Mtn 28	Chief Joseph 137	Lost Trail 28	Lost Trail 29	Lost Trail 30	Lost Trail 33	North Fork 112	North Fork 82
Whitebark Pine	0.0%	0.0%	5.6%	20.0%	0.0%	85.0%	43.5%	66.7%	50.0%
Lodgepole Pine	80.0%	100.0%	11.1%	40.0%	100.0%	15.0%	22.8%	0.0%	0.0%
Subalpine Fir	0.0%	0.0%	83.3%	40.0%	0.0%	0.0%	31.5%	33.3%	50.0%
Douglas-Fir	20.0%	0.0%	0.0%	0.0%	0.0%	0.0%	2.2%	0.0%	0.0%

Figure 6. Species Composition by Stand (Saplings less than 5 inches dbh)

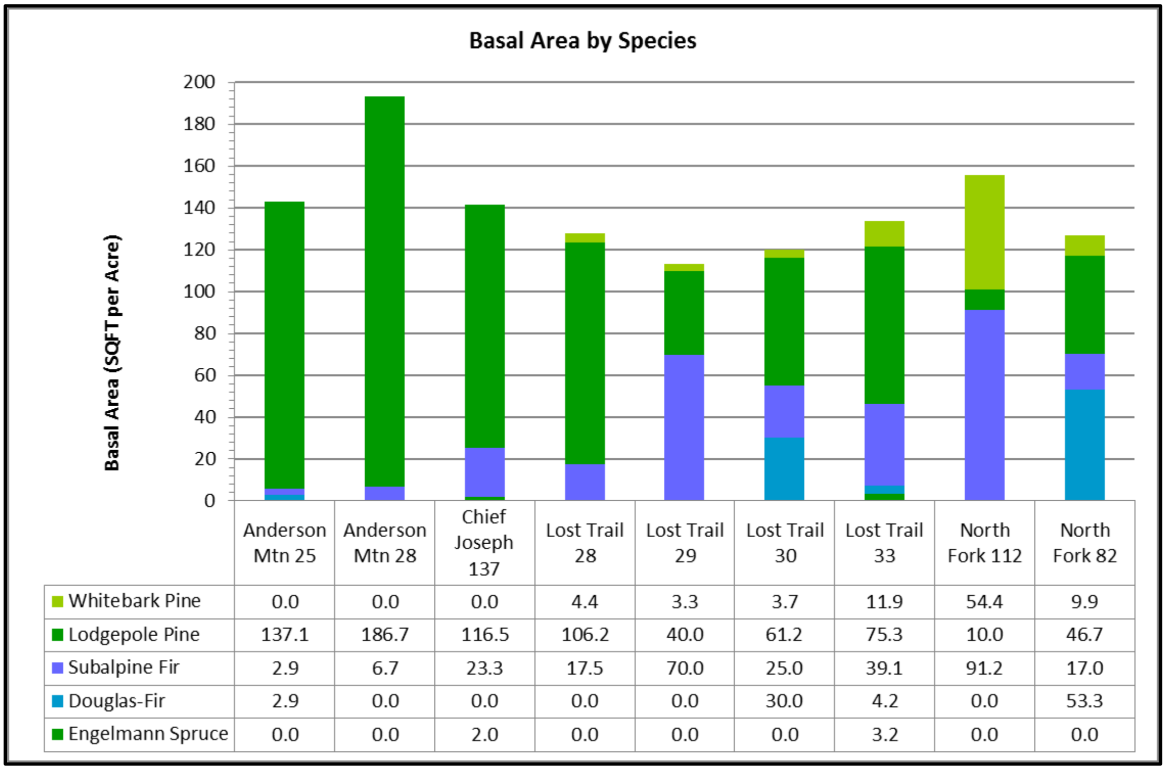


	Anderson Mtn 25	Anderson Mtn 28	Chief Joseph 137	Lost Trail 28	Lost Trail 29	Lost Trail 30	Lost Trail 33	North Fork 112	North Fork 82
Whitebark Pine	0.0%	0.0%	1.8%	14.3%	2.3%	42.1%	14.6%	4.5%	26.3%
Lodgepole Pine	100.0%	37.5%	17.6%	19.0%	86.0%	7.9%	8.2%	0.8%	5.3%
Subalpine Fir	0.0%	0.0%	80.6%	66.7%	11.6%	31.6%	75.9%	94.7%	10.5%
Douglas-Fir	0.0%	62.5%	0.0%	0.0%	0.0%	18.4%	1.2%	0.0%	57.9%
Engelmann Spruce	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%

Figure 7. Species Composition by Stand (Seedlings less than 4.5 feet in height)

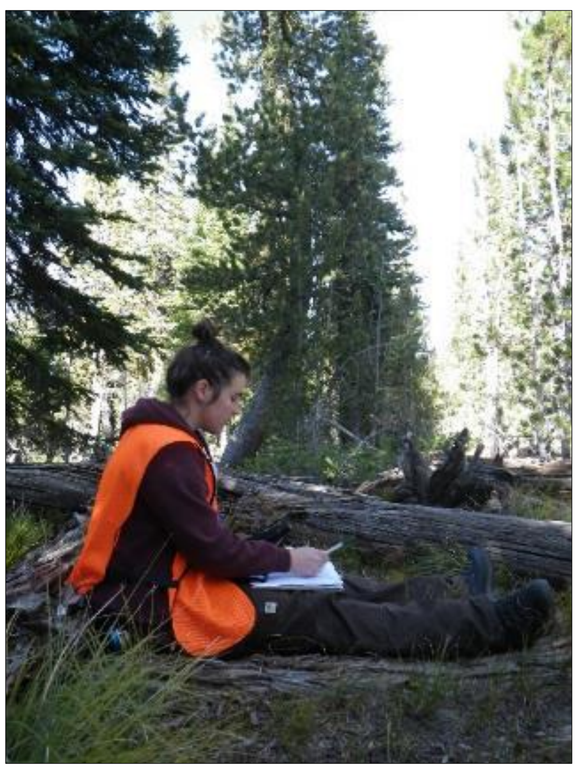
Determining age of a lodgepole pine by coring the tree.

Figure 8 displays stand density, by calculating the basal area in square feet per acre, by species. Stand density is commonly calculated for trees of dbh 3 inches and greater.



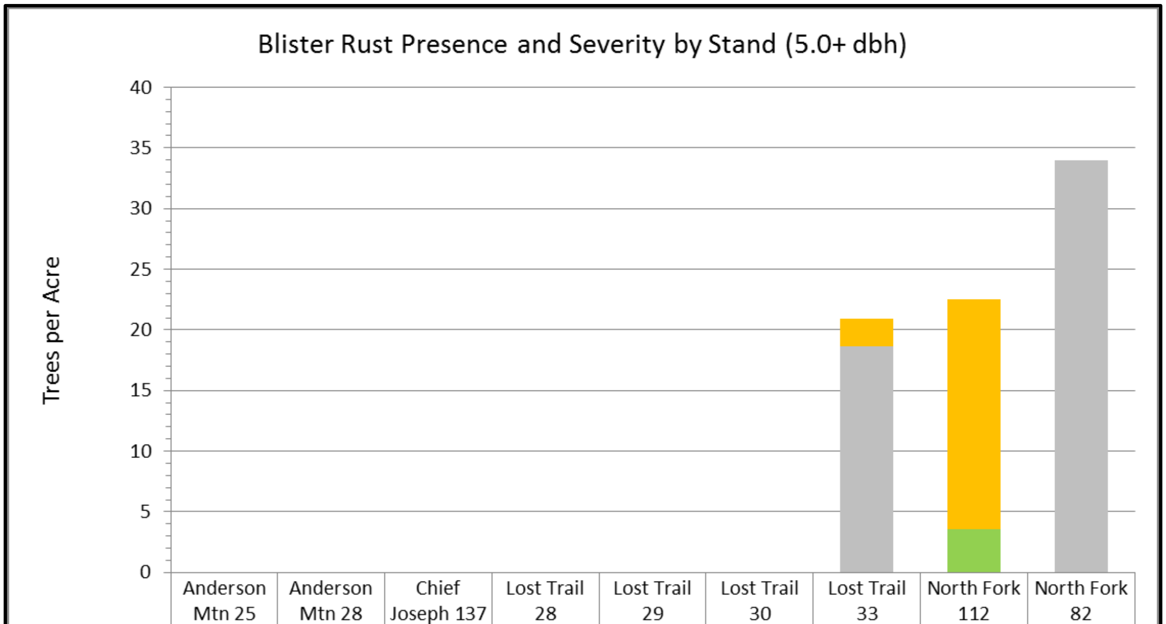
	Anderson Mtn 25	Anderson Mtn 28	Chief Joseph 137	Lost Trail 28	Lost Trail 29	Lost Trail 30	Lost Trail 33	North Fork 112	North Fork 82
Whitebark Pine	0.0	0.0	0.0	4.4	3.3	3.7	11.9	54.4	9.9
Lodgepole Pine	137.1	186.7	116.5	106.2	40.0	61.2	75.3	10.0	46.7
Subalpine Fir	2.9	6.7	23.3	17.5	70.0	25.0	39.1	91.2	17.0
Douglas-Fir	2.9	0.0	0.0	0.0	0.0	30.0	4.2	0.0	53.3
Engelmann Spruce	0.0	0.0	2.0	0.0	0.0	0.0	3.2	0.0	0.0

Figure 8. Basal Area per Stand by Species



Keeping count while a coworker calls out seedlings in the micro plot.

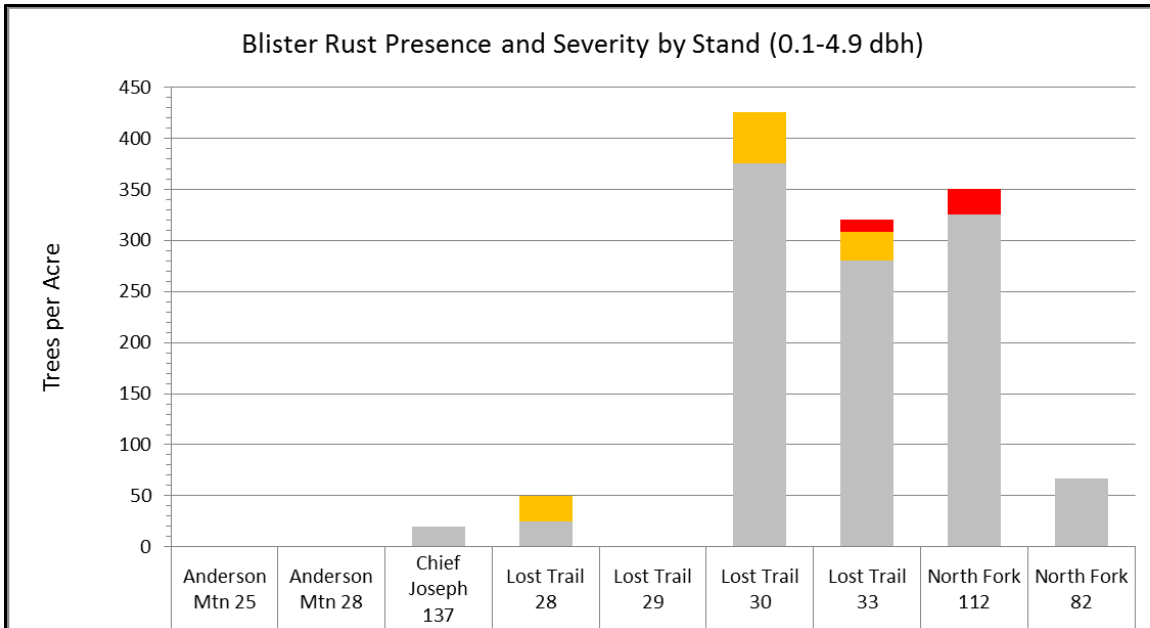
Figures 9, 10, and 11 display levels of blister rust on live trees within stands by size class, i.e., mature trees, saplings, and seedlings. Data was collected on live trees only in the micro plot, and therefore blister rust levels are somewhat underrepresented, despite being observably relatively low. An additional blister rust-killed sapling was noted in a plot in North Fork 112, and the live saplings tallied with severe blister rust will likely succumb in the future.



	Anderson Mtn 25	Anderson Mtn 28	Chief Joseph 137	Lost Trail 28	Lost Trail 29	Lost Trail 30	Lost Trail 33	North Fork 112	North Fork 82
Severe	0	0	0	0	0	0	0	0	0
Moderate	0	0	0	0	0	0	2	19	0
Low	0	0	0	0	0	0	0	4	0
Unaffected	0	0	0	0	0	0	19	0	34

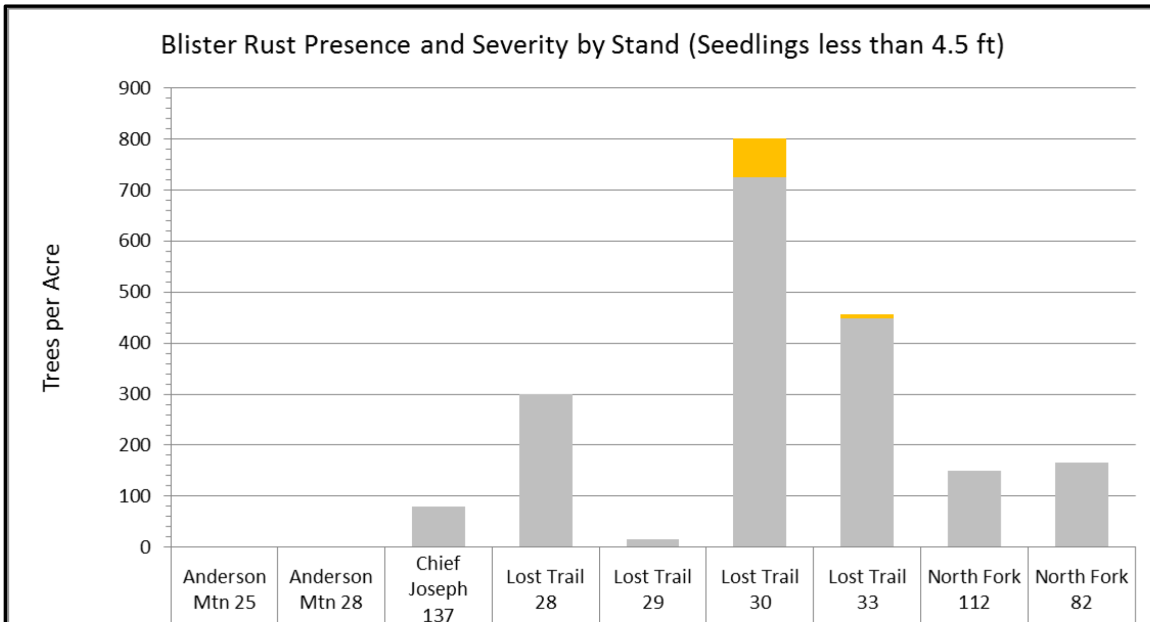
Figure 9. White Pine Blister Rust Presence and Severity by Stand (dbh 5 inches and greater).

Whitebark pine in North Fork 112.



	Anderson Mtn 25	Anderson Mtn 28	Chief Joseph 137	Lost Trail 28	Lost Trail 29	Lost Trail 30	Lost Trail 33	North Fork 112	North Fork 82
Severe	0	0	0	0	0	0	12	25	0
Moderate	0	0	0	25	0	50	28	0	0
Low	0	0	0	0	0	0	0	0	0
Unaffected	0	0	20	25	0	375	280	325	67

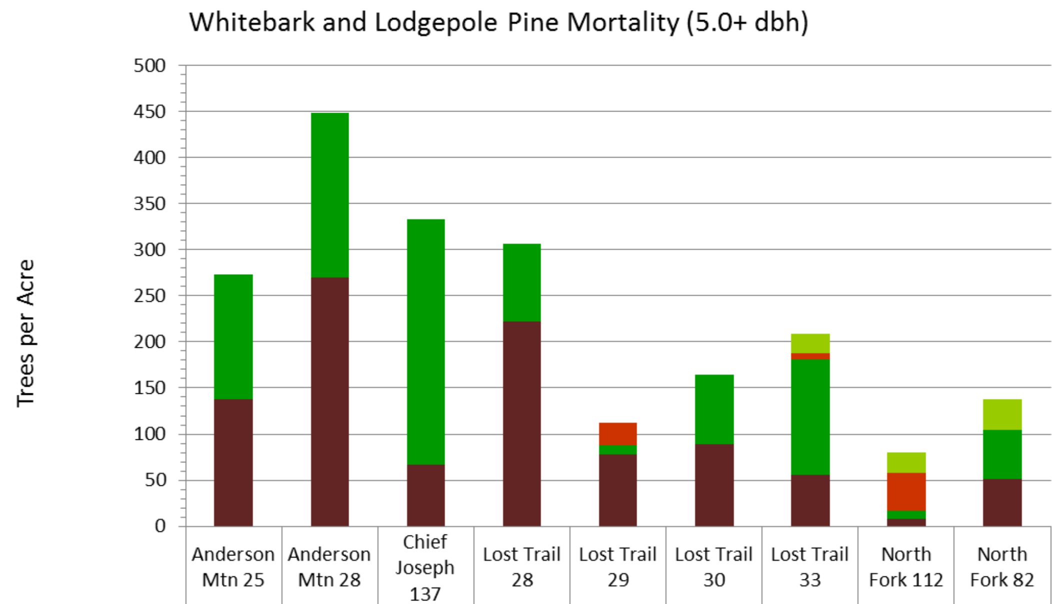
Figure 10. White Pine Blister Rust Presence and Severity by Stand (Saplings less than 5 inches dbh)



	Anderson Mtn 25	Anderson Mtn 28	Chief Joseph 137	Lost Trail 28	Lost Trail 29	Lost Trail 30	Lost Trail 33	North Fork 112	North Fork 82
Severe	0	0	0	0	0	0	0	0	0
Moderate	0	0	0	0	0	75	8	0	0
Low	0	0	0	0	0	0	0	0	0
Unaffected	0	0	80	300	17	725	448	150	167

Figure 11. White Pine Blister Rust Presence and Severity by Stand (Seedlings less than 4.5 feet high)

Figure 12 displays mortality levels in lodgepole and whitebark pines, primarily due to mountain pine beetle. The great majority of trees in the burned stands (Lost Trail 28 and 29) showed signs of lethal beetle attack prior to the fire.



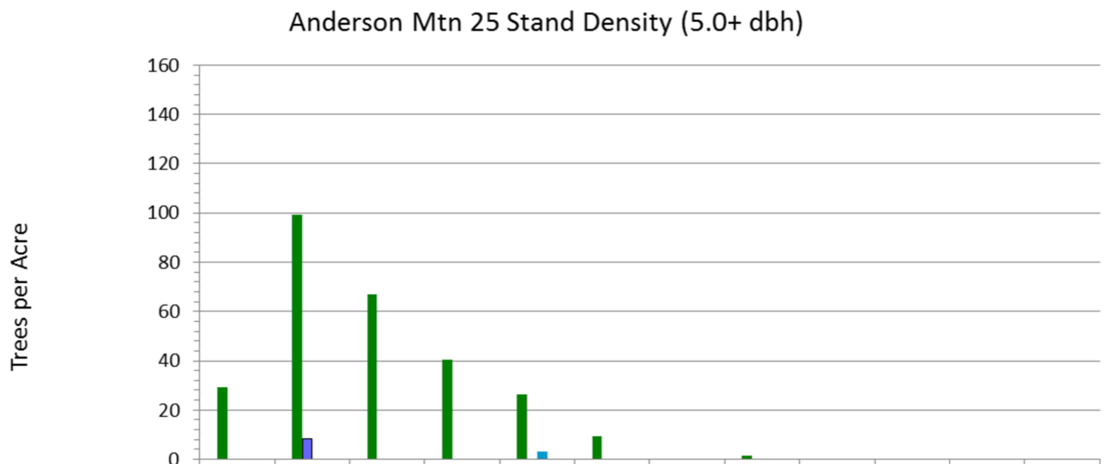
	Anderson Mtn 25	Anderson Mtn 28	Chief Joseph 137	Lost Trail 28	Lost Trail 29	Lost Trail 30	Lost Trail 33	North Fork 112	North Fork 82
Whitebark Pine - Live	0	0	0	0	0	0	21	22	34
Whitebark Pine - Dead	0	0	0	0	24	0	7	41	0
Lodgepole Pine - Live	135	179	266	84	10	76	125	9	54
Lodgepole Pine - Dead	138	270	67	222	77	89	56	8	51

Figure 12. Whitebark and Lodgepole Pine Mortality (dbh 5 inches and greater)

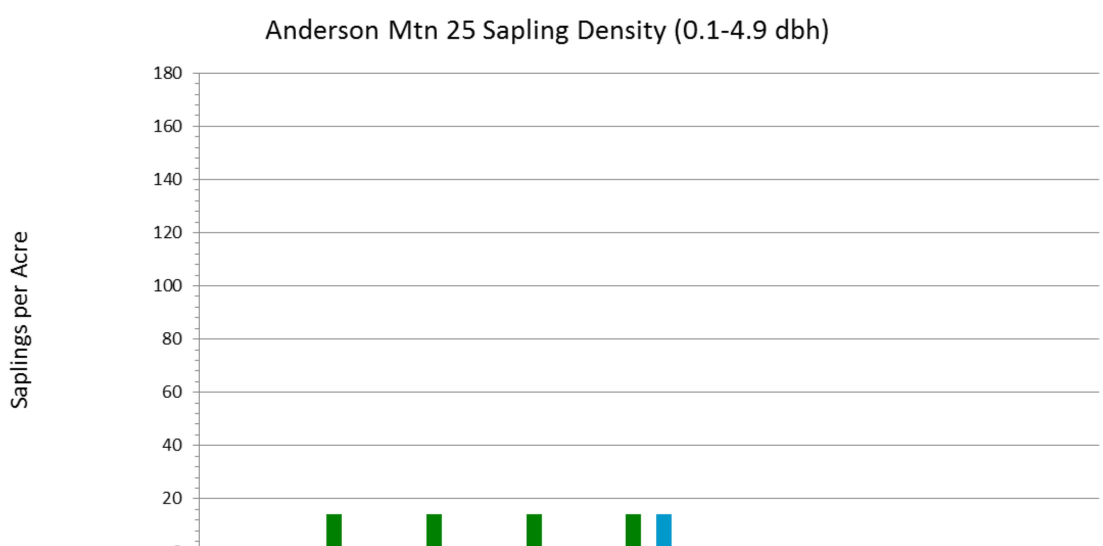
One of the primary goals of long-term monitoring on whitebark pine within treatment stands, is to determine if successful recruitment into larger size classes occurs post-treatment. Therefore the following figures display numbers of trees per acre by size classes and species for each individual stand.

Due to the considerable differences in numbers per acre for seedlings, saplings, and mature trees, 3 figures are provided per stand to adequately display the data. For comparison between stands, all figures display the same scale, regardless of the density within a particular stand.

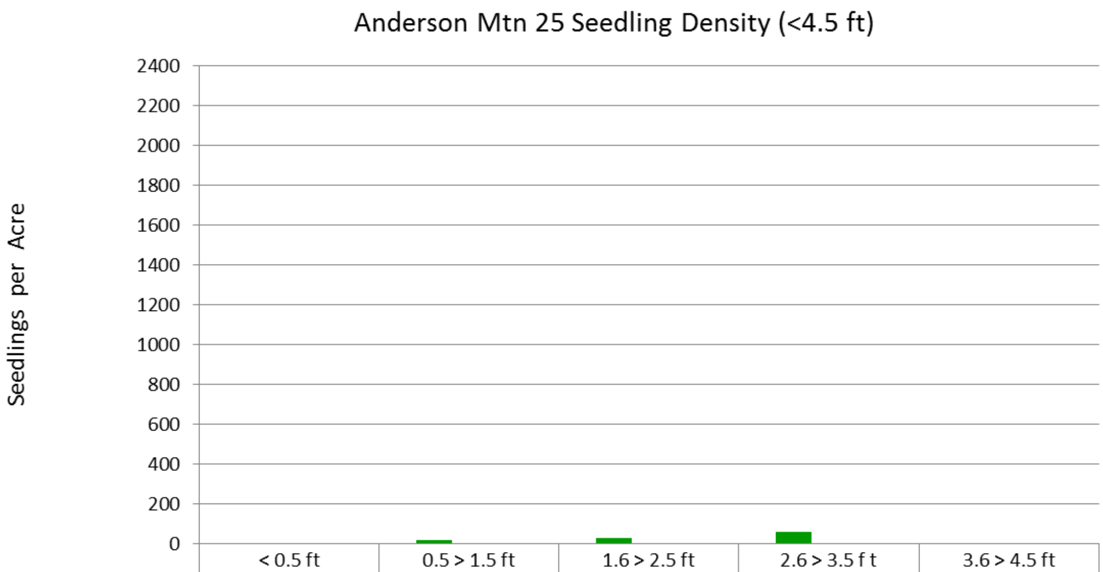
Anderson Mountain 25



	5-6	7-8	9-10	11-12	13-14	15-16	17-18	19-20	21-22	27-28	33-34	37-38
Whitebark Pine	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lodgepole Pine	29.1	99.1	66.9	40.5	26.5	9.3	0.0	1.5	0.0	0.0	0.0	0.0
Subalpine Fir	0.0	8.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Douglas-Fir	0.0	0.0	0.0	0.0	3.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Engelmann Spruce	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Unknown	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

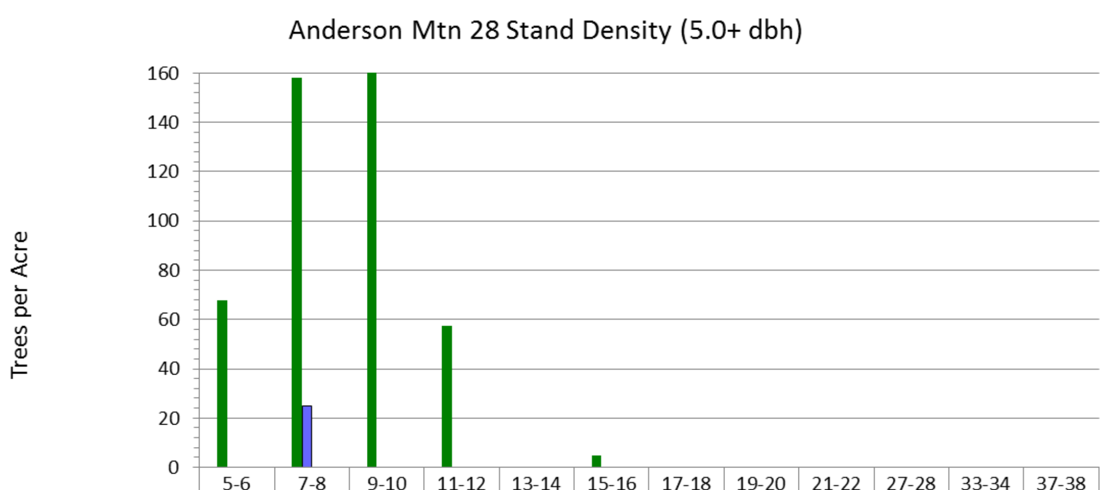


	0.5	1	1.5	2	2.5	3	3.5	4	4.5
Whitebark Pine	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lodgepole Pine	0.0	14.3	14.3	14.3	14.3	0.0	0.0	0.0	0.0
Subalpine Fir	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Douglas-Fir	0.0	0.0	0.0	0.0	14.3	0.0	0.0	0.0	0.0
Engelmann Spruce	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0



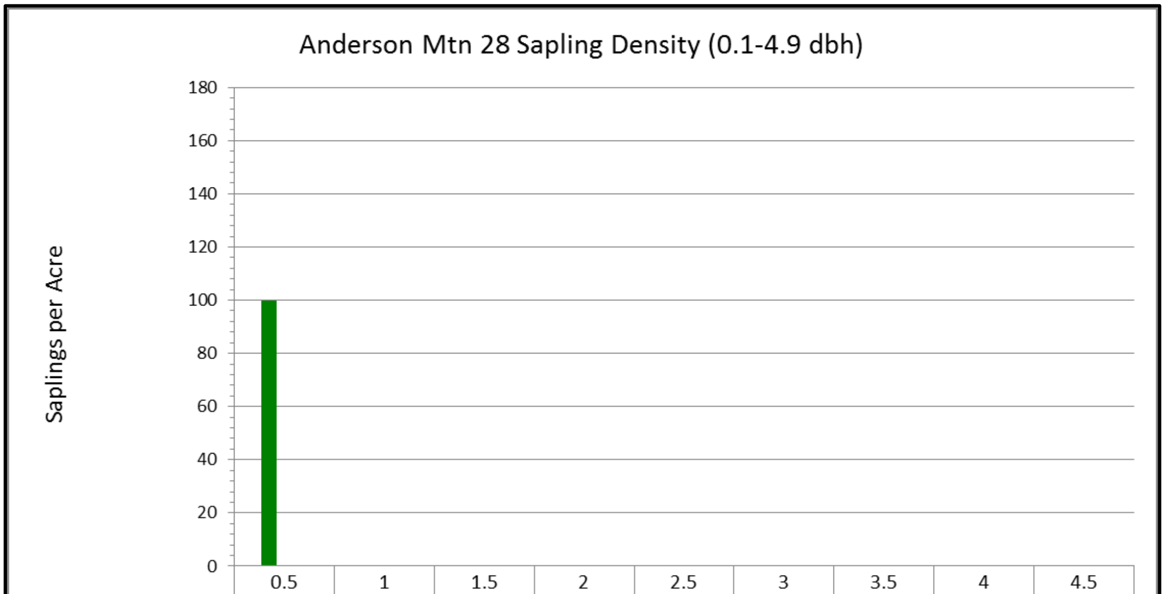
	< 0.5 ft	0.5 > 1.5 ft	1.6 > 2.5 ft	2.6 > 3.5 f t	3.6 > 4.5 ft
Whitebark Pine	0	0	0	0	0
Lodgepole Pine	0	14	29	57	0
Subalpine Fir	0	0	0	0	0
Douglas-Fir	0	0	0	0	0
Engelmann Spruce	0	0	0	0	0

Anderson Mountain 28

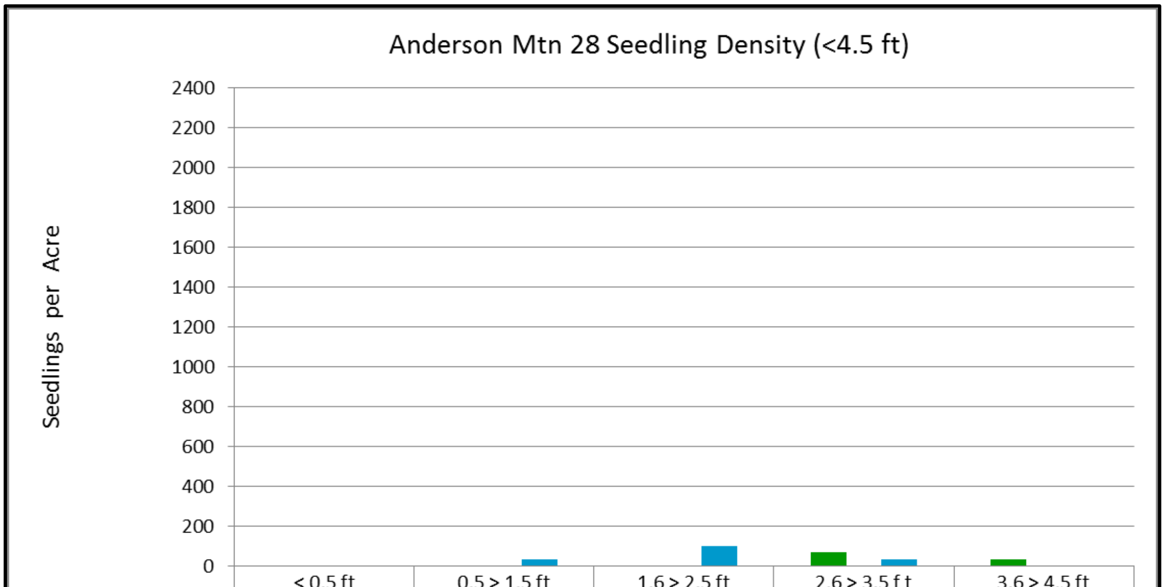


	5-6	7-8	9-10	11-12	13-14	15-16	17-18	19-20	21-22	27-28	33-34	37-38
Whitebark Pine	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lodgepole Pine	67.9	158.3	160.5	57.4	0.0	4.8	0.0	0.0	0.0	0.0	0.0	0.0
Subalpine Fir	0.0	24.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Douglas-Fir	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Engelmann Spruce	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Unknown	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Density by Species and Diameter Class (Inches)



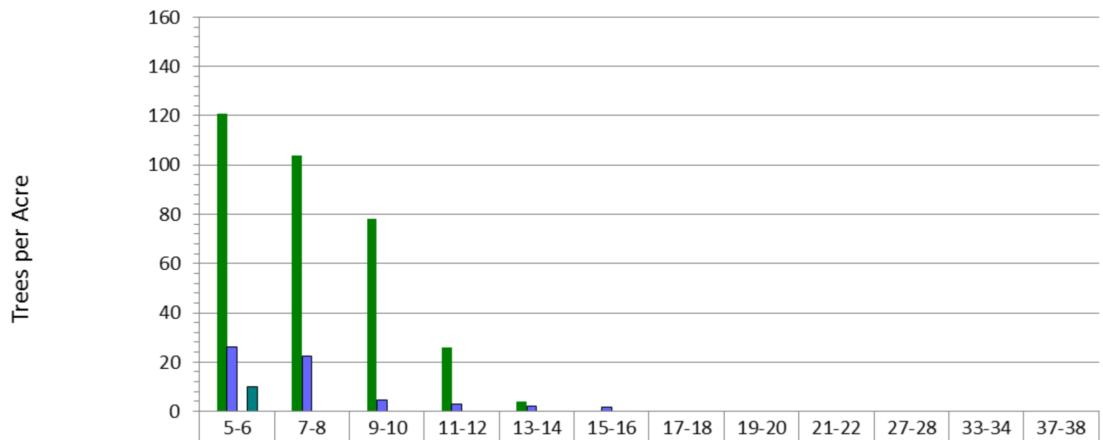
	0.5	1	1.5	2	2.5	3	3.5	4	4.5
Whitebark Pine	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lodgepole Pine	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Subalpine Fir	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Douglas-Fir	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Engelmann Spruce	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0



	< 0.5 ft	0.5 > 1.5 ft	1.6 > 2.5 ft	2.6 > 3.5 f t	3.6 > 4.5 ft
Whitebark Pine	0	0	0	0	0
Lodgepole Pine	0	0	0	67	33
Subalpine Fir	0	0	0	0	0
Douglas-Fir	0	33	100	33	0
Engelmann Spruce	0	0	0	0	0

Chief Joseph 137

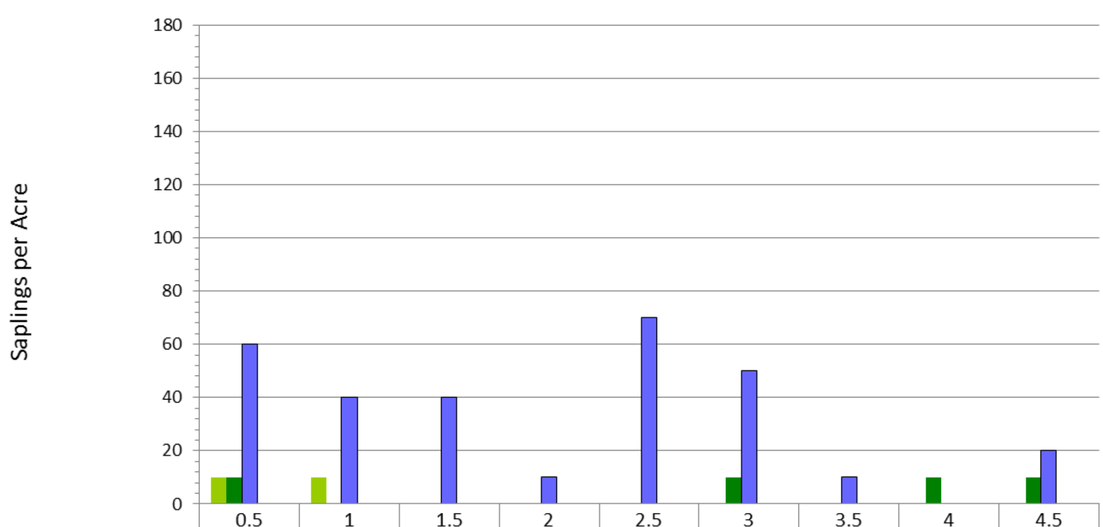
Chief Joseph 137 Stand Density (5.0+ dbh)



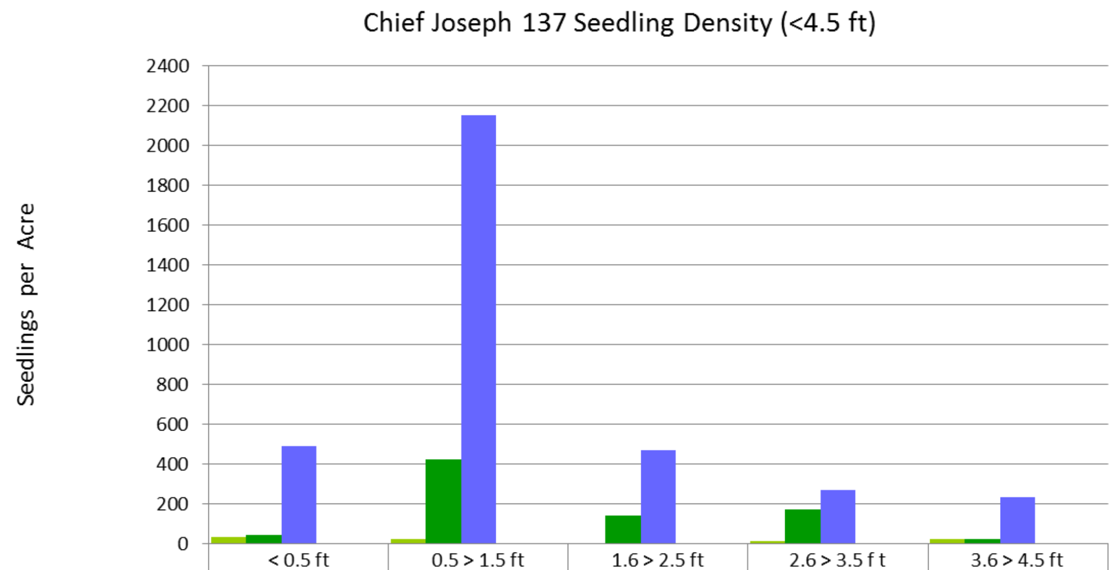
	5-6	7-8	9-10	11-12	13-14	15-16	17-18	19-20	21-22	27-28	33-34	37-38
Whitebark Pine	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lodgepole Pine	121.0	103.8	78.2	25.8	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Subalpine Fir	26.0	22.2	4.5	3.0	2.2	1.6	0.0	0.0	0.0	0.0	0.0	0.0
Douglas-Fir	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Engelmann Spruce	9.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Unknown	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Density by Species and Diameter Class (Inches)

Chief Joseph 137 Sapling Density (0.1-4.9 dbh)

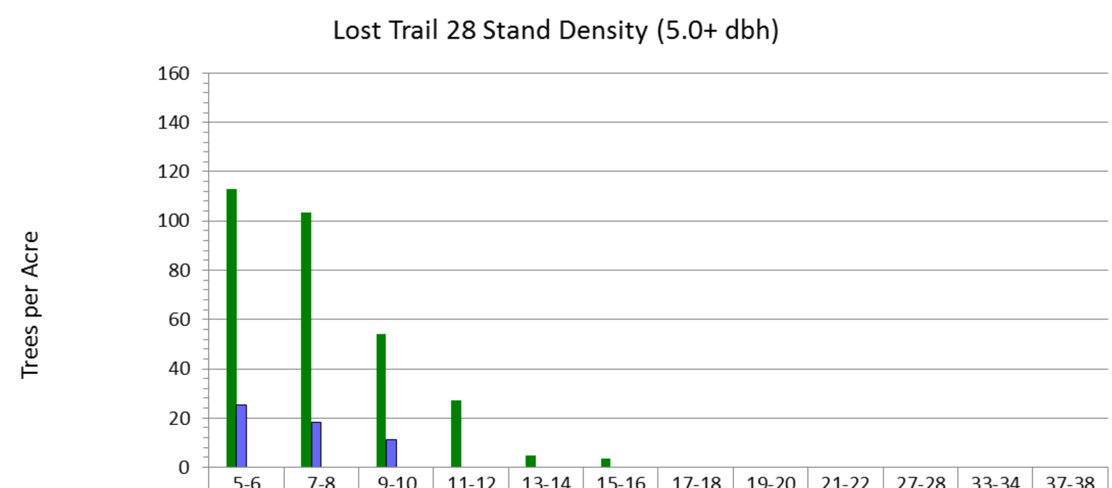


	0.5	1	1.5	2	2.5	3	3.5	4	4.5
Whitebark Pine	10.0	10.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lodgepole Pine	10.0	0.0	0.0	0.0	0.0	10.0	0.0	10.0	10.0
Subalpine Fir	60.0	40.0	40.0	10.0	70.0	50.0	10.0	0.0	20.0
Douglas-Fir	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Engelmann Spruce	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0



	< 0.5 ft	0.5 > 1.5 ft	1.6 > 2.5 ft	2.6 > 3.5 f t	3.6 > 4.5 ft
Whitebark Pine	30	20	0	10	20
Lodgepole Pine	40	420	140	170	20
Subalpine Fir	490	2150	470	270	230
Douglas-Fir	0	0	0	0	0
Engelmann Spruce	0	0	0	0	0

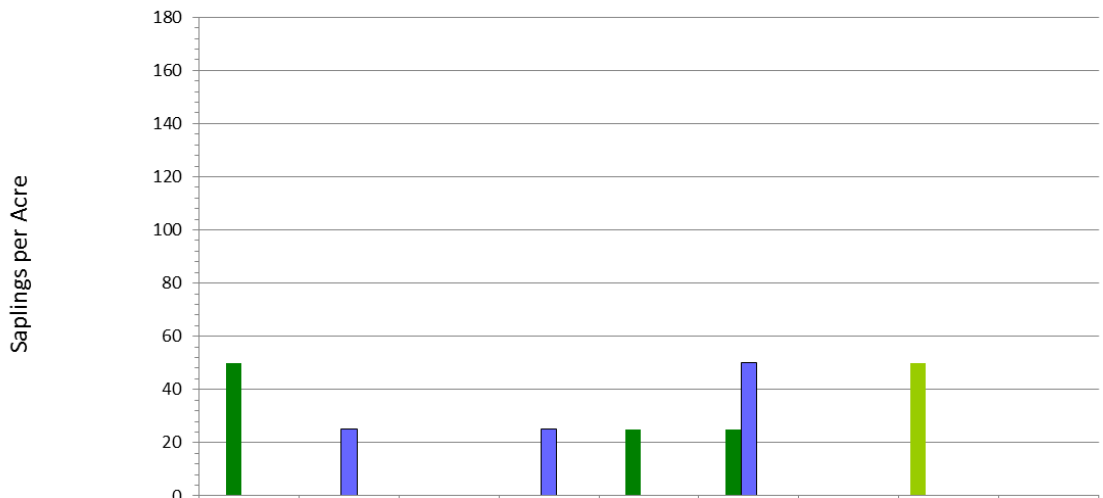
Lost Trail 28



	5-6	7-8	9-10	11-12	13-14	15-16	17-18	19-20	21-22	27-28	33-34	37-38
Whitebark Pine	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lodgepole Pine	113.1	103.5	54.2	27.1	4.7	3.6	0.0	0.0	0.0	0.0	0.0	0.0
Subalpine Fir	25.5	18.2	11.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Douglas-Fir	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Engelmann Spruce	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Unknown	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

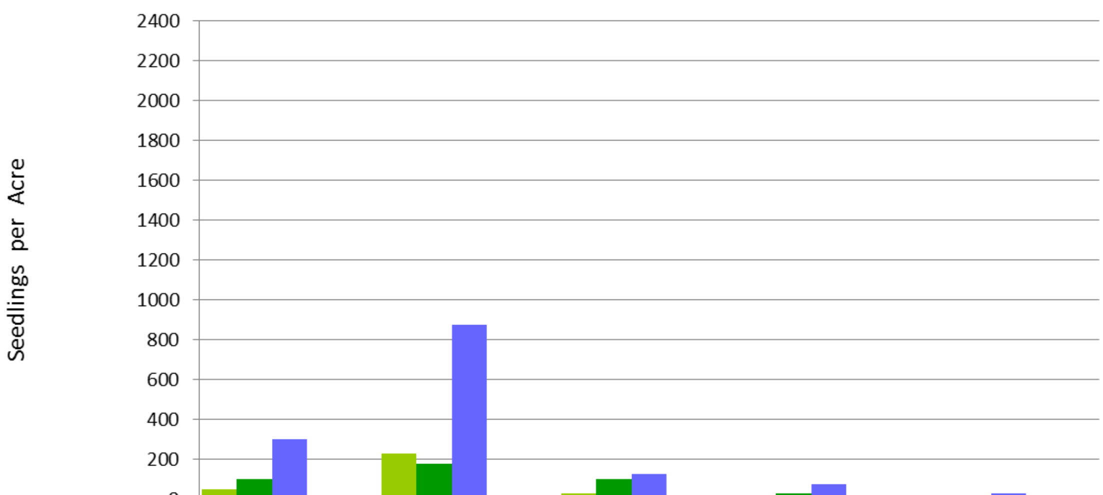
Density by Species and Diameter Class (Inches)

Lost Trail 28 Sapling Density (0.1-4.9 dbh)



	0.5	1	1.5	2	2.5	3	3.5	4	4.5
Whitebark Pine	0.0	0.0	0.0	0.0	0.0	0.0	0.0	50.0	0.0
Lodgepole Pine	50.0	0.0	0.0	0.0	25.0	25.0	0.0	0.0	0.0
Subalpine Fir	0.0	25.0	0.0	25.0	0.0	50.0	0.0	0.0	0.0
Douglas-Fir	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Engelmann Spruce	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

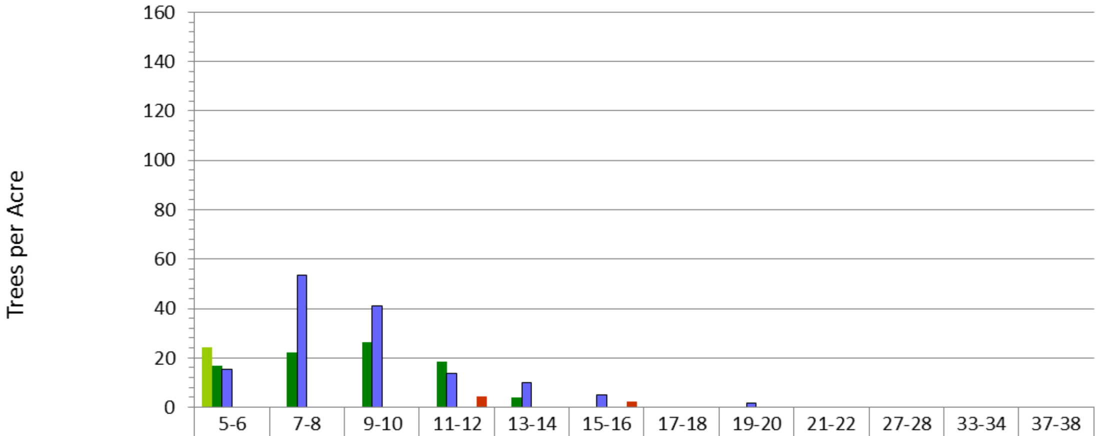
Lost Trail 28 Seedling Density (<4.5 ft)



	< 0.5 ft	0.5 > 1.5 ft	1.6 > 2.5 ft	2.6 > 3.5 f t	3.6 > 4.5 ft
Whitebark Pine	50	225	25	0	0
Lodgepole Pine	100	175	100	25	0
Subalpine Fir	300	875	125	75	25
Douglas-Fir	0	0	0	0	0
Engelmann Spruce	0	0	0	0	0

Lost Trail 29

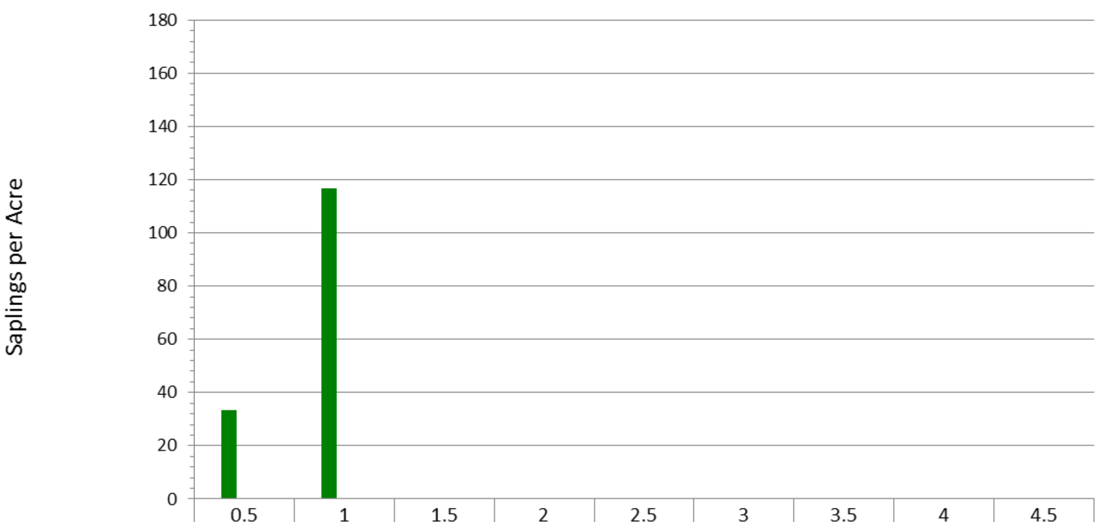
Lost Trail 29 Stand Density (5.0+ dbh)



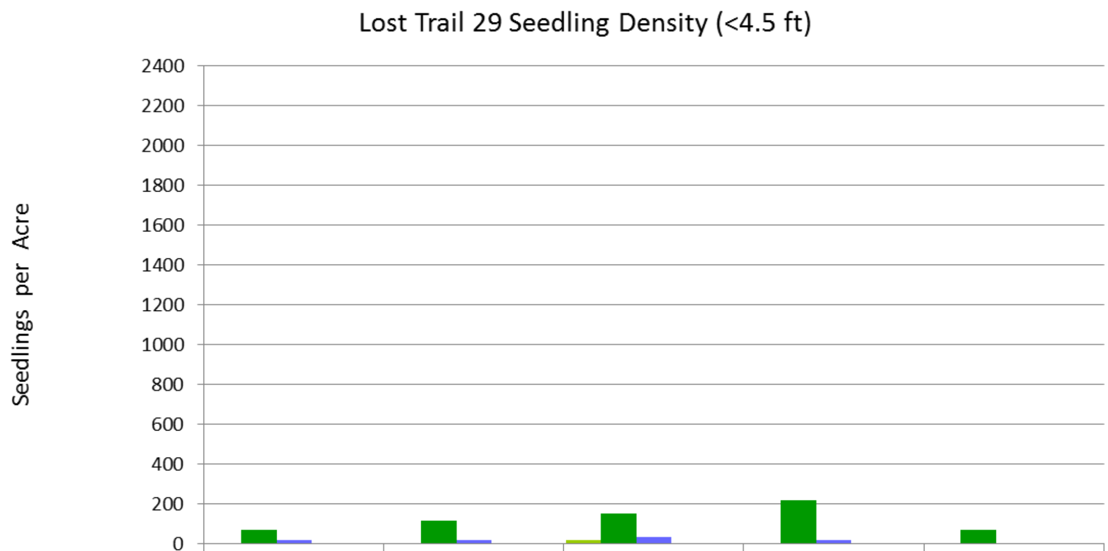
	5-6	7-8	9-10	11-12	13-14	15-16	17-18	19-20	21-22	27-28	33-34	37-38
Whitebark Pine	24.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lodgepole Pine	17.0	22.0	26.1	18.6	3.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Subalpine Fir	15.4	53.6	41.0	13.5	9.9	5.1	0.0	1.5	0.0	0.0	0.0	0.0
Douglas-Fir	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Engelmann Spruce	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Unknown	0.0	0.0	0.0	4.2	0.0	2.4	0.0	0.0	0.0	0.0	0.0	0.0

Density by Species and Diameter Class (Inches)

Lost Trail 29 Sapling Density (0.1-4.9 dbh)

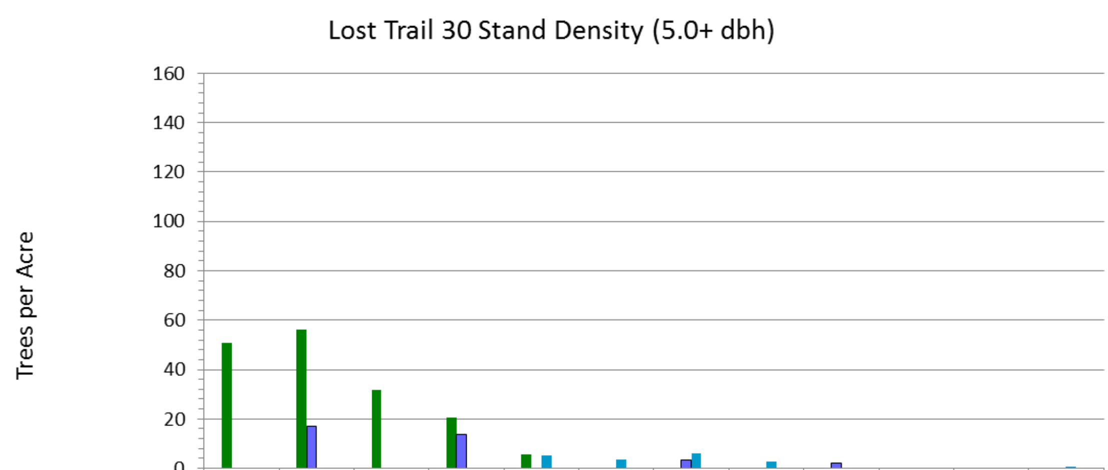


	0.5	1	1.5	2	2.5	3	3.5	4	4.5
Whitebark Pine	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lodgepole Pine	33.3	116.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Subalpine Fir	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Douglas-Fir	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Engelmann Spruce	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0



	< 0.5 ft	0.5 > 1.5 ft	1.6 > 2.5 ft	2.6 > 3.5 f t	3.6 > 4.5 ft
Whitebark Pine	0	0	17	0	0
Lodgepole Pine	67	117	150	217	67
Subalpine Fir	17	17	33	17	0
Douglas-Fir	0	0	0	0	0
Engelmann Spruce	0	0	0	0	0

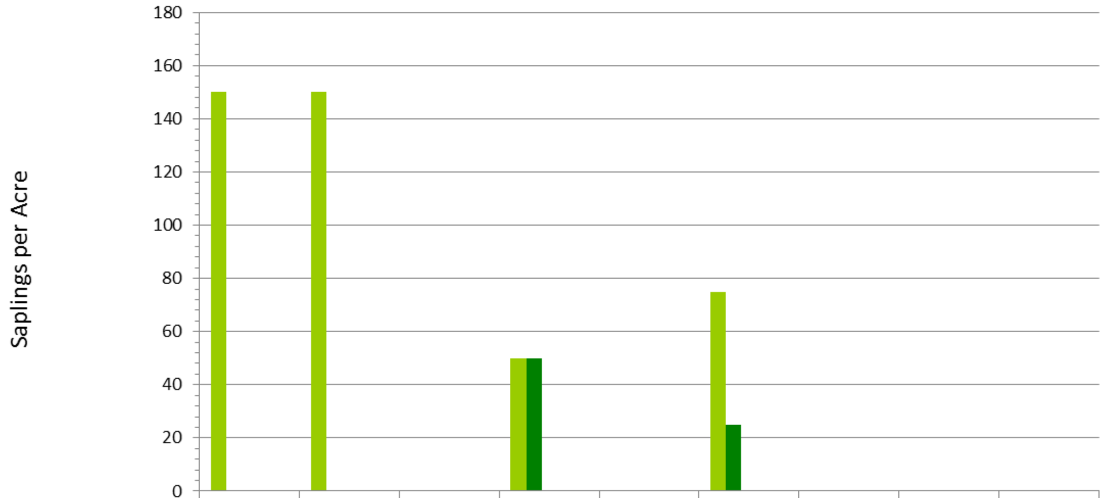
Lost Trail 30



	5-6	7-8	9-10	11-12	13-14	15-16	17-18	19-20	21-22	27-28	33-34	37-38
Whitebark Pine	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lodgepole Pine	50.9	56.1	31.8	20.5	5.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Subalpine Fir	0.0	17.2	0.0	13.5	0.0	0.0	3.2	0.0	2.1	0.0	0.0	0.0
Douglas-Fir	0.0	0.0	0.0	0.0	5.3	3.6	6.0	2.5	0.0	0.0	0.0	0.6
Engelmann Spruce	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Unknown	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

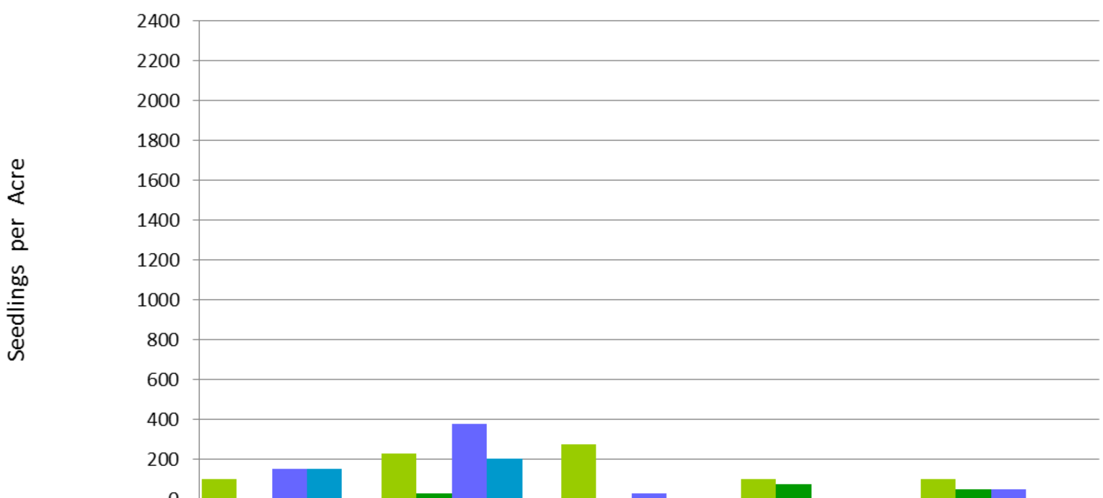
Density by Species and Diameter Class (Inches)

Lost Trail 30 Sapling Density (0.1-4.9 dbh)



	0.5	1	1.5	2	2.5	3	3.5	4	4.5
Whitebark Pine	150.0	150.0	0.0	50.0	0.0	75.0	0.0	0.0	0.0
Lodgepole Pine	0.0	0.0	0.0	50.0	0.0	25.0	0.0	0.0	0.0
Subalpine Fir	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Douglas-Fir	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Engelmann Spruce	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

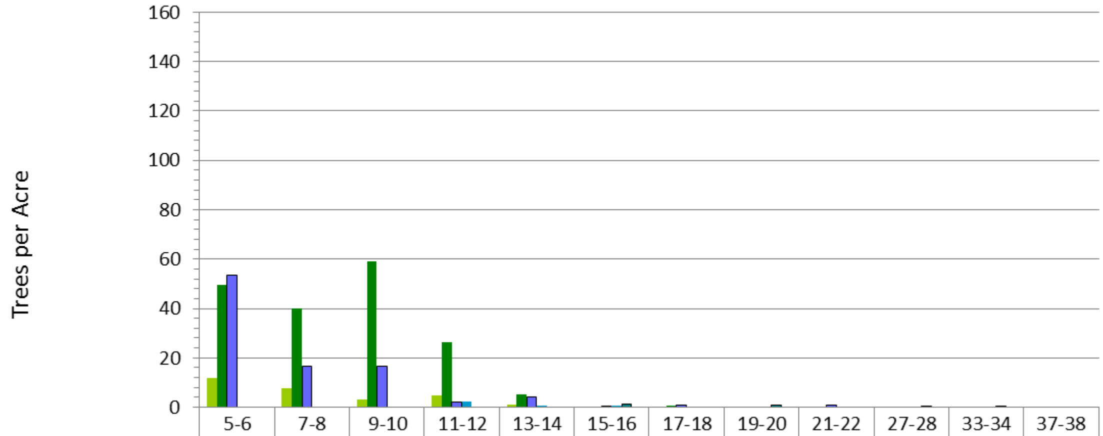
Lost Trail 30 Seedling Density (<4.5 ft)



	< 0.5 ft	0.5 > 1.5 ft	1.6 > 2.5 ft	2.6 > 3.5 f t	3.6 > 4.5 ft
Whitebark Pine	100	225	275	100	100
Lodgepole Pine	0	25	0	75	50
Subalpine Fir	150	375	25	0	50
Douglas-Fir	150	200	0	0	0
Engelmann Spruce	0	0	0	0	0

Lost Trail 33

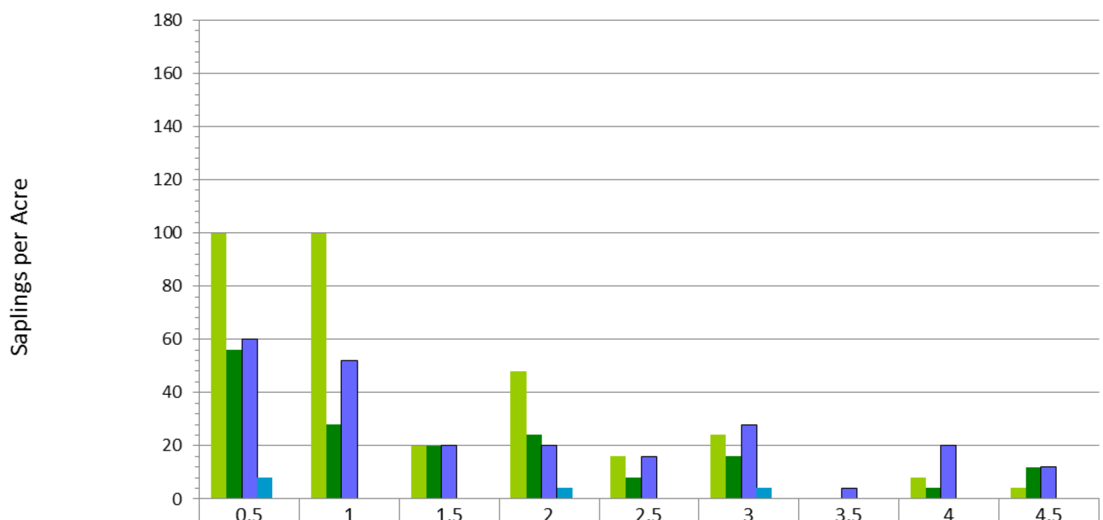
Lost Trail 33 Stand Density (5.0+ dbh)



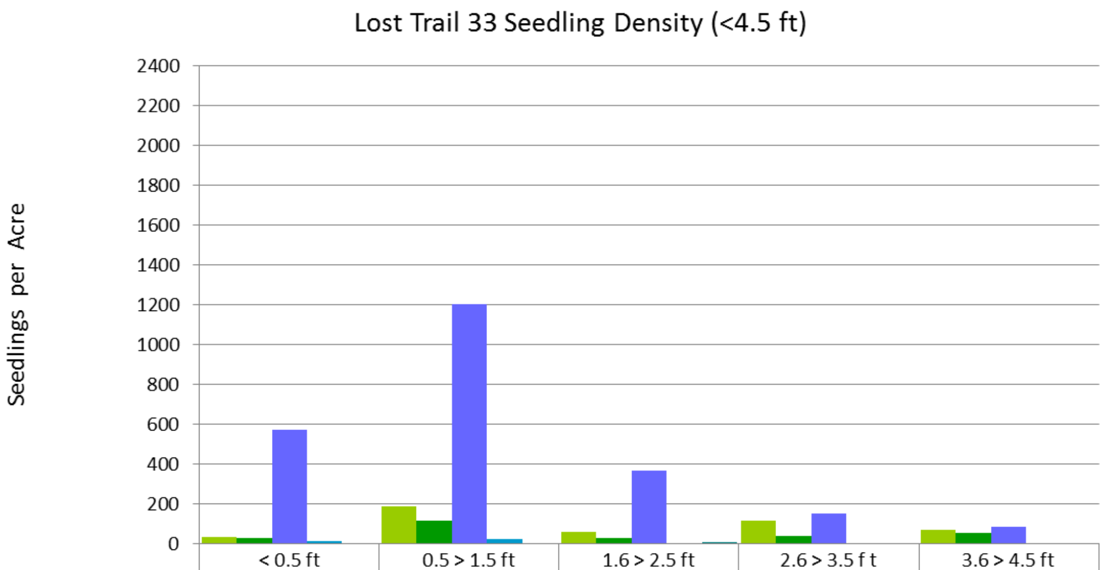
	5-6	7-8	9-10	11-12	13-14	15-16	17-18	19-20	21-22	27-28	33-34	37-38
Whitebark Pine	11.7	7.6	3.3	4.7	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lodgepole Pine	49.7	40.2	58.9	26.1	5.2	0.0	0.5	0.0	0.0	0.0	0.0	0.0
Subalpine Fir	53.4	16.7	16.7	2.2	3.9	0.6	1.0	0.0	0.7	0.0	0.0	0.0
Douglas-Fir	0.0	0.0	0.0	2.3	0.7	0.7	0.0	0.0	0.3	0.0	0.0	0.0
Engelmann Spruce	0.0	0.0	0.0	0.0	0.0	1.1	0.0	0.8	0.0	0.2	0.3	0.0
Unknown	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Density by Species and Diameter Class (Inches)

Lost Trail 33 Sapling Density (0.1-4.9 dbh)

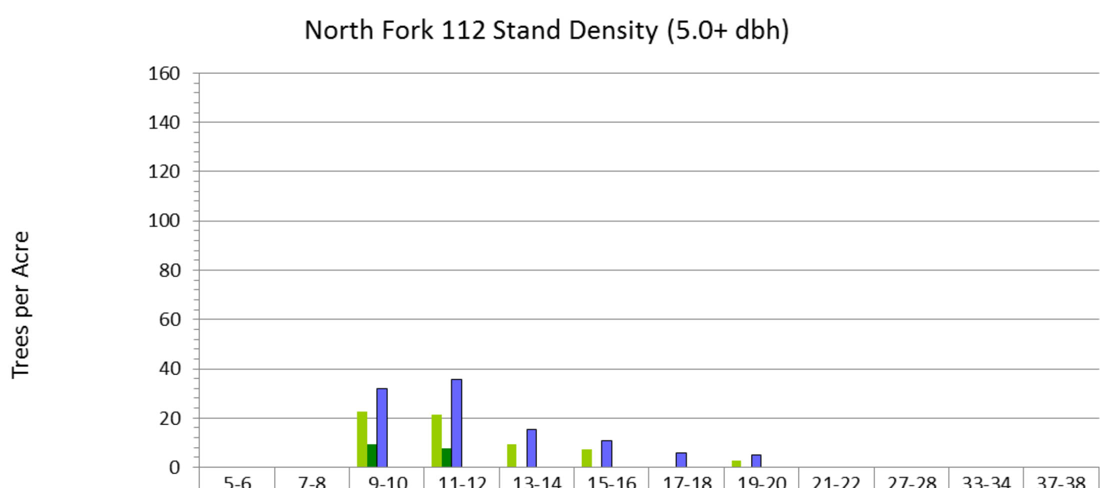


	0.5	1	1.5	2	2.5	3	3.5	4	4.5
Whitebark Pine	100.0	100.0	20.0	48.0	16.0	24.0	0.0	8.0	4.0
Lodgepole Pine	56.0	28.0	20.0	24.0	8.0	16.0	0.0	4.0	12.0
Subalpine Fir	60.0	52.0	20.0	20.0	16.0	28.0	4.0	20.0	12.0
Douglas-Fir	8.0	0.0	0.0	4.0	0.0	4.0	0.0	0.0	0.0
Engelmann Spruce	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0



	< 0.5 ft	0.5 > 1.5 ft	1.6 > 2.5 ft	2.6 > 3.5 ft	3.6 > 4.5 ft
Whitebark Pine	32	184	56	116	68
Lodgepole Pine	28	112	28	36	52
Subalpine Fir	572	1200	364	148	84
Douglas-Fir	12	24	0	0	0
Engelmann Spruce	0	0	4	0	0

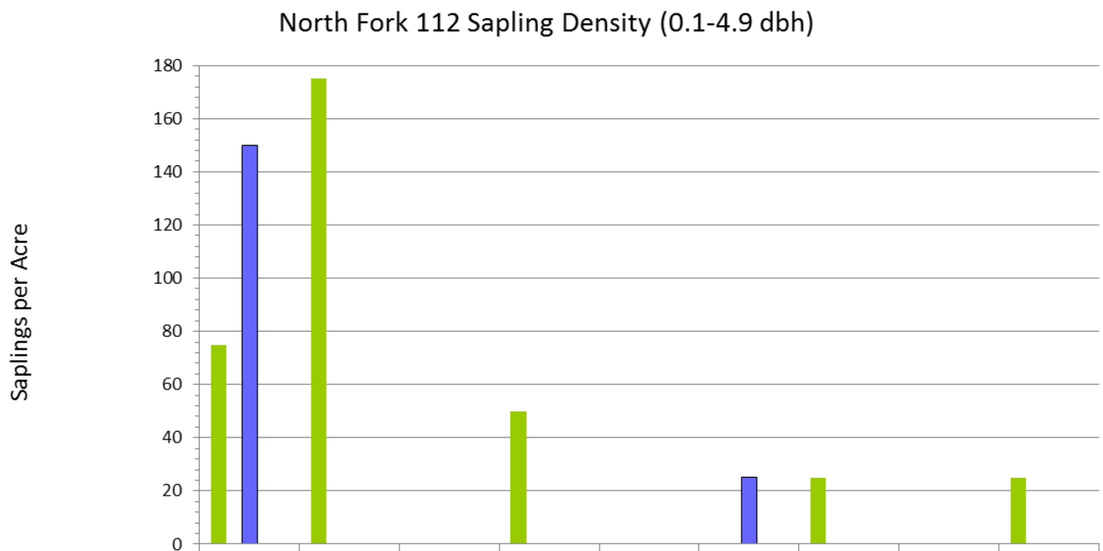
North Fork 112



	5-6	7-8	9-10	11-12	13-14	15-16	17-18	19-20	21-22	27-28	33-34	37-38
Whitebark Pine	0.0	0.0	22.6	21.5	9.4	7.2	0.0	2.5	0.0	0.0	0.0	0.0
Lodgepole Pine	0.0	0.0	9.2	7.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Subalpine Fir	0.0	0.0	31.8	35.5	15.5	10.7	6.0	5.1	0.0	0.0	0.0	0.0
Douglas-Fir	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Engelmann Spruce	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Unknown	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

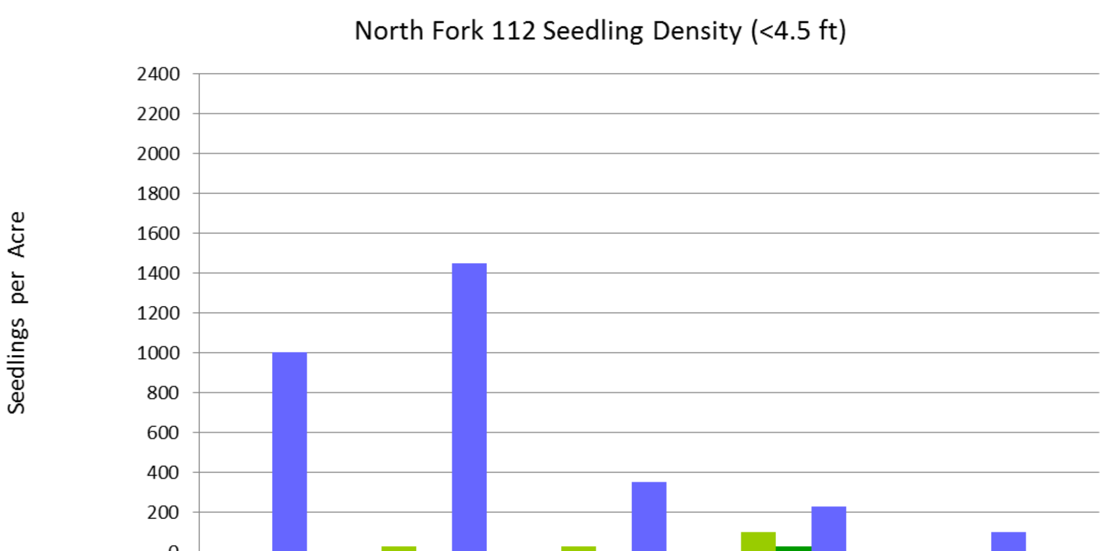
Density by Species and Diameter Class (Inches)

North Fork 112 Sapling Density (0.1-4.9 dbh)



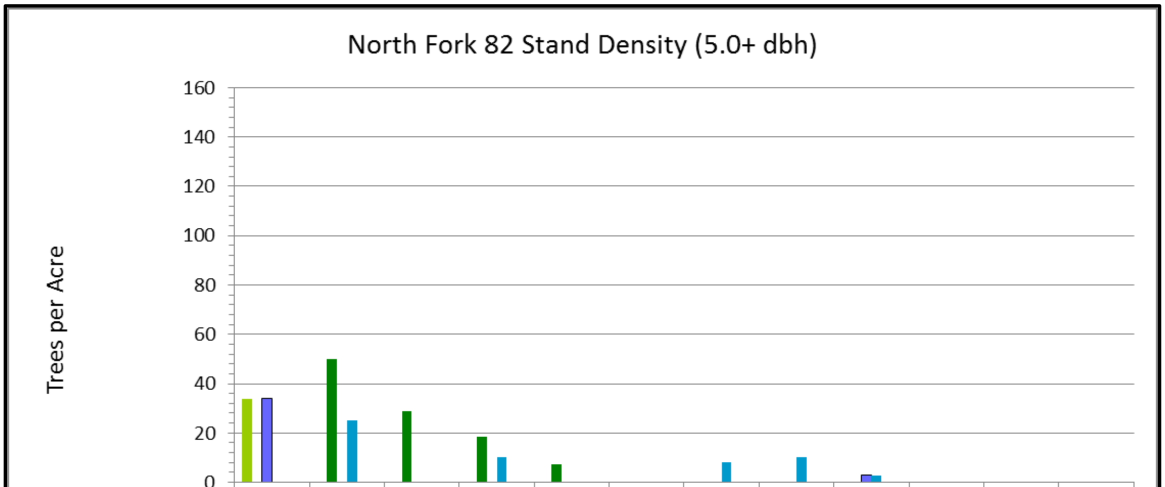
	0.5	1	1.5	2	2.5	3	3.5	4	4.5
Whitebark Pine	75.0	175.0	0.0	50.0	0.0	0.0	25.0	0.0	25.0
Lodgepole Pine	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Subalpine Fir	150.0	0.0	0.0	0.0	0.0	25.0	0.0	0.0	0.0
Douglas-Fir	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Engelmann Spruce	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

North Fork 112 Seedling Density (<4.5 ft)



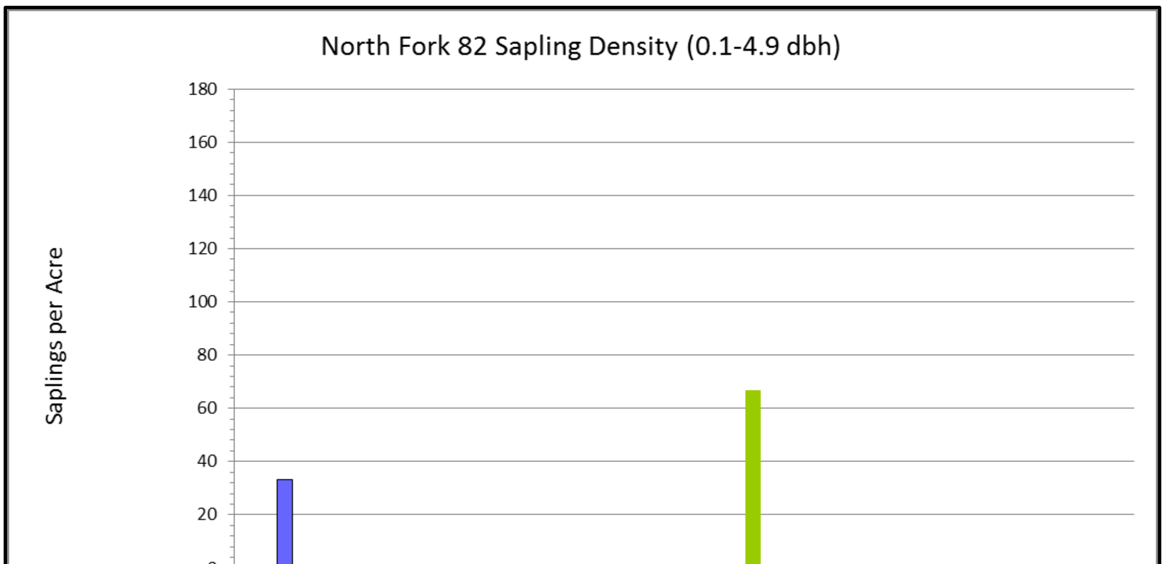
	< 0.5 ft	0.5 > 1.5 ft	1.6 > 2.5 ft	2.6 > 3.5 f t	3.6 > 4.5 ft
Whitebark Pine	0	25	25	100	0
Lodgepole Pine	0	0	0	25	0
Subalpine Fir	1000	1450	350	225	100
Douglas-Fir	0	0	0	0	0
Engelmann Spruce	0	0	0	0	0

North Fork 82

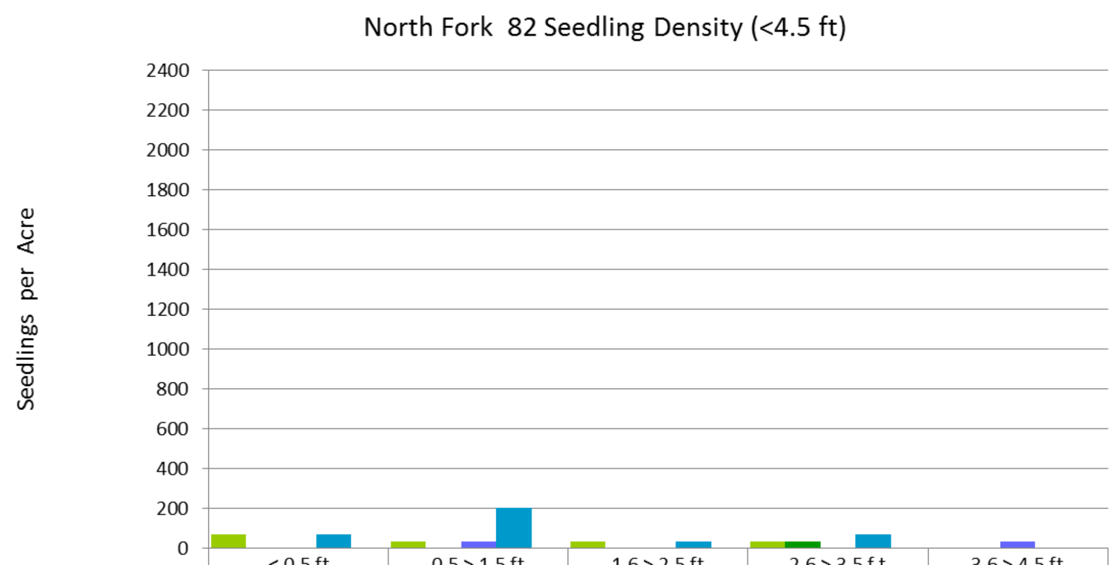


	5-6	7-8	9-10	11-12	13-14	15-16	17-18	19-20	21-22	27-28	33-34	37-38
Whitebark Pine	34.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lodgepole Pine	0.0	49.9	28.6	18.6	7.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Subalpine Fir	34.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.8	0.0	0.0	0.0
Douglas-Fir	0.0	24.9	0.0	10.1	0.0	0.0	8.2	10.2	2.5	0.0	0.0	0.0
Engelmann Spruce	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Unknown	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Density by Species and Diameter Class (Inches)



	0.5	1	1.5	2	2.5	3	3.5	4	4.5
Whitebark Pine	0.0	0.0	0.0	0.0	0.0	66.7	0.0	0.0	0.0
Lodgepole Pine	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Subalpine Fir	33.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Douglas-Fir	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Engelmann Spruce	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0



	< 0.5 ft	0.5 > 1.5 ft	1.6 > 2.5 ft	2.6 > 3.5 f t	3.6 > 4.5 ft
Whitebark Pine	67	33	33	33	0
Lodgepole Pine	0	0	0	33	0
Subalpine Fir	0	33	0	0	33
Douglas-Fir	67	200	33	67	0
Engelmann Spruce	0	0	0	0	0

DISCUSSION

We collected data in fewer stands and across reduced areas within several stands than originally planned, due to the lack of whitebark pine in several areas originally targeted for data collection.

Only one stand (North Fork 112) shows signs of historic whitebark pine presence, based on 1930's standing dead or residual multi-stemmed stumps. This is also the sole stand where mature whitebark pine approaches codominance, and where recruitment (sapling and seedling size classes) is highest.

However, the second North Fork stand and all Lost Trail stands except Lost Trail 29 also contain a substantial whitebark pine component in the sapling and seedling size classes. The Chief Joseph stand contains sapling and seedling whitebark pine, but in fewer absolute numbers and particularly in relative numbers compared to subalpine fir saplings and seedlings.

Blister rust is present in North Fork and Lost Trail stands, at low to moderate levels. Its presence is likely underrepresented by our data due to the protocols used. Dead seedlings and saplings were not tallied in the micro plot, and we were therefore unable to quantify blister rust-caused mortality. For future data collection it would be prudent to adjust the methodology to also tally dead seedlings and saplings in the micro plot, to fully capture the effect of blister rust in a stand.

MANAGEMENT IMPLICATIONS

Whitebark pine is functionally absent (vanishingly rare and not captured in our data) in the Anderson Mountain stands, and unlikely to be affected either positively or negatively by management actions.

Whitebark pine is a minor presence in the sapling and seedling size classes in the Chief Joseph stand. These size classes are predominately subalpine fir, which will outcompete whitebark pine in the absence of natural disturbances that reduce overall canopy cover and remove shade-tolerant subalpine fir. Due to the absence of mature whitebark pine, and low densities of saplings and seedlings, this stand is unlikely to benefit from treatments to the same degree as the North Fork and Lost Trail stands.

North Fork 112 contains the highest densities of mature whitebark pine, together with sapling and seedling recruitment, but the North Fork stands are remote with no road access. Treatments would be difficult and expensive to implement due to access issues and terrain. The Lost Trail stands are most likely to benefit from and should likely be the highest priority for management actions, due to the combination of sufficient whitebark pine presence and ease of access.

REFERENCES

Hansen, A., K. Ireland, K. Legg, R. Keane, E. Barge, M. Jenkins, and M. Pillet. 2016. Complex challenges of maintaining whitebark pine in Greater Yellowstone under climate change: A call for innovative research, management, and policy approaches. [accessed online]. http://www.fs.fed.us/rm/pubs_journals/2016/rmrs_2016_hansen_a001.pdf.

Perkins, D.L., R.E. Means, and A.C. Cochrane. 2016. Conservation and management of whitebark pine ecosystems on Bureau of Land Management lands in the Western United States. Technical Reference 6711-1. Bureau of Land Management, Denver, CO, USA.

Steele, R., R.D. Pfister, R.A. Ryker, and J. A. Kittams. 1981. Forest habitat types of central Idaho. Gen. Tech. Rep. INT-GTR-114. U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station, Ogden, UT, USA.

U.S. Fish and Wildlife Service. 2011. Endangered and threatened wildlife and plants; 12-Month finding on a petition to list Pinus albicaulis as endangered or threatened with critical habitat. [accessed online]. Fed Regist. 76:42631–42654. https://www.gpo.gov/fdsys/pkg/FR-2011-07-19/pdf/2011-17943.pdf.

APPENDIX A – METHODOLOGY

Inventory data was collected using USFS Common Stand Exam (CSE) Intensive methodology, as detailed in the CSE Field Guide for Region 4.

Sampling plots were established in 9 stands, spaced equidistantly throughout the stand, using the following sampling density per stand size:

1-10 acres = 3 plots

11-20 acres = 4 plots

21-30 acres = 5 plots

31-40 acres = 6 plots

41-50 acres = 7 plots

51=60 acres = 8 plots, and so on

Plot locations were determined prior to field work, using ArcGIS, in order to generate a plot file for use on the Trimble Juno GPS unit, for field navigation.

A variable macro plot with a BAF (basal area factor) of 20 was used to tally trees with a dbh (diameter at breast height) of 5 inches and above, using BAF 20 prisms. Alternatively, a relaskop or digital dendrometer could be used. Both live and dead trees were tallied. Heights were calculated using a laser rangefinder; alternatively a logger's tape and clinometer could be used.

Data fields included: species, status (live/dead) dbh to the nearest inch (to the nearest 0.1 inch for designated site trees), height to the nearest foot, crown ratio to 10%, crown class (dominant, codominant, open grown etc.), snag decay class on dead trees, and disease presence and severity for bark beetles, mistletoe, and rust.

One or more site trees were designated at enough plots per stand to ensure that 5 live representative trees of the dominant and codominant species were cored and aged. Whitebark pine was never cored, and after counting age rings on a core taken at breast height (4.5 feet) - a straight count, with no addition to account for the years before a tree reached 4.5 feet tall, the core was returned to the tree.

When necessary, a site tree was designated offplot (i.e., in area of high mortality, where no suitable live trees were being tallied in plots). The nearest suitable tree was cored, and given the tally number (tag id) 999, to facilitate separating it out during later data management to ensure it was not included in stand density, composition, size class, and all other calculations. The distance to plot center was included in the tree remarks.

A fixed micro plot of 1/100 of an acre was used to tally live saplings of less than 5 inches dbh, and live seedlings of less than 4.5 feet tall. Future data collection would be improved by also collecting data on dead whitebark pine seedlings and saplings, to capture mortality due to white pine blister rust.

Data fields included species, dbh to the nearest 0.5 inch (zero value for seedlings less than 4.5 feet tall), height to the nearest foot, and disease for rust. Saplings were grouped when possible by similar size class, height, and disease status to give tree counts of greater than 1, for a given tag id. Seedlings were grouped by height classes 0.5 (less than 0.5 feet), 1, 2, 3, 4. Seedlings less than 0.5 feet were tested for well-rootedness (with a gentle tug) before tallying, to reduce counting specimens with a low likelihood of survival.

At each plot, a representative seedling or sapling for each species present was measured for 5-year height growth to the nearest 0.1 feet, or the nearest 0.5 feet for saplings taller than 10 feet. This data was noted in the “tree remarks” field in CSE.

Plot data included existing vegetation cover type, potential vegetation cover type (habitat type [Steele and Pfister 1981]), elevation, aspect, and slope. Photographs were taken at each plot, facing each of the cardinal directions. To facilitate photo management, a whiteboard photo was also taken, displaying plot ID, date, and lat/long read from the GPS unit. The GPS unit was also used to record a plot point in ArcPad.

Additionally, wildlife comments were recorded, with emphasis on noting occurrence of Clark’s nutcracker, wolverine, fisher, American marten, American red squirrel, and woodpeckers.

Stand data was compiled in the office once field data collection was complete, and stand boundaries were redelineated where necessary. Plot data was averaged to provide characteristic aspect, slope, and elevation figures for the stand as a whole.

R4 CSE FieldGuide.pdf

APPENDIX B – PLOT PHOTOS

Anderson Mtn 25 Plot 1 N

Anderson Mtn 25 Plot 1 E

Anderson Mtn 25 Plot 1 S

Anderson Mtn 25 Plot 1 W

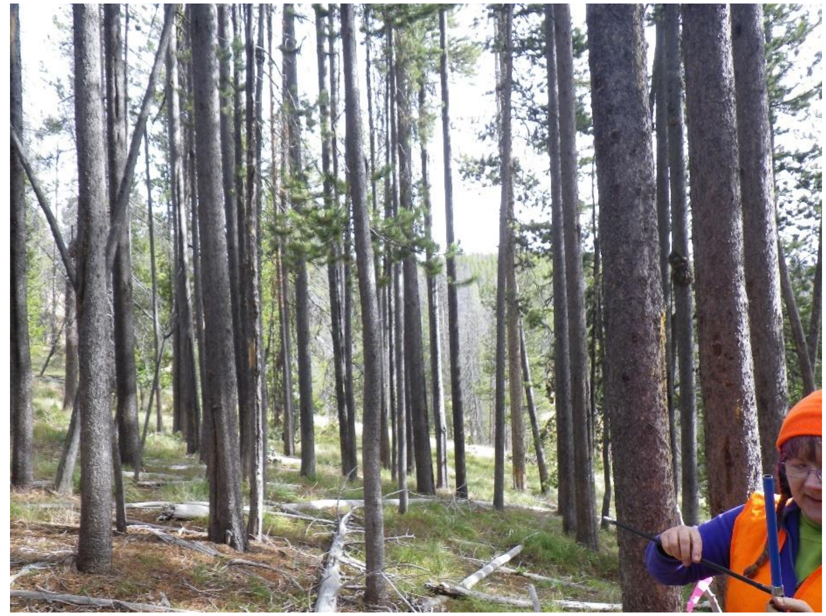

Anderson Mtn 25 Plot 2 N


Anderson Mtn 25 Plot 2 E


Anderson Mtn 25 Plot 2 S


Anderson Mtn 25 Plot 2 W


Anderson Mtn 25 Plot 3 N


Anderson Mtn 25 Plot 3 E


Anderson Mtn 25 Plot 3 S


Anderson Mtn 25 Plot 3 W


Anderson Mtn 25 Plot 4 N


Anderson Mtn 25 Plot 4 E


Anderson Mtn 25 Plot 4 S


Anderson Mtn 25 Plot 4 W


Anderson Mtn 25 Plot 5 N


Anderson Mtn 25 Plot 5 E


Anderson Mtn 25 Plot 5 S


Anderson Mtn 25 Plot 5 W


Anderson Mtn 25 Plot 6 N


Anderson Mtn 25 Plot 6 E


Anderson Mtn 25 Plot 6 S


Anderson Mtn 25 Plot 6 W


Anderson Mtn 25 Plot 7 N


Anderson Mtn 25 Plot 7 E


Anderson Mtn 25 Plot 7 S


Anderson Mtn 25 Plot 7 W

Anderson Mtn 28 Plot 1 N

Anderson Mtn 28 Plot 1 E

Anderson Mtn 28 Plot 1 S

Anderson Mtn 28 Plot 1 W


Anderson Mtn 28 Plot 2 N


Anderson Mtn 28 Plot 2 E


Anderson Mtn 28 Plot 2 S


Anderson Mtn 28 Plot 2 W

Anderson Mtn 28 Plot 3 N

Anderson Mtn 28 Plot 3 E

Anderson Mtn 28 Plot 3 S

Anderson Mtn 28 Plot 3 W


Chief Joseph 137 Plot 1 N


Chief Joseph 137 Plot 1 E


Chief Joseph 137 Plot 1 S


Chief Joseph 137 Plot 1 W

Chief Joseph 137 Plot 2 N

Chief Joseph 137 Plot 2 E

Chief Joseph 137 Plot 2 S

Chief Joseph 137 Plot 2 W


Chief Joseph 137 Plot 3 N


Chief Joseph 137 Plot 3 E


Chief Joseph 137 Plot 3 S


Chief Joseph 137 Plot 3 W


Chief Joseph 137 Plot 4 N

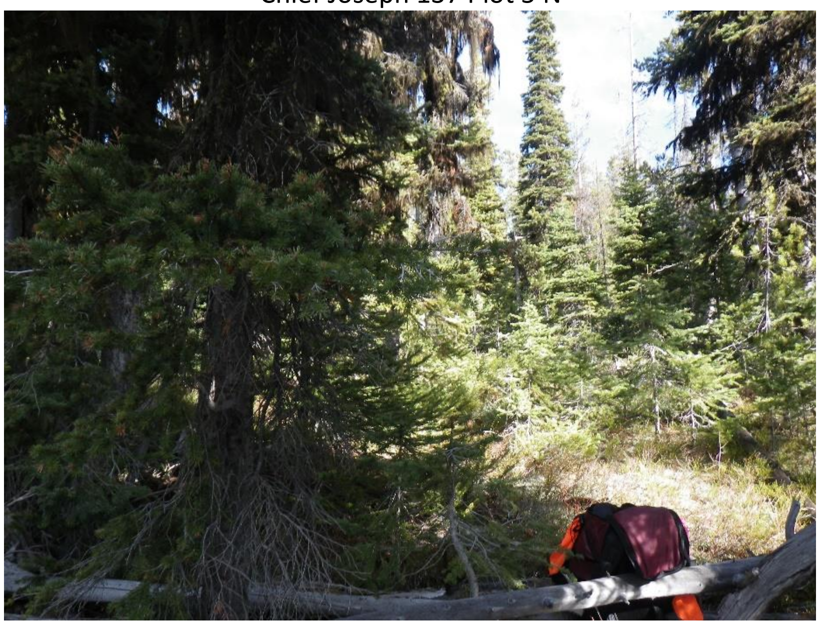

Chief Joseph 137 Plot 4 E

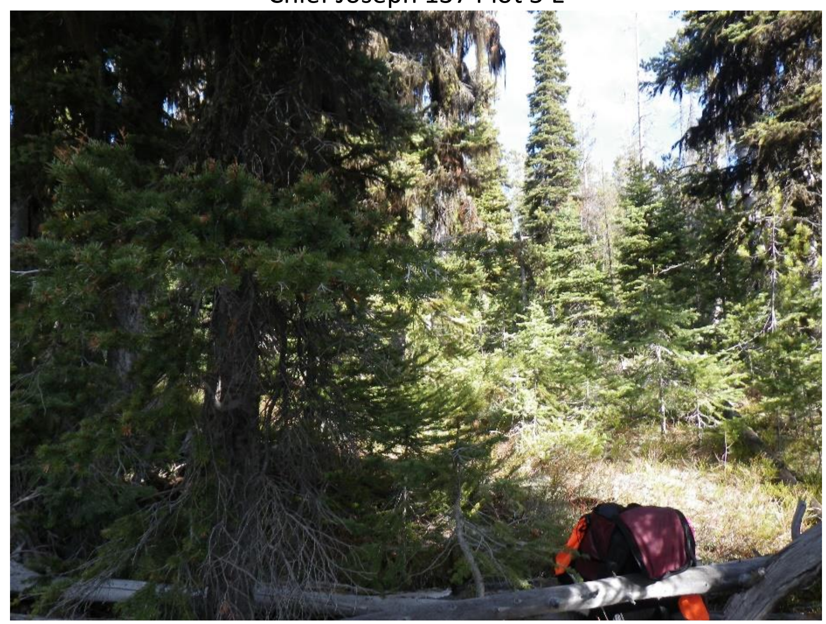

Chief Joseph 137 Plot 4 S


Chief Joseph 137 Plot 4 W


Chief Joseph 137 Plot 5 N


Chief Joseph 137 Plot 5 E


Chief Joseph 137 Plot 5 S


Chief Joseph 137 Plot 5 W


Chief Joseph 137 Plot 6 N

Chief Joseph 137 Plot 6 E

Chief Joseph 137 Plot 6 S

Chief Joseph 137 Plot 6 W

Chief Joseph 137 Plot 7 N

Chief Joseph 137 Plot 7 E

Chief Joseph 137 Plot 7 S

Chief Joseph 137 Plot 7 W


Chief Joseph 137 Plot 8 N


Chief Joseph 137 Plot 8 E


Chief Joseph 137 Plot 8 S

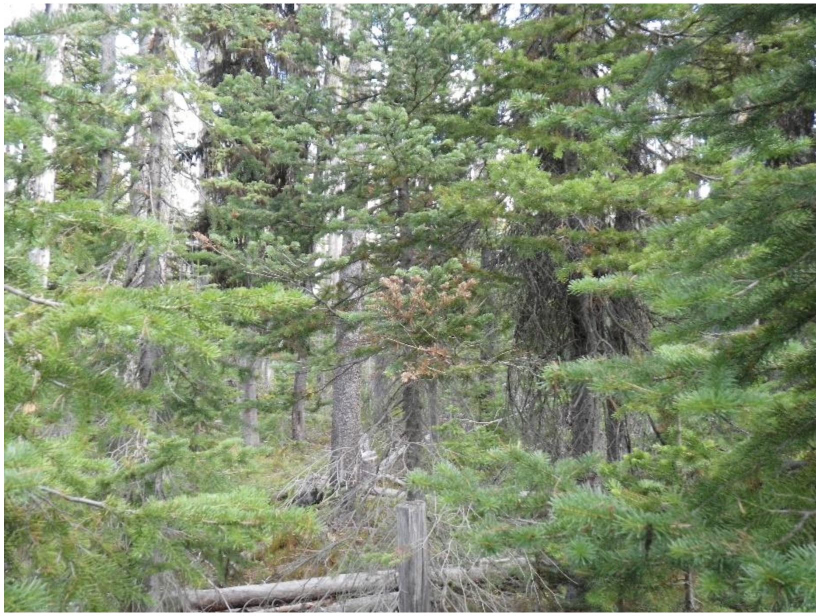

Chief Joseph 137 Plot 8 W


Chief Joseph 137 Plot 9 N


Chief Joseph 137 Plot 9 E


Chief Joseph 137 Plot 9 S


Chief Joseph 137 Plot 9 W



Chief Joseph 137 Plot 10 N

Chief Joseph 137 Plot 10 E

Chief Joseph 137 Plot 10 S

Chief Joseph 137 Plot 10 W

Lost Trail 28 Plot 1 N

Lost Trail 28 Plot 1 E

Lost Trail 28 Plot 1 S

Lost Trail 28 Plot 1 W

Lost Trail 28 Plot 2 N

Lost Trail 28 Plot 2 E

Lost Trail 28 Plot 2 S

Lost Trail 28 Plot 2 W


Lost Trail 28 Plot 3 N


Lost Trail 28 Plot 3 E


Lost Trail 28 Plot 3 S


Lost Trail 28 Plot 3 W


Lost Trail 28 Plot 4 N


Lost Trail 28 Plot 4 E


Lost Trail 28 Plot 4 S


Lost Trail 28 Plot 4 W


Lost Trail 29 Plot 1 N


Lost Trail 29 Plot 1 E


Lost Trail 29 Plot 1 S


Lost Trail 29 Plot 1 W

Lost Trail 29 Plot 2 N

Lost Trail 29 Plot 2 E

Lost Trail 29 Plot 2 S

Lost Trail 29 Plot 2 W


Lost Trail 29 Plot 3 N


Lost Trail 29 Plot 3 E


Lost Trail 29 Plot 3 S


Lost Trail 29 Plot 3 W

Lost Trail 29 Plot 4 N

Lost Trail 29 Plot 4 E

Lost Trail 29 Plot 4 S

Lost Trail 29 Plot 4 W


Lost Trail 29 Plot 5 N


Lost Trail 29 Plot 5 E


Lost Trail 29 Plot 5 S


Lost Trail 29 Plot 5 W

Lost Trail 29 Plot 6 N

Lost Trail 29 Plot 6 E

Lost Trail 29 Plot 6 S

Lost Trail 29 Plot 6 W


Lost Trail 30 Plot 1 N


Lost Trail 30 Plot 1 E


Lost Trail 30 Plot 1 S


Lost Trail 30 Plot 1 W


Lost Trail 30 Plot 2 N


Lost Trail 30 Plot 2 E


Lost Trail 30 Plot 2 S


Lost Trail 30 Plot 2 W

Lost Trail 30 Plot 3 N

Lost Trail 30 Plot 3 E

Lost Trail 30 Plot 3 S

Lost Trail 30 Plot 3 W

Lost Trail 30 Plot 4 N

Lost Trail 30 Plot 4 E

Lost Trail 30 Plot 4 S

Lost Trail 30 Plot 4 W


Lost Trail 33 Plot 1 N


Lost Trail 33 Plot 1 E


Lost Trail 33 Plot 1 S


Lost Trail 33 Plot 1 W


Lost Trail 33 Plot 2 N


Lost Trail 33 Plot 2 E


Lost Trail 33 Plot 2 S


Lost Trail 33 Plot 2 W


Lost Trail 33 Plot 3 N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Lost Trail 33 Plot 4 N

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Lost Trail 33 Plot 6 N


Lost Trail 33 Plot 6 E


Lost Trail 33 Plot 6 S


Lost Trail 33 Plot 6 W


Lost Trail 33 Plot 7 N


Lost Trail 33 Plot 7 E


Lost Trail 33 Plot 7 S


Lost Trail 33 Plot 7 W


Lost Trail 33 Plot 8 N


Lost Trail 33 Plot 8 E


Lost Trail 33 Plot 8 S


Lost Trail 33 Plot 8 W


Lost Trail 33 Plot 9 N


Lost Trail 33 Plot 9 E


Lost Trail 33 Plot 9 S


Lost Trail 33 Plot 9 W

Lost Trail 33 Plot 10 N

Lost Trail 33 Plot 10 E

Lost Trail 33 Plot 10 S

Lost Trail 33 Plot 10 W


Lost Trail 33 Plot 11 N


Lost Trail 33 Plot 11 E


Lost Trail 33 Plot 11 S


Lost Trail 33 Plot 11 W

Lost Trail 33 Plot 12 N

Lost Trail 33 Plot 12 E

Lost Trail 33 Plot 12 S

Lost Trail 33 Plot 12 W

Lost Trail 33 Plot 13 N

Lost Trail 33 Plot 13 E

Lost Trail 33 Plot 13 S

Lost Trail 33 Plot 13 W


Lost Trail 33 Plot 14 N


Lost Trail 33 Plot 14 E


Lost Trail 33 Plot 14 S


Lost Trail 33 Plot 14 W


Lost Trail 33 Plot 15 N


Lost Trail 33 Plot 15 E


Lost Trail 33 Plot 15 S


Lost Trail 33 Plot 15 W


Lost Trail 33 Plot 16 N


Lost Trail 33 Plot 16 E


Lost Trail 33 Plot 16 S


Lost Trail 33 Plot 16 W


Lost Trail 33 Plot 17 N


Lost Trail 33 Plot 17 E


Lost Trail 33 Plot 17 S


Lost Trail 33 Plot 17 W

Lost Trail 33 Plot 18 N

Lost Trail 33 Plot 18 E

Lost Trail 33 Plot 18 S

Lost Trail 33 Plot 18 W

Lost Trail 33 Plot 19 N

Lost Trail 33 Plot 19 E

Lost Trail 33 Plot 19 S

Lost Trail 33 Plot 19 W

Lost Trail 33 Plot 20 N

Lost Trail 33 Plot 20 E

Lost Trail 33 Plot 20 S

Lost Trail 33 Plot 20 W


Lost Trail 33 Plot 21 N


Lost Trail 33 Plot 21 E


Lost Trail 33 Plot 21 S


Lost Trail 33 Plot 21 W


Lost Trail 33 Plot 22 N


Lost Trail 33 Plot 22 E


Lost Trail 33 Plot 22 S


Lost Trail 33 Plot 22 W

Lost Trail 33 Plot 23 N

Lost Trail 33 Plot 23 E

Lost Trail 33 Plot 23 S

Lost Trail 33 Plot 23 W

Lost Trail 33 Plot 24 N

Lost Trail 33 Plot 24 E

Lost Trail 33 Plot 24 S

Lost Trail 33 Plot 24 W


Lost Trail 33 Plot 25 N


Lost Trail 33 Plot 25 E


Lost Trail 33 Plot 25 S


Lost Trail 33 Plot 25 W

North Fork 82 Plot 1 N

North Fork 82 Plot 1 E

North Fork 82 Plot 1 S

North Fork 82 Plot 1 W

North Fork 82 Plot 2 N

North Fork 82 Plot 2 E

North Fork 82 Plot 2 S

Not Available

North Fork 82 Plot 2 W


North Fork 82 Plot 3 N


North Fork 82 Plot 3 E


North Fork 82 Plot 3 S


North Fork 82 Plot 3 W

North Fork 112 Plot 1 N

North Fork 112 Plot 1 E

North Fork 112 Plot 1 S

Not Available

North Fork 112 Plot 1 W


North Fork 112 Plot 2 N


North Fork 112 Plot 2 E


North Fork 112 Plot 2 S


North Fork 112 Plot 2 W


North Fork 112 Plot 3 N


North Fork 112 Plot 3 E


North Fork 112 Plot 3 S


North Fork 112 Plot 3 W

North Fork 112 Plot 4 N

North Fork 112 Plot 4 E

North Fork 112 Plot 4 S

North Fork 112 Plot 4 W

APPENDIX C – DATA FILES

Excel Spreadsheet:

Whitebark_data_2015_2016.xlsx

CSE File:

Whitebark pine CSE.cse

Shapefiles (Nad83 UTM Zone11N):

GIS_Data

Plot Photos:

Photos