Montana DNRC - West Fork Swift Creek Timber Sale Whitebark Regeneration

2012 progress report

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Note: In the 2009 progress report the two harvest units described were Unit 8 and Unit 10. Unit 8, however, was actually Unit 12; that mistake has been corrected in this report and so the units are referred to as Unit 10 and Unit 12.

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Introduction

Whitebark pine is a keystone species of high-elevation ecosystems in western North America, providing important watershed, wildlife, and aesthetic functions (Schwandt 2006). In western North America the species occurs across a continuum of environmental conditions and successional roles, including as a: 1) fire-dependent, early-seral component of spruce-fir communities on moist sites; 2) persistent seral or minor climax on drier sites; 3) major climax or the only tree present under even drier or wind-exposed sites; and 4) major component or the sole dominant of communities above treeline (Arno and Weaver 1990). On the lower-elevation, subalpine fir habitat types found on Montana DNRC lands in northwestern Montana whitebark pine occurs as a fire-dependent seral species.

Whitebark pine is a slow-growing, long-lived tree constituting a major component of high-elevation forests between 5900-8200 feet in northwestern Montana (Arno and Hoff 1989). The best growing sites in Montana are the found on the *Abies lasiocarpa*/*Luzula hitchcockii* (*Menziesia ferruginea* phase) habitat type where whitebark pine can reach 20-30" DBH and 70-100 feet in height, although even on these sites Engelmann spruce are generally larger and the focus of forest management efforts. Its distribution and dominance are strongly influenced by topography and its influence on microclimate (Arno and Weaver 1990). Whitebark pine's success as an early seral is due to the seed-caching habits of the Clark's nutcracker and its ability to withstand harsh microclimate on exposed, disturbed sites.

Morgan and Bunting (1990) describe fire as likely being of great importance in maintaining reproducing populations of whitebark pine in the face of competition from more shade-tolerant, less-fire-resistant conifers such as subalpine fir. The more advanced successional stages of stands composed primarily of whitebark pine, subalpine fir, and Engelmann spruce are more susceptible to stand-replacing fires due to the buildup of coarse woody debris and understory ladder fuels. Whitebark pine often regenerates naturally following wildfire or clearcutting on southern exposures and (or) ridge tops, but these sites have highly variable fire-return intervals of 50-300 years (Fischer and Bradley 1987). In addition periodic, mixed-severity fires are also considered important in providing intermittent disturbance and subsequent opportunities for whitebark pine regeneration (Keane 2001).

Whitebark pine produces seed crops at irregular intervals; the seeds are very desirable to several wildlife species including bears, squirrels, and Clark's nutcrackers. Most important for regeneration of whitebark pine is the caching of seeds in the soil by the Clarks' nutcracker (Hutchins and Lanner 1982). The nutcrackers cache 1-5 seeds at a depth of approximately one inch, often on newly-burned areas. Many of these cached seeds are not recovered and are apparently the main source of natural regeneration. The thick seed coat is likely responsible for poor and (or) delayed germination that can result in seeds germinating in succeeding years from the same seed cache (McCaughey 1993, Pitel and Wang 1980, Schwandt et al. 2011).

Whitebark pine has been in steady decline across northwestern Montana due to the impacts of the mountain pine beetle (MPB), the non-native disease white pine blister rust (WPBR), and a lack of suitable sites for regeneration due to decades of fire exclusion (Keane and Arno 1993). Current goals for conservation and restoration of whitebark pine include: 1) protecting and enhancing existing populations; 2) providing opportunities for regeneration; and 3) increasing the proportion of trees with natural resistance to white pine blister rust (Schwandt 2006).

This regeneration-monitoring project is taking place on a recently-completed timber sale on the Montana DNRC's Stillwater State Forest. Included in this sale were two mixed-conifer units, 120-acres and 12-acres respectively, that possess components of mature, seral whitebark pine, and which underwent scheduled for regeneration harvest. Information is lacking on the success of various regeneration-harvest and site-preparation combinations in maintaining and promoting whitebark pine regeneration on lower-elevation subalpine fir habitat types. At various places in northwest Montana the DNRC manages commercial forest lands extending into forest types that include whitebark pine, and the agency wishes to maintain whitebark pine in the species composition of such stands, thus requiring operational data on the effects of various silvicultural treatments on promoting successful regeneration.

Methods: Pre-treatment data collection

The objective of pre-treatment data collection was to describe the structure and composition of the overstory and understory prior to harvest and site preparation. Data were collected on temporary, 1/20th- and 1/100th-acre, fixed-radius, nested plots spaced approximately four chains apart on transects. In Unit 10 the transects were run along the ridgeline that bisects the unit as well as parallel to the slope on either side of the ridgeline. In Unit 12, which is predominantly flat, just three plots were installed at random locations.

The field form used in pre-treatment data collection is provided in Appendix B. The data was collected as noted on the form except that which addressed the age structure of whitebark pine overstory and regeneration. Age of overstory trees were assessed from several stumps of trees cut during pre-harvest preparation (i.e. - road and landing construction), along with old-growth data collected by staff of the Stillwater State Forest as part of timber sale preparation. Virtually no whitebark regeneration (seedlings, saplings, or trees < 5" DBH) were found during the pre-treatment survey so our plan to collect age-structure data via analysis of stem cookies was dropped.

Results: Pre-treatment data collection

Analysis of the pre-treatment data collected from both units reveal late-successional stands typical of these habitat types when disturbance has been lacking (Figure 1). The overstories consists of whitebark pine, Engelmann spruce, subalpine fir, and a very few Douglas-fir. There is, however, substantially more Douglas-fir, and less whitebark pine, further down the ridge in Unit 10 from where our plots were installed.

The mature whitebark pine, a seral species in these habitat types, has suffered substantial mortality due to mountain pine beetle (MPB). Over 50% of the whitebark pine $\geq$5 inches DBH is dead on both units, mainly due to MPB attacks. The top portion of the crowns of some still-living whitebark are dead; this pattern is likely due to infection by white pine blister rust (WPBR) although it was difficult to definitively identify WPBR infections due to the heights of the trees.

Subalpine fir, a shade-tolerant species, dominates the understory regeneration, with a lesser amount of Engelmann spruce. We found no whitebark pine regeneration of any size on or between plots. However, stand-exam notes from Stillwater State Forest staff note whitebark pine regeneration on a disturbed area, but the type of disturbance and amount/age of regeneration was not noted. We did not come across this regeneration area during our pre-treatment survey.

Lack of fire, either mixed-severity or stand-replacing, has apparently resulted in few if any opportunities for whitebark pine to regenerate in these stands following seed-caching by Clark's nutcrackers. These upper-elevation stands are still within their highly-variable fire-return intervals, however, so we cannot simply attribute lack of fire to human-caused fire exclusion (Fischer and Bradley 1987). It would be problematic to try to determine whether or not fire exclusion has directly affected these stands. One way would be to construct a very localized fire history and then estimate the likelihood these stands would have experienced burning if fires of recent decades had not been suppressed, but this type of exercise would be at best an estimation.

Figure 1. Pre-harvest condition of Unit 10. Dominated by whitebark pine, Engelmann spruce, and subalpine fir.

Table 1. Summary of plot-condition data from Unit 12.

Aspect[1]	No. plots[2]	Habitat type[3]	% slope[1]	% herbaceous[4]	% shrub[4]	% mineral soil[4]	Ribes[5]	Cone-bearing PIAL[6]
Flat	3	ABLA/MEFE (2) ABLA/LUHI/MEFE (1)	Flat	68	77	0	0	12, 30, and >100 ft.

1 - Measured across 1/20th acre plot.
2 - Nested, temporary plots consisting of a 1/20th acre plot (26.3 foot radius) and a 1/100th acre plot (11.8 foot radius).
3 - Habitat type as per Pfister et al. (1977); number in parentheses is the number of plots having the designated habitat type.
4 - Herbaceous cover, shrub cover, and exposed mineral soil were estimated on the 1/100th acre plot.
5 - Recorded as the presence/absence of any *Ribes* spp. on the 1/20th acre plot.
6 - Ocular estimate of distance to nearest cone-bearing (having a live upper crown) overstory whitebark pine.

Table 2. Numbers of live and dead trees-per-acre (≥5" DBH) on Unit 12.

DBH	ABLA[1] - live	ABLA - dead	PIEN[2] - live	PIEN - dead	PIAL[3] - live	PIAL - dead
5.0 - 9.9"	20	0	0	0	0	0
10.0 – 14.9"	20	0	0	0	7	7
15.0 – 19.9"	7	0	7	0	0	13
≥20.0"	0	0	27	0	0	0
	47	0	33	0	7	20

1 - *Abies lasiocarpa* (subalpine fir)
2 - *Picea engelmannii* (Engelmann spruce)
3 - *Pinus albicaulis* (whitebark pine)

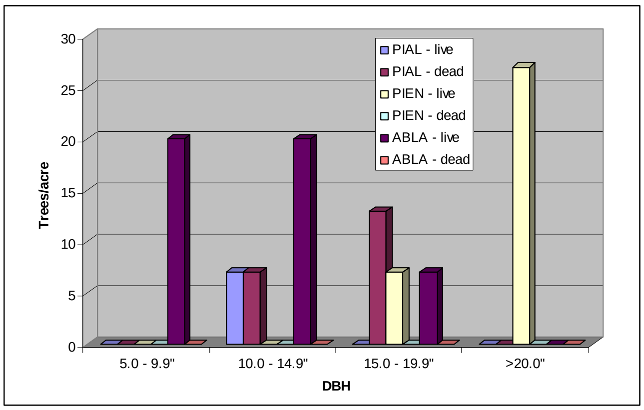

Figure 2. Comparison of live/dead trees per acre (≥5" DBH) on Unit 12 by species and size class.

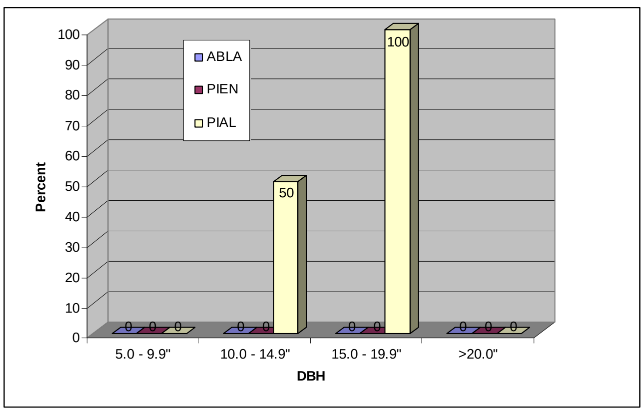

Figure 3. Percent of trees-per-acre (≥ 5" DBH) dead on Unit 12 by species and size class.

Table 3. Summary of plot-condition data from Unit 10.

Aspect[1]	No. plots[2]	Habitat type[3]	% slope[1]	% herbaceous[4]	% shrub[4]	% mineral soil[4]	Ribes[5]	Cone-bearing PIAL[6]
SE-SSE	5	ABLA/MEFE/VAGL (4) ABLA/MEFE/XETE (1)	44	44	64	0	3	All plots >100 ft.
Ridgeline	6	ABLA/MEFE/VAGL (6)	15	51	58	Trace	1	~45 ft.
NE-NNE	7	ABLA/MEFE/VAGL (5) ABLA/MEFE (2)	49	35	75	0	2	5 plots average ~48 ft. 2 plots >100 ft.

1 - Measured across 1/20th acre plot.
2 - Nested, temporary plots consisting of a 1/20th acre plot (26.3 foot radius) and a 1/100th acre plot (11.8 foot radius).
3 - Habitat type as per Pfister et al. (1977); number in parentheses is the number of plots having the designated habitat type.
4 - Herbaceous cover, shrub cover, and exposed mineral soil were estimated on the 1/100th acre plot.
5 - Recorded as the presence/absence of any *Ribes* spp. on the 1/20th acre plot.
6 - Ocular estimate of distance to nearest cone-bearing (having a live upper crown) overstory whitebark pine.

Table 4. Numbers of live and dead trees-per-acre (≥ 5" DBH) by species and size class on Unit 10.

DBH	ABLA[1] - live	ABLA - dead	PIEN[2] - live	PIEN - dead	PIAL[3] - live	PIAL - dead
5.0 - 9.9"	68	9	7	0	1	1
10.0 – 14.9"	36	1	8	1	3	4
15.0 – 19.9"	14	1	4	3	6	8
≥20.0"	1	0	10	1	0	3
	119	11	29	6	10	17

1 - *Abies lasiocarpa* (subalpine fir)
2 - *Picea engelmannii* (Engelmann spruce)
3 - *Pinus albicaulis* (whitebark pine)

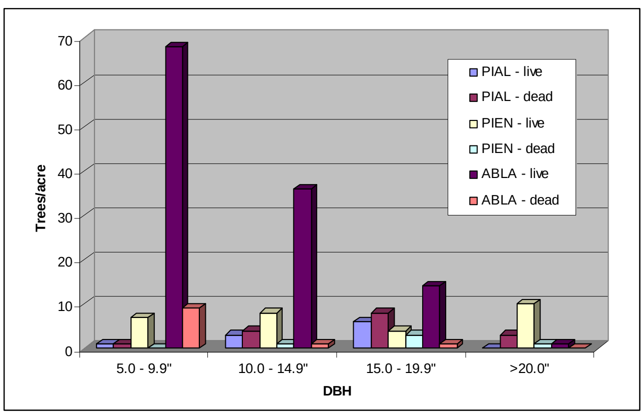

Figure 4. Comparison of live/dead trees per acre (≥5" DBH) on Unit 10 by species and size class.

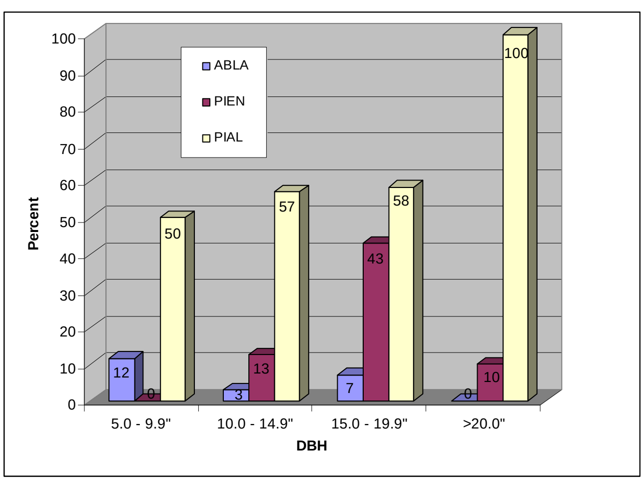

Figure 5. Percent of trees-per-acre (≥ 5" DBH) dead on Unit 10 by species and size class.

Methods: Harvest, site preparation, and regeneration

The following are descriptions of the *intended* harvest, site preparation, and regeneration plans for Unit 10, the larger of the two units, as provided by staff of the Stillwater State Forest.

Treatment objectives: Regenerate the entire stand and increase the percent of western larch, whitebark pine, and Douglas-fir. Retain all western larch and plant both western larch and Douglas-fir to try to ensure inclusion in future species mix. Remove all Engelmann spruce, Douglas-fir, and subalpine fir that have been attacked by bark beetles, as well as other trees with insect and (or) disease problems. Retain 8-10 tons of down woody material larger then three inches in diameter.

Prescribed treatment:

Harvest method: Clearcut with reserves. Remove existing overstory leaving one live tree per acre greater than 21" DBH for snag replacement purposes. Retain all live cull trees greater than 18" DBH. If available leave one snag per acre ≥18" DBH.

Figure 6. Harvest results in Units 10 & 11 (along far ridgeline) in fall of 2008.

Yarding method: Most of unit requires cable logging; there are a few blind leads where harvest will likely not be possible. A yarder capable of working from low-standard skid trails and slope breaks is also required.

Figure 7. Cable yarding to ridgeline in Unit 10.

Hazard reduction: The purchaser is required to buck tops and leave limbs in the unit in order to retain sufficient fuel for broadcast burning. All material within 125 feet of sides and bottom of unit will be yarded. Excavator and hand fire lines will be required.

Site preparation: Broadcast burn to reduce fuels, reduce duff, and reduce brush cover to 20%. If conditions are not favorable for site preparation via broadcast burning a contingency plan will be implemented. This plan calls for excavator piling as much of the harvest area as is feasible.

Note: The following information (slightly edited) was provided my Mike McMahon of the Stillwater State Forest:

Over the summer and fall of 2010 and 2011 the DNRC was unable to broadcast burn Unit 10 (120-acre clearcut with reserves). We knew a broadcast burn of Unit 10 would be difficult to accomplish due to the high elevation and northeast aspect of much of the unit. Burn plans had been developed to burn the unit when the risk of escape was minimized (i.e. - the fall) but our experience on similar sites is that once the fall rains begin and freezing occurs the fuels will rarely dry enough to subsequently carry fire. The risk of a summer burn was rejected by the unit manager and fire administrators.

Excavator scarification within the unit was also considered but not completed, in part due to the timing constraints of the extended snow season in 2011, but also the operational limits of an excavator on steep slopes. One positive is that the upper slopes and ridge line received a higher amount of disturbance (i.e.- scarification) than expected during harvest operations thereby exposing mineral soil.

Planting stock had been germinated for a summer plant in 2011. We determined it would be best to plant these trees early after the disturbance so that potentially the trees would establish themselves well before being overtopped by the menziesia and alder.

Author's note:

I believe the above is a very good illustration of the operational constraints faced by forest managers on whitebark pine sites. Broadcast burns may not occur if a burning window does not present itself in the time frame necessary. Managers in a case such as this do not then have the luxury of waiting for several years with the hopes that burning can take place. Rather they need to take into consideration the readiness of non-whitebark seedlings that may have been planted specifically for regeneration of such high-elevation units, as well as the implications of waiting to plant and thus giving vegetative competition a head start.

Regeneration: Summer-plant with western larch and Douglas-fir at 14x14 foot spacings. Plant five-cubic-inch containerized stock. DNRC needs to collect high-elevation western larch and Douglas-fir seed to facilitate this planting plan.

Anticipated future treatments: Check survival of planted stock the first fall after planting. Survey regeneration five years after scarification and planting. Evaluate precommercial thinning needs 15 years after planting.

Methodology for post-treatment regeneration surveys:

Sampling schemes are yet to be finalized; will follow some type of standard, regeneration survey methodology.

Timeline of Completed and Planned Activities:

The original timeline has been set back several years. The start of logging was delayed one season (year) due to high fire danger, and then difficulty in logging extended the harvest across two seasons. Items in blue in the following list are part of the current regeneration monitoring project:

Completed:

- Spring/summer 2008: *Develop methodology for pre-treatment data collection*.
- Summer/fall 2008: *Conduct pre-treatment data collection*.
- Fall 2008 & summer 2009: Sale units harvested. (See Appendix C for images of post-harvest conditions.)
- Fall 2009: *Submission of 2009 progress report based on pre-treatment data collection*.
- Fall 2010 & summer 2011: Broadcast burn of Unit 10 ***could*** ***not*** be performed due to lack of suitable burning window. Mechanical scarification of Unit 12 was performed with an excavator; no excavator scarification was done on Unit 10 due primarily to steep terrain. Hand scalping at time of planting was the only means of site preparation used in Unit 10; ground-yarding provided scarification for both planting and natural regeneration.
- Summer 2011: Units 10 and 12 planted with western larch at a 14' x 14' spacing.
- Summer 2012: *Walk-through inspection*. (See Appendices C and D for images.)
- Summer 2012: *Submission of 2012 progress report*.

Planned:

- Fall 2012: *Walk-through inspection looking for any first-year whitebark germination.*
- Summer/fall 2013-2017: *Regeneration surveys of Units 10 and 12 for both planting survival and natural regeneration of whitebark pine, Engelmann spruce, Douglas-fir, and subalpine fir*. (In cooperation with Stillwater Forest.)
- Fall 2013-2017: *Submission of annual progress reports (2013-2016) and then final report (2017)*.

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Appendix A. Four-letter codes, scientific names, and common names for key species found in relevant habitat types:

Trees

ABLA = *Abies lasiocarpa* (subalpine fir)

LAOC = *Larix occidentalis* (western larch)

PIAL = *Pinus albicaulis* (whitebark pine)

PICO = *Pinus contorta* (lodgepole pine)

PIEN = *Picea engelmannii* (Engelmann spruce)

PSME = *Pseudotsuga menziesii* (Douglas-fir)

Shrubs

ALSI = *Alnus sinuata* (Sitka alder)

MEFE = *Menziesia ferruginea* (menziesia / false huckleberry)

VAGL = *Vaccinium globulare* (dwarf huckleberry)

VASC = *Vaccinium scoparium* (grouse huckleberry / grouse whortleberry)

Forbs

CLUN = *Clintonia uniflora* (queencup beadlily)

LUHI = *Luzula hitchcockii* (smooth woodrush)

XETE = *Xerophyllum tenax* (beargrass)

Graminoids

ARLA = *Arctagrostis latifolia* (polargrass)

CAGE = *Carex geyeri* (elk sedge)

Appendix B: Pre-treatment data collection form.

Stillwater Whitebark Regen Study - Pre-Treatment Data Collection

Page ___ of ___

Transect #:	Plot #:
Elevation (ft):	Waypoint: Yes - No

Aspect across 1/20th acre plot (degrees):
Slope across 1/20th acre plot (%):

	1/100th acre nested plot (tally)			
Species	Live: < 4.5'	Dead: < 4.5'	Live: 1-4.9" DBH	Dead: 1-4.9" DBH
PIAL				
PIEN		NA		NA
ABLA		NA		NA
PSME		NA		NA
Other		NA		NA

Whitebark ages: Collect cores for 2 co-dominants; basal cookies for 2 saplings; basal cookies for 2 seedlings

1/20th acre plot						
Trees > 5" DBH				**On dead PIAL check for**		
Tree #	Species	DBH	Live/Dead	MPB	WPBR	RD
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						

On 1/100th acre plot
% herbaceous cover:
% shrub cover:
% mineral soil:
Ribes (# bushes):

On 1/20th acre plot
Ribes spp.: **Present - Absent**

Nearest seed-bearing PIAL
Feet from plot center:

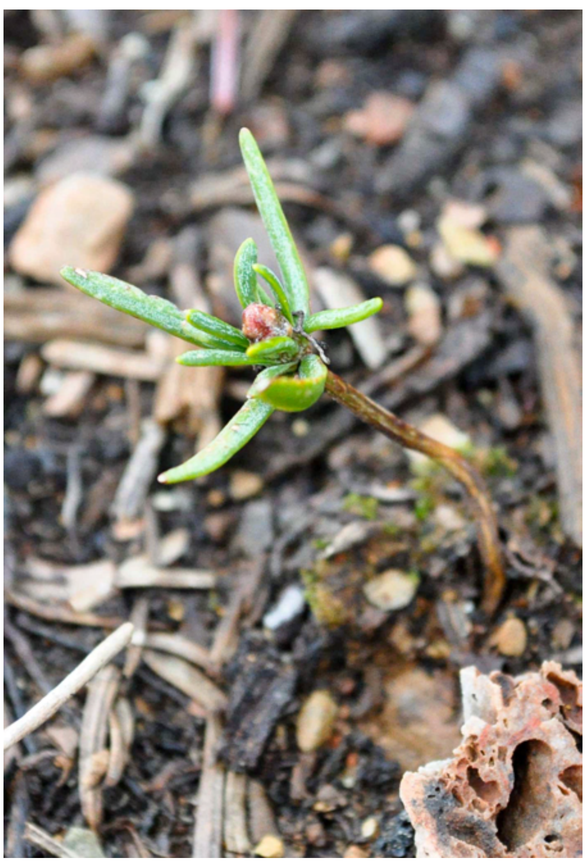
Habitat type

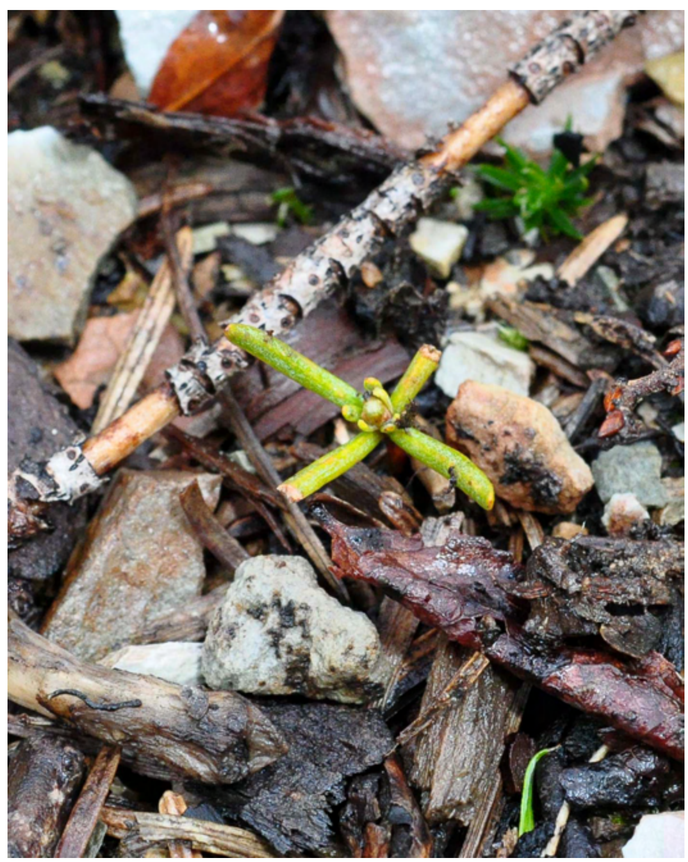
Species codes	
PIAL	Whitebark pine
PIEN	Engelmann spruce
ABLA	Subalpine fir
PSME	Douglas-fir
Plot radii	
1/20th acre	26.3'
1/100th acre	11.8'

Appendix C: Condition of Unit 10 following completion of harvesting activities.

Appendix C: Condition of Unit 10 following completion of harvesting activities. (continued)

Appendix D: Unidentified germinants or advanced regeneration seen in walk-through inspection in June 2012.





Appendix D: Unidentified germinants or advanced regeneration seen in walk-through inspection of June 2012. (continued)