

# Eldorado National Forest

## Whitebark Pine Pilot Fieldwork Report



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Photo on cover page: *Pinus albicaulis* in the Mokelumne Wilderness. Photo by CNPS.

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## Background

Whitebark pine (*Pinus albicaulis*) is a long-lived and slow-growing tree found in upper montane to subalpine forests of southwestern Canada and the western United States. It regularly defines upper treeline and co-occurs with other conifers. Of the approximately 250,000 acres where whitebark pine forms pure stands in California, >95% is on public land, often in remote wilderness settings on National Forest and Park lands; however, the acreage of the pine's populations in the state is much greater (see Figure 1).

Across the state, the species is found from 1,830 m – 4,240 m (6,000 ft-13,899 ft) in the Sierra Nevada, Cascade, Warner, and Klamath mountains where it is an outlier of a much broader range (Arno et al. 1989, Murray 2005) from the more contiguous Rocky Mountains and Cascades in western North America. Within this range, the species prefers cold, windy, snowy, and generally moist zones. In the moist areas of the Klamath and Cascades, it is most abundant on the warmer and drier sites. In the more arid Warner Mountains and in the Sierra Nevada, the species prefers the cooler north-face slopes and more mesic regions. But some of these phytogeographic patterns are shifting.

Western coniferous forests are currently undergoing large-scale changes in composition and distribution. These changes are due to shifts in the following: climate regimes, insect and fungal pathogen distributions, fire return intervals, fire severity/intensity, and logging practices—among others. High elevation five-needle pines have been harbingers for climate change for millions of years, and because high-elevation ecosystems are likely to be the first to register the impacts of global climate change (Bunn et al. 2005), surveying high elevation five-needle pine is a way to catalog trends in vegetation and climatic shifts.

Unlike other five-needle pines, whitebark pine is set apart in that its cone does not open at maturity and its seed is “wingless”; consequently, they are solely dependent on Clark's nutcrackers (*Nucifraga columbiana*) for seed distribution and future seedling recruitment. The birds open the cone, collect the seeds, and cache them. Inevitably, around 20% of the seeds are forgotten or moved by other animals (Lanner 1996) and, in the years following, clumps of whitebark pine saplings grow from these forgotten caches. These two species are keystone mutualists, where the loss of one species would have a profound impact upon the ecosystem as a whole.

Whitebark pine (WBP) is currently the most susceptible of the five-needle pines to mortality due to the combined effects of climate change-induced disturbance. Mortality across much of its range is attributed to white pine blister rust (WPBR) outbreaks caused by the non-native

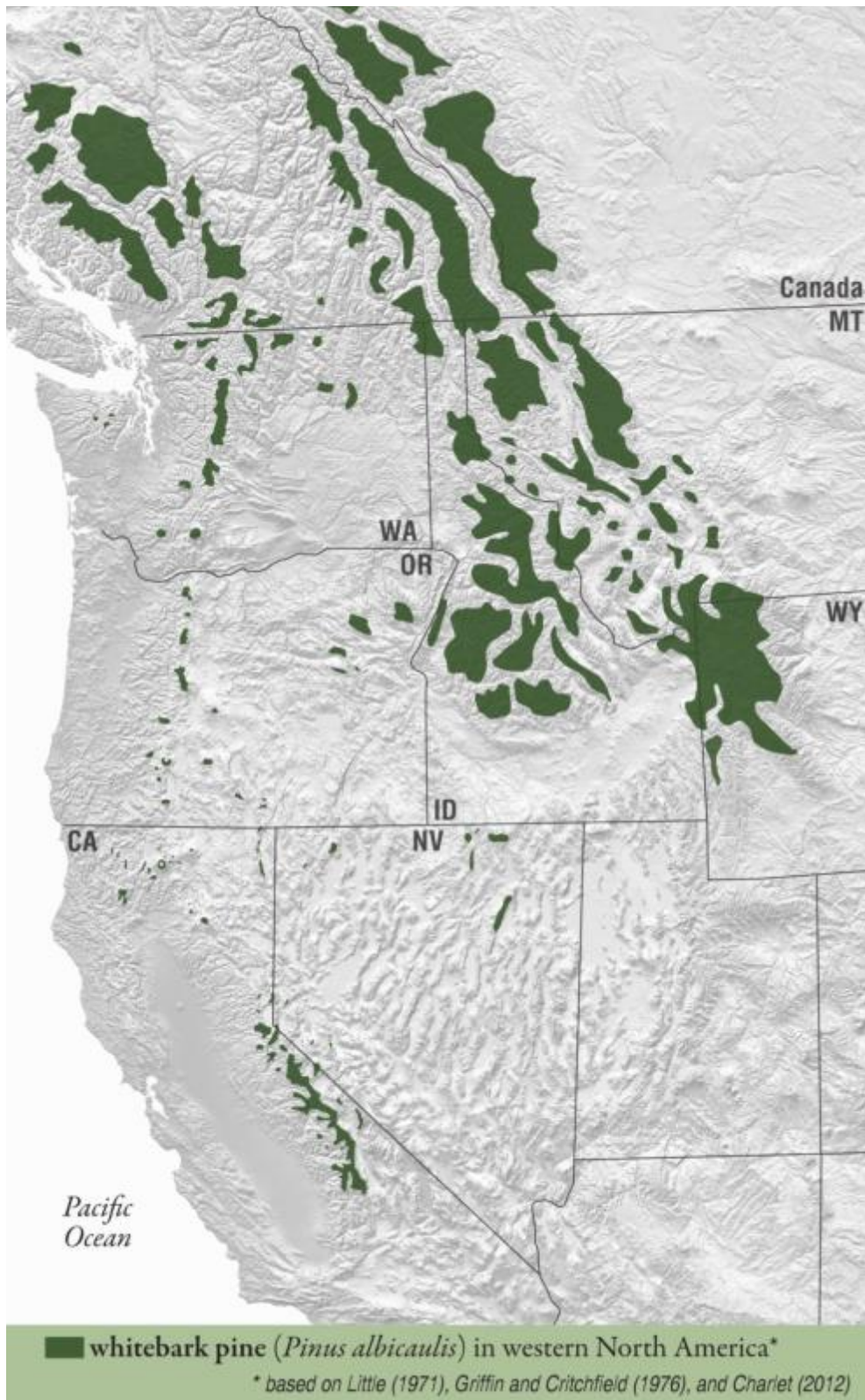


Figure 1. Map created by Michael Kauffmann.

invasive pathogen (*Cronartium ribicola*) (Tomback and Achuff 2010) and native mountain pine beetle (*Dendroctonus ponderosae*) attacks (Logan and Powell 2001, Logan et al. 2010). Decimation of populations in the northern Rocky Mountains has led Canada to list the species as endangered in 2010 ([http://www.cosewic.gc.ca/eng/sct1/searchdetail\\_e.cfm](http://www.cosewic.gc.ca/eng/sct1/searchdetail_e.cfm)). The current and potential loss of this keystone species in the high mountains of California poses serious threats to biodiversity and losses of ecosystem services, since whitebark pine is one of only a few tree species in these settings.

Mountain pine beetles (MPB) are of concern with respect to high elevation conifers and a warming climate. The beetle is a native insect, having co-evolved with western pine forests in fluctuations of periodic disturbance often followed by cleansing fire regime events. More recently, mass beetle infestations have been correlated with increased climatic warming (Mock 2007). Mountain pine beetles require sufficient thermal input to complete the life cycle in one season. Historically, high elevation ecosystems did not meet these conditions. However, due to recent warming trends, there is adequate thermal input at high elevations for the lifecycle such that infestations of whitebark pine are now increasingly common (Logan and Powell 2001). The preponderance of mass infestations at high elevations has been witnessed throughout California—especially in the arid Warner and eastern Sierra Nevada mountains.

In addition to native insects, a non-native fungal pathogen is affecting high elevation forests. In 1910 white pine blister rust (*Cronartium ribicola*) arrived in a British Columbia port and by 1930 had spread to southern Oregon, infecting western white pine (*Pinus monticola*) and sugar pine (*Pinus lambertiana*) (Murray 2005) along the way. The lifecycle completion requires WPBR to utilize *Ribes* spp. as alternate hosts. In late summer, spores from *Cronartium ribicola* are blown from the *Ribes* host and then enter 5-needle pines through stomata. Upon successful entry, hyphae grow, spread through the phloem, then ultimately swell and kill tissue above the site of infection. Infected trees can survive for over 10 years, but the infection inhibits reproduction (Murray 2005). For species like WBP, which live in fringe habitat and therefore delay reproductive events until conditions are optimal, having an infection that further inhibits cone production is a dangerous proposition. The fungus is found on foxtail and whitebark pines in northwest California (Maloy 2001) where variability in microsite infestation occurs (Ettl 2007). On Mount Ashland in the Siskiyou Mountains, blister rust has infected 4 of the 9 WBP trees in the population (Murray 2005). All five-needle native western pines have shown some heritable resistance in the past 100 years (Schoettle et al. 2007), but enduring an infection works against a long-lived pine's survival strategy. Populations of whitebark pine did not evolve to withstand fungal infections.

Seedling establishment for organisms that are on the ecological edge, like WBP, is also jeopardized because of the effects of climate change. Causes of unsuccessful seedling



recruitment are many but at high elevation include the effects of fire suppression over the past 100 years. While fire has never been a common phenomenon in high-elevation forests, a shift in fire regime occurred in WBP populations during the Holocene, around 4500 years ago. Before that time, fire was not a significant factor in WBP ecology but since has become significant (Murray 2005). The introduction of fire regime suppression in the 1930s is another factor in maintaining whitebark populations. The lack of fire, when coupled with effects of climate change, could also lead to population decline. Whitebark pines need open space for seedling establishment and historically some of this open space has been created by fire events. Fire suppression has also led to increased fire severity and intensity which could be compounded by pathogens. If blister rust and mountain pine beetles continue to move into the high elevations of California, they will potentially generate more dead and downed wood. While considering the potential for the risk of stand replacing fire, this would not mimic historical fire regimes—which have been of low intensity and often focused on individual trees by lightning strikes (Murray 2007).

## **Introduction**

Mapping of whitebark pine occurrence and status/threat has been done primarily using aerial imagery in the National Forests of California by the US Forest Service, including the Pacific Southwest Region - Remote Sensing Lab's CALVEG (Classification and Assessment with Landsat of Visible Ecological Groupings) system. The existing USFS vegetation tiles are a result of a 2004-2005 CALVEG map product; source imagery, for each vegetation tile, ranges from 2002-2009 (USFS 2013c). Even though tile data is continually updated, many stands have not been visited in the field to confirm the accuracy of CALVEG vegetation types. Additionally, little field assessment has been done in the state to identify the presence of whitebark pine, its abundance and status.

The California Native Plant Society (CNPS), working in collaboration with the US Forest Service, initiated field surveys in the summer/fall of 2013 to assess the extent and status of whitebark pine in areas lacking ground surveys in California. Three national forests in the Sierra Nevada and four national forests in the Cascades and Klamath Mountains were selected for field surveys in 2013. The goals of the field assessments were to verify distribution and status of whitebark pine, ground-truth polygons designated by CALVEG as Whitebark Pine Regional Dominance Type, conduct modified rapid assessments and reconnaissance surveys (recons) on whitebark pine and related stands, and check the USDA Forest Service (USFS) Forest Health Protection Margins dataset (Bokach 2013) points for changes in mortality of whitebark pine due to mountain pine beetle and white pine blister rust, if time allowed. Locations within national

forests were targeted for the assessment based on potential occurrence of healthy stands in high elevations within the western-most range for the species. Post field assessment, photo interpretation and delineation of whitebark pine extent beyond field surveyed areas were also conducted. This information is being used, along with other reputable sources, to develop a range-wide map of whitebark pine in California (see Figure 2). The map is what we have compiled to date and is a work in progress.

## **Methods and Materials**

The California Native Plant Society (CNPS) obtained existing GIS data from various sources including the USFS Pacific Southwest - Region Remote Sensing Lab's CALVEG maps (USFS 2013c), USFS Forest Health Technology Enterprise Team's National Insect and Disease Risk Model (USFS 2013a) Host species layers, USFS Pacific Southwest Regional Forest Health and Monitoring Aerial Detection Survey Data (USFS 2013b), USFS Forest Health Protection Margins dataset (Bokach 2013), USFS Forest and Inventory Analysis database (USFS 2013d), The Consortium of California Herbaria (UC Berkeley 2013), USFS Central Sierra Province Ecologist-Becky Estes, USFS Southern Sierra Nevada Province Ecologist - Marc Meyer, National Park Service (NPS) Sierra Nevada Network Inventory and Monitoring Program Ecologist - Jonathan Nesmith, US Geological Survey (USGS) Western Ecological Research Center Ecologist - Nathan Stephenson, California Department of Fish and Wildlife (CDFW) Wildlife Biologist - Pete Figura and USFS Northern California Shared Service Center Entomologists - Cynthia Snyder and Danny Cluck. In addition, we used older sources of whitebark pine distribution in the state for context (Griffin and Critchfield 1972) and for lone populations or individuals not delineated or attributed by CALVEG (UC Berkeley 2013).

CNPS also reviewed existing protocols for evaluating whitebark pine vegetation and insect/disease impacts. These protocols included the NPS Standard Operation Procedures for monitoring White Pine (USDOI 2012), Whitebark Pine Ecosystem Foundation (Tomback, et al. 2005), Whitebark Pine Inventory and Monitoring Plot protocol (USFS 2013e) and several government research and staff reports (i.e., Millar et al. 2012, Simons and Cluck 2010, Figura 1997, McKinney et al. 2011, and Maloney et al. 2012). We also discussed the existing protocols for assessing whitebark pine vegetation with USFS staff, including Marc Meyer and Shana Gross.

Upon evaluating existing datasets and obtaining input from local National Forest staff, we identified areas to further ground-truth to better determine the distribution and health/status of whitebark pine on the National Forest lands. Priorities included sampling within wilderness lands and identifying areas with low-levels of insect/disease impact. See Appendix 1 for a list of contacts made overall for this assessment.

Two wilderness areas were selected for sampling in Eldorado National Forest: Mokelumne and Desolation. During the field visits, staff visited areas where CALVEG polygons were designated as Whitebark Pine for the Regional Dominance Type, when accessible, to determine if whitebark pine was present. Staff also visited other areas that were identified through aerial photo interpretation and through recommendations of USFS staff as having high likelihood of whitebark pine occurring in the area.

We selected the CNPS/CDFW Vegetation Rapid Assessment protocol (see Appendix 2) to gather information on occurrence, habitat, and impacts of stands with whitebark pine. We modified this protocol to include signs of Mountain Pine Beetle (MPB) and White Pine Blister Rust (WPBR), and overall whitebark pine status/health. The modified rapid assessment aimed to gather as much information on whitebark pine health without spending a significant amount of time establishing plots or collecting data on individual trees. Therefore, the survey technique was stand based to assess the extent of whitebark pine vegetation across broad areas in a short amount of time. Sampling included pure stands, mixed conifer stands, and high elevation krummholz, as long as whitebark pine was deemed a component.

The modifications to the rapid assessment included additional information from the Pacific Southwest Research Station (PSW) Ecology Program's Whitebark Pine Protocol such as; whitebark pine impacts from MPB and WPBR, MPB level of attack and % of WBP cones (female). Other protocol information added included; # of individual clumps/stems per area, phenology of WBP (% vegetative, % male flowers and % fruiting) and overall site/ occurrence quality/viability (site + population) from the California Natural Diversity Database (CNDDDB). Since MPB attack and WPBR infestation were the main disturbance of interest to be recorded, USFS Pathologists and Entomologists were contacted for visual aids for accurate whitebark pine health assessment. Subsequently, comprehensive field guides were made for recognizing symptoms and signs of MPB and WPBR attack (Kauffmann 2014).

The reconnaissance (recon) form used for the assessment takes pertinent information from the CNPS/CDFW Vegetation Rapid Assessment protocol to gather simplified, general information about a stand (see Appendix 2). Since the goal of the assessment was to gather information on healthy stands of WBP over a large area, the three purposes of the recon form were to collect data either on 1) WBP stands that were largely diseased or infested, 2) stands attributed as WBP by CALVEG but were incorrect, or 3) WBP stands that were close to stands sampled by a Rapid Assessment.

## Results

In August of 2013, CNPS staff assessed whitebark pine in two ranger districts (Amador and Pacific) in the Eldorado National Forest, and two regions were visited, Desolation and Mokelumne wilderness areas (see Appendix 3 for overview maps). In the Desolation Wilderness, whitebark pine was restricted to elevations around 2,745 m (9,000 ft.) along Crystal Range, Red Peak area. Obvious signs of MPB impacts to whitebark pine were found in the high elevations near Lois Lake (off Rockbound Trail). Here evidence of MPB hits on whitebark pine stems was found, along with more symptoms of WPBR and more stem mortality in all *Pinus* spp. Upright stands were the most impacted and overall more krummholz than upright stands were observed. As a general observation, stands lower along the slopes were the most impacted and stands along the ridgelines (krummholz dominant) were healthier, with little to no impacts. In two days, 3 rapid assessments (whitebark pine dominant) and 8 recons (4 CALVEG polys of whitebark pine dominant, 2 of mixed conifer with whitebark pine and 2 CALVEG polys of mixed conifer without whitebark pine) were conducted. Less area was surveyed due to the steepness of the ridgelines and difficulty in accessing whitebark pine.

In the Mokelumne Wilderness, most of the assessment was conducted in the Round Top Botanical Area near Carson Pass. In two days, 5 rapid assessments (whitebark pine dominant) and 10 recons (6 CALVEG polygons of whitebark pine dominant, 3 of mixed conifer with whitebark pine and 1 polygon of mixed conifer without whitebark pine) were conducted. Whitebark pine was abundant from Frog Lake to Winnemucca Lake to Fourth of July Peak from 2680 – 2925 m (8800 – 9600 ft.). Lower in elevation, North of Frog Lake (below 2680 m or 8800 ft), the stands were mixed with *Pinus monticola*, *Pinus contorta*, *Abies magnifica* and *Juniperus occidentalis*; however, south of Frog Lake (above 2680 m) along Elephants Back to Fourth of July Peak the stands were pure *Pinus albicaulis*. All of the areas surveyed in the Mokelumne Wilderness had little stem/tree mortality and most of the stem mortality and branch death appeared to be from unknown/natural causes. No signs of mortality due to Mountain Pine Beetle (MPB) or White Pine Blister Rust (WPBR) were obvious in this region, and the general stand health was good. Also, the whitebark pine stands assessed and observed were mostly upright and not krummholz. Stands, such as these, provide better habitat for wildlife but consequently are more prone to attack from MPB and WPBR (personal communication Marc Meyer). One margins dataset point by Dunlap from 2004-2006 was assessed on the west side of Winnemucca Lake. It had previously been recorded as having a presence of WPBR but no presence of MPB. During our assessment, the stand looked healthy with no strong evidence of WPBR infection. One *Pinus albicaulis* was found dead with no obvious cause of death.

In the Eldorado National Forest, the total area attributed as Whitebark Pine (WBP) for the Regional Dominance Type was 116 hectares (287 acres) in the CALVEG map (see Table 1). The two wilderness areas that we assessed totaled about 45 hectares (110 acres) of the CALVEG map, or about 38% of the total. In the Desolation Wilderness over 50% (12 ha ÷ 22 ha) of the CALVEG polygons attributed as WBP were assessed by CNPS as incorrect (Table 1). In addition, about 72% (28 ha ÷ 39 ha) of the CALVEG polygons that are in the updated CNPS delineation of *Pinus albicaulis* Alliance were attributed inaccurately (see Table 2). In the Mokelumne Wilderness, approximately 9% (2 ha ÷ 22 ha) of the CALVEG polygons attributed as WBP were assessed by CNPS as incorrect (Table 1). In addition, about 90 % (146 ha ÷ 162 ha) of the CALVEG polygons that are in the updated CNPS delineation of the *Pinus albicaulis* Alliance were attributed inaccurately (see Table 3).

**Table 1.** CALVEG delineation in hectares, acres in parentheses, of Whitebark Pine Regional Dominance Type and CNPS delineation of *Pinus albicaulis* Alliance in the portions of Desolation and Mokelumne Wilderness areas that were assessed.

	CALVEG delineation	CALVEG negative and altered delineations	CNPS updated delineations in Eldorado NF	CNPS updated delineation not originally in CALVEG	Updated delineation in Eldorado and Toiyabe NFs
Desolation Wilderness	<b>22</b> (55)	<b>12</b> (29)	<b>38</b> (95)	<b>28</b> (69)	<b>39</b> (95)
Mokelumne Wilderness	<b>22</b> (55)	<b>2</b> (5)	<b>151</b> (372)	<b>142</b> (351)	<b>162</b> (401)
Totals with the National Forest(s)	<b>116</b> (287)	<b>14</b> (34)	<b>189</b> (467)	<b>170</b> (420)	<b>201</b> (496)

The increase in the *Pinus albicaulis* Alliance vegetation type was approximately 265% in Desolation Wilderness and approximately 700% in Mokelumne. With only about one third of the CALVEG distribution assessed, we increased the delineated area in Eldorado NF by 166%.

The CALVEG delineations for WBP ranged from 2,613 m – 2,999 m, with a mean value of 2,820 m. The CNPS updated delineations of WBP similarly ranged from 2,631 – 2,916 m with a mean value of 2,766 m. Therefore, our delineations are on average slightly lower in mean elevation.

For more detailed summary information from this field work see Appendix 4. Photographs of field sites are provided in Appendix 5, and detailed maps of the field sites and updated delineations of whitebark pine are in Appendix 6. The updated delineations show areas previously mapped as Whitebark Pine for Regional Dominance Type that were not found in the field, and areas not previously mapped that were found to have whitebark pine dominant.

**Table 2.** Comparison of the CALVEG map of Regional Dominance Types and the updated CNPS delineations for *Pinus albicaulis* Alliance in Desolation Wilderness (hectares in bold, acres in parentheses)

Regional Dominance Type of CALVEG	CALVEG	CNPS (total area mapped)	CNPS (additional area mapped)
Barren	<b>17</b> (42)		
Subalpine conifers*	<b>11</b> (26)		
Whitebark pine	<b>11</b> (26)	<b>39</b> (95)	<b>28</b> (69)
<b>Total</b>	<b>39</b> (95)	<b>39</b> (95)	<b>28</b> (69)

\* Note: Subalpine conifers may include whitebark pine trees, but the whitebark pine would have less relative cover.

**Table 3.** Comparison of the CALVEG map of Regional Dominance Types and updated CNPS delineations for *Pinus albicaulis* Alliance in Mokelumne Wilderness (hectares in bold, acres in parentheses)

Regional Dominant Vegetation types	CALVEG	CNPS (total area mapped)	CNPS (additional area mapped)
Barren	<b>83</b> (204)		
Whitebark pine	<b>20</b> (50)	<b>162</b> (401)	<b>142</b> (351)
Subalpine conifers*	<b>19</b> (46)		
Upper montane mixed shrub	<b>10</b> (24)		
Alpine grasses and forbs	<b>6</b> (15)		
Lodgepole pine	<b>6</b> (14)		
Annual grasses and forbs	<b>6</b> (14)		
Willow (riparian scrub)	<b>5</b> (11)		
Low sagebrush	<b>3</b> (7)		
Red fir	<b>2</b> (4)		
Perennial grasses and forbs	<b>2</b> (4)		
Big sagebrush	<b>1</b> (3)		
Upper montane mixed chaparral	<b>1</b> (3)		
Wet grasses and forbs	<b>1</b> (2)		
Perennial Lakes or Ponds	<b>1</b> (2)		
Huckleberry oak	<b>0.1</b> (0.3)		
<b>Total</b>	<b>162</b> (401)	<b>162</b> (401)	<b>142</b> (351)

\* Note: Subalpine conifers may include whitebark pine trees, but the whitebark pine would have less relative cover.

## Conclusions and Discussion

The whitebark pine field work in Eldorado National Forest was important in assessing the overall distribution of this vegetation, including significant increases in mapped areas of whitebark pine compared to previous delineations from remote sensing. The total amount of *Pinus albicaulis* Alliance delineated through photo-interpretation after the field assessment was approximately 201 hectares (496 acres); this includes CALVEG polygons confirmed as Whitebark Pine for the Regional Dominance Type and stands assessed on the ground during the survey. The increase in mapped area for Mokelumne Wilderness Area was substantial, with a 700% change. In Eldorado NF all four of the CALVEG polygons that had been attributed incorrectly were *Tsuga mertensiana* Alliance. Updated delineations of the *Pinus albicaulis* Alliance have also been imported into a new state draft map from the 7 forests that were visited in the summer/fall of 2013 (See Figure 2).

Using the California Natural Diversity Database (CNDDDB ) protocol for documenting overall quality and viability of whitebark pine stands observed in the Mokelumne and Desolation wilderness areas, we conclude that stands overall had good to excellent viability (probability of persistence) over the next 20 years. Due to size of stands, amount of threat/impacts, abiotic and biotic conditions, and signs of reproductive health, whitebark pine in these areas of the Eldorado NF, representing about 38% of the estimated area dominated by the species according to CALVEG, are relatively healthy. Additionally, no evidence of increased WPBR infection was detected in the area since the Dunlap survey of 2004-2006. We recommend future surveys in the area to include a long-term monitoring protocol, such as provided in Appendix 7, since this area is easily accessible for monitoring.

Areas of concern in the Eldorado NF are whitebark pine stands in the southern Desolation Wilderness near Tyler Lake and Blue Mountain. Long-term monitoring plots have been established in these locations by Central Sierra Province Ecologist, Becky Estes, to detect the change in MPB infestation over time; these areas were picked for monitoring purposes due to their evidence of MPB attack. Overall quality and viability of these stands may differ substantially from the areas assessed for this project. For an understanding of the overall health of whitebark pine in the Eldorado NF, the Estes long-term monitoring plot data will be an important addition for the health assessment and management of whitebark pine in this region.

## Data Gaps and Recommendations for Future Work

Areas for priority assessment in the Eldorado National Forest are CALVEG polygons in the Desolation Wilderness near McConnel Peak and Mount Price; these areas were suggested by

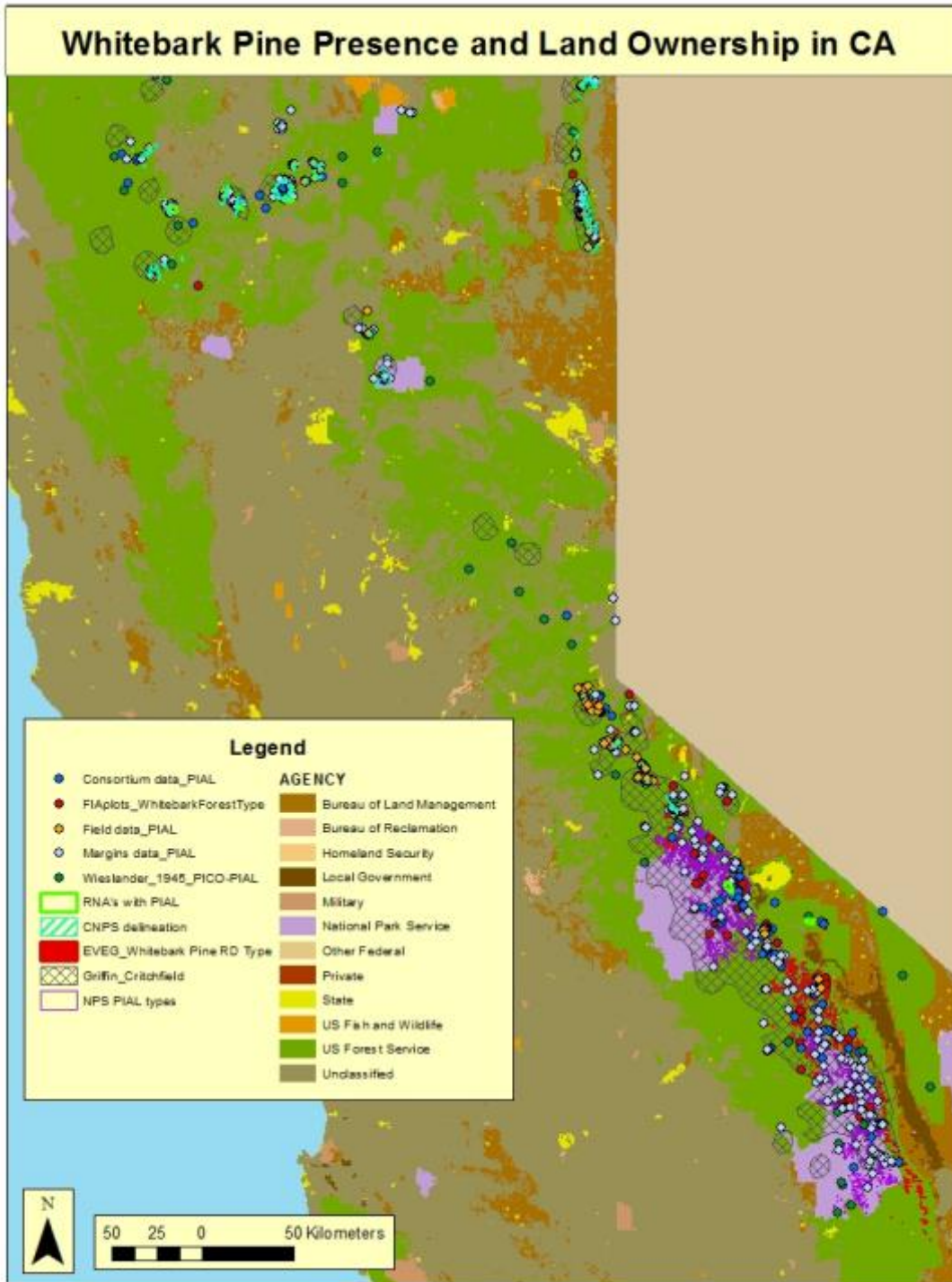
Becky Estes, Central Sierra Province Ecologist, as probable locations for healthy stands. In the Mokelumne Wilderness, CALVEG polygons south of the Round Top Botanical Area near Deadwood Peak would be recommended to ground truth and stands north of Forestdale Divide along the PCT were suggested by Cecilia Reed, Mokelumne Wilderness Manager, to assess; however, these stands would be primarily in the Toiyabe National Forest (Region 4).

As stated above, priority areas for long term monitoring would be the Mokelumne Wilderness in the Round Top Botanical Area; since healthy, upright stands of whitebark pine can be easily accessed in a 1-2 hour hike. In the Desolation Wilderness, since Becky Estes has been establishing long term monitoring plots in stands infested or attacked by MBP, this area would be good to assess further for healthy stands and then establish long term monitoring plots.

Areas of priority for future assessment in other National Forests are as follows: 1) northern Sequoia NF in the Monarch and Jennie Lakes Wilderness areas near 3,000 m (10,000 ft) 2) southern Sierra NF in the Monarch Wilderness and CALVEG polygons near Florence and Edison Lakes 3) Lake Tahoe Basin near Relay and Freel Peaks 4) southern Inyo NF CALVEG polygons in the Golden Trout Wilderness 5) northern Inyo NF Research Natural Areas, Sentinel Meadow and Harvey Monroe Hall, based on ecological surveys (Keeler-Wolf 1990) and 6) Stanislaus NF peaks above 2,700 m (9,000 ft) in Carson-Iceberg and Emigrant Wilderness areas.

Lastly, this report is not comprehensive; it was based upon the available funding and resources for pilot fieldwork and the USDA Forest Service staff schedules in 2013. The draft map of whitebark pine distribution (see Figure 2) is therefore not complete but provides an updated version of its distribution from field surveys and aerial interpretation with limited modeled data. The modeled data presented from CALVEG in Figure 2 can be used to prioritize additional areas for field assessments, since from our calculation CALVEG is less than 20% accurate for the Whitebark Pine Regional Dominance Type.





**Figure 2.** Draft map of whitebark pine presence and land ownership in California. Field data\_PIAL includes all PIAL data points collected from CNPS in 2013, USFS botanist survey/research points, academic research points, etc. Land ownership layer is from the Bureau of Land Management (BLM 2014), <http://www.blm.gov/ca/gis/>. Note: Private property is classified mostly as Unclassified in this map. Figure by Sara Taylor.

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## **Appendix 1: Key Individuals/Contacts**

Matt Brown	Botanist/Forest Noxious Weed Coordinator, Eldorado National Forest, USFS
Becky Estes	Central Sierra Province Ecologist, Pacific Southwest Region, USFS
Shana Gross	Ecologist, Lake Tahoe Basin Management Unit, USFS
Marc Meyer	South Sierra Province Ecologist, USFS
Cecilia Reed	Winter Sports & Mokelumne Wilderness Manager, Amador Ranger District, Eldorado National Forest, USFS
Cynthia Snyder	Entomologist, Northern California Shared Service Center, USFS

## Appendix 2: Inventory and Monitoring Protocols / Field Forms from 2013

CALIFORNIA NATIVE PLANT SOCIETY / DEPARTMENT OF FISH AND GAME PROTOCOL  
FOR COMBINED VEGETATION RAPID ASSESSMENT  
AND RELEVÉ SAMPLING FIELD FORM  
(Modified for WBP)  
July 8, 2013

### Introduction

This protocol describes the methodology for both the relevé and rapid assessment vegetation sampling techniques as recorded in the combined relevé and rapid assessment field survey form dated June 28, 2013. The same environmental data are collected for both techniques. However, the relevé sample is plot-based, with each species in the plot and its cover being recorded. The rapid assessment sample is based not on a plot but on the entire stand, with 12-20 of the dominant or characteristic species and their cover values recorded. For more background on the relevé and rapid assessment sampling methods, see the relevé and rapid assessment protocols at [www.cnps.org](http://www.cnps.org).

### Selecting stands to sample:

To start either the relevé or rapid assessment method, a stand of vegetation needs to be defined.

A stand is the basic physical unit of vegetation in a landscape. It has no set size. Some vegetation stands are very small, such as alpine meadow or tundra types, and some may be several square kilometers in size, such as desert or forest types. A stand is defined by two main unifying characteristics:

- 1) It has compositional integrity. Throughout the site, the combination of species is similar. The stand is differentiated from adjacent stands by a discernable boundary that may be abrupt or indistinct.
- 2) It has structural integrity. It has a similar history or environmental setting that affords relatively similar horizontal and vertical spacing of plant species. For example, a hillside forest originally dominated by the same species that burned on the upper part of the slopes, but not the lower, would be divided into two stands. Likewise, sparse woodland occupying a slope with very shallow rocky soils would be considered a different stand from an adjacent slope with deeper, moister soil and a denser woodland or forest of the same species.

The structural and compositional features of a stand are often combined into a term called homogeneity. For an area of vegetated ground to meet the requirements of a stand, it must be homogeneous (uniform in structure and composition throughout).

Stands to be sampled may be selected by evaluation prior to a site visit (e.g., delineated from aerial photos or satellite images), or they may be selected on site during reconnaissance (to determine extent and boundaries, location of other similar stands, etc.).

Depending on the project goals, you may want to select just one or a few representative stands of each homogeneous vegetation type for sampling (e.g., for developing a classification for a

vegetation mapping project), or you may want to sample all of them (e.g., to define a rare vegetation type and/or compare site quality between the few remaining stands).

*For the rapid assessment method, you will collect data based on the entire stand.*

### **Selecting a plot to sample within in a stand (for relevés only):**

Because many stands are large, it may be difficult to summarize the species composition, cover, and structure of an entire stand. We are also usually trying to capture the most information as efficiently as possible. Thus, we are typically forced to select a representative portion to sample.

When sampling a vegetation stand, the main point to remember is to select a sample that, in as many ways possible, is representative of that stand. This means that you are not randomly selecting a plot; on the contrary, you are actively using your own best judgment to find a representative example of the stand.

Selecting a plot requires that you see enough of the stand you are sampling to feel comfortable in choosing a representative plot location. Take a brief walk through the stand and look for variations in species composition and in stand structure. In many cases in hilly or mountainous terrain look for a vantage point from which you can get a representative view of the whole stand. Variations in vegetation that are repeated throughout the stand should be included in your plot. Once you assess the variation within the stand, attempt to find an area that captures the stand's common species composition and structural condition to sample.

### **Plot Size**

All relevés of the same type of vegetation to be analyzed in a study need to be the same size. Plot shape and size are somewhat dependent on the type of vegetation under study. Therefore, general guidelines for plot sizes of tree-, shrub-, and herbaceous communities have been established. Sufficient work has been done in temperate vegetation to be confident the following conventions will capture species richness:

Herbaceous communities: 100 sq. m plot

Special herbaceous communities, such as vernal pools, fens: 10 sq m plot

Shrublands and Riparian forest/woodlands: 400 sq. m plot

Open desert and other shrublands with widely dispersed but regularly occurring woody species: 1000 sq. m plot

Upland Forest and woodland communities: 1000 sq. m plot

### **Plot Shape**

A relevé has no fixed shape, though plot shape should reflect the character of the stand. If the stand is about the same size as a relevé, the plot boundaries may be similar to that of the entire stand. If we are sampling streamside riparian or other linear communities, our plot dimensions should not go beyond the community's natural ecological boundaries. Thus, a relatively long, narrow plot capturing the vegetation within the stand, but not outside it would be appropriate. Species present along the edges of the plot that are clearly part of the adjacent stand should be excluded.

If we are sampling broad homogeneous stands, we would most likely choose a shape such as a circle (which has the advantage of the edges being equidistant to the center point) or a square (which can be quickly laid out using perpendicular tapes).

## **Definitions of fields in the protocol**

**Relevé or Rapid Assessment:** Circle the method that you are using.

### **I. LOCATIONAL/ENVIRONMENTAL DESCRIPTION**

**Polygon/Stand #:** Number assigned either in the field or in the office prior to sampling. It is usually denoted with a four-letter abbreviation of the sampling location and then a four-number sequential number of that locale (e.g. CARR0001 for Carrizo sample #1). The maximum number of letters/numbers is eight.

**Air photo #:** The number given to the aerial photo in a vegetation-mapping project, for which photo interpreters have already done photo interpretation and delineations of polygons. If the sample site has not been photo-interpreted, leave blank.

**Date:** Date of the sampling.

**Name(s) of surveyors:** The full names of each person assisting should be provided for the first field form for the day. On successive forms, initials of each person assisting can be recorded. Please note: The person recording the data on the form should circle their name/initials.

**GPS waypoint #:** The waypoint number assigned by a Global Positioning System (GPS) unit when marking and storing a waypoint for the sample location. Stored points should be downloaded in the office to serve as a check on the written points and to enter into a GIS.

*For relevé plots, take the waypoint in the southwest corner of the plot or in the center of a circular plot.*

**GPS name:** The name/number assigned to each GPS unit. This can be the serial number if another number is not assigned.

**Datum: (NAD 83)** The standard GPS datum used is NAD 83. If you are using a different datum, note it here.

**Bearing, left axis at SW pt (note in degrees) of Long or Short side:** For square or rectangular plots: from the SW corner (= the GPS point location), looking towards the plot, record the bearing of the axis to your left. If the plot is a rectangle, indicate whether the left side of the plot is the long or short side of the rectangle by circling "long" or "short" side (no need to circle anything for circular or square plots). If there are no stand constraints, you would choose a circular or square plot and straight-sided plots should be set up with boundaries running in the cardinal directions. If you choose a rectangular plot that is not constrained by the stand dimensions, the short side should run from east to west, while the long side should run from north to south.

**UTM coordinates:** Easting (UTME) and northing (UTMN) location coordinates using the Universal Transverse Mercator (UTM) grid. Record in writing the information from a GPS unit or a USGS topographic map.



**UTM zone:** Universal Transverse Mercator zone. Zone 10 is for California west of the 120<sup>th</sup> longitude, zone 11 is for California east of 120<sup>th</sup> longitude, which is the same as the straight portion of California's eastern boundary.

**Error:** ± The accuracy of the GPS location, when taking the UTM field reading. Please record the error units by circling feet (ft), meters (m), or positional dilution of precision (pdop). If your GPS does not determine error, insert N/A in this field.

**Is GPS within stand? Yes / No** Circle "Yes" to denote that the GPS waypoint was taken directly within or at the edge of the stand being assessed for a rapid assessment, or circle "No" if the waypoint was taken at a distance from the stand (such as with a binocular view of the stand).

**If No, cite from waypoint to stand, distance (note in meters) & bearing (note in degrees):** An estimate of the number of meters and the compass bearing from the GPS waypoint to the stand.

**Elevation:** Recorded from the GPS unit or USGS topographic map. Please circle feet (ft) or meters (m).

**Photograph #s:** Write the name or initials of the camera owner, JPG/frame number, and direction of photos (note the roll number if using film). *Take four photos in the main cardinal directions (N, E, S, W) clockwise from the north, from the GPS location.* If additional photos are taken in other directions, please note this information on the form. Also include overview photos of Whitebark pine.

**Stand Size:** Estimate the size of the entire stand in which the sample is taken. As a measure, one acre is about 4000 square meters (approximately 64 x 64 m), or 208 feet by 208 feet. One acre is similar in size to a football field.

**Plot Size:** If this is a relevé, circle the size of the plot.

**Plot Shape:** Record the length and width of the plot and circle measurement units (i.e., ft or m). If it is a circular plot, enter radius (or just put a check mark in the space).

**Exposure:** (Enter actual ° and circle general category): With your back to the general uphill direction of the slope (i.e., by facing downhill of the slope), read degrees of the compass for the aspect or the direction you are standing, using degrees from north, adjusted for declination. Average the reading over the entire stand, even if you are sampling a relevé plot, since your plot is representative of the stand. If estimating the exposure, write "N/A" for the actual degrees, and circle the general category chosen. "Variable" may be selected if the same, homogenous stand of vegetation occurs across a varied range of slope exposures. Select "all" if stand is on top of a knoll that slopes in all directions or if the same, homogenous stand of vegetation occurs across all ranges of slope.

**Steepness:** (Enter actual ° and circle general category): Read degree slope from a compass or clinometer. If estimating, write "N/A" for the actual degrees, and circle the general category chosen.. Make sure to average the reading across the entire stand even if you are sampling in a relevé plot.

**Topography:** First assess the broad (**Macro**) topographic feature or general position of the stand in the surrounding watershed, that is, the stand is at the top, upper (1/3 of slope), middle (1/3 of slope), lower (1/3 of slope), or bottom. **Circle all of the positions that apply for macrotopography.**

Then assess the local (**Micro**) topographic features or the lay of the area (e.g., surface is flat or concave). **Circle only one of the microtopographic descriptors.**

**Geology:** Geological parent material of site. If exact type is unknown, use a more general category (e.g., igneous, metamorphic, sedimentary). *See code list for types.*

**Soil Texture:** Record soil texture that is characteristic of the site (e.g., coarse loamy sand, sandy clay loam). *See soil texture key and code list for types.*

**Upland or Wetland/Riparian** (circle one): Indicate if the stand is in an upland or a wetland. There are only two options. Wetland and riparian are one category. Note that a site need not be officially delineated as a wetland to qualify as such in this context (e.g., seasonally wet meadow).

**% Surface cover (abiotic substrates).** It is helpful to imagine “mowing off” all of the live vegetation at the base of the plants and removing it – you will be estimating what is left covering the surface. **The total should sum to 100%.** Note that non-vascular cover (lichens, mosses, cryptobiotic crusts) is not estimated in this section.

**% Water:** Estimate the percent surface cover of running or standing water, ignoring the substrate below the water.

**% BA Stems:** Percent surface cover of the plant basal area, *i.e.*, the basal area of stems at the ground surface. Note that for most vegetation types BA is 1-3% cover. Estimate for a set area (e.g., 400 m<sup>2</sup>) of BA to help calibrate on this % (on average % is between 1.5-4.5% for conifers)

**% Litter:** Percent surface cover of litter, duff, or wood on the ground.

**% Bedrock:** Percent surface cover of bedrock.

**% Boulders:** Percent surface cover of rocks > 60 cm in diameter.

**% Stone:** Percent surface cover of rocks 25-60 cm in diameter.

**% Cobble:** Percent surface cover of rocks 7.5 to 25 cm in diameter.

**% Gravel:** Percent surface cover of rocks 2 mm to 7.5 cm in diameter.

**% Fines:** Percent surface cover of bare ground and fine sediment (e.g. dirt) < 2 mm in diameter.

**% Current year bioturbation:** Estimate the percent of the sample or stand exhibiting soil disturbance by fossorial organisms (any organism that lives underground). Do not include disturbance by ungulates. Note that this is a separate estimation from surface cover.

**Past bioturbation present?** Circle Yes if there is evidence of bioturbation from previous years.

**% Hoof punch:** Note the percent of the sample or stand surface that has been punched down by hooves (cattle or native grazers) in wet soil.

**Fire Evidence:** Circle Yes if there is visible evidence of fire, and note the type of evidence in the “Site history, stand age and comments section,” for example, “charred dead stems of *Quercus berberidifolia* extending 2 feet above resprouting shrubs.” If you are certain of the year of the fire, put this in the Site history section.

**Site history, stand age, and comments:** Briefly describe the stand age/seral stage, disturbance history, nature and extent of land use, and other site environmental and vegetation factors. Examples of disturbance history: fire, landslides, avalanching, drought, flood, animal burrowing, or pest outbreak. Also, try to estimate year or frequency of disturbance. Examples of land use: grazing, timber harvest, or mining. Examples of other site factors: exposed rocks, soil with fine-textured sediments, high litter/duff build-up, multi-storied vegetation structure, or other stand dynamics.

**Disturbance code / Intensity (L,M,H):** List codes for potential or existing impacts on the stability of the plant community. Characterize each impact each as **L** (=Light), **M** (=Moderate), or **H** (=Heavy). For invasive exotics, divide the total exotic cover (e.g. 25% *Bromus diandrus* + 8% *Bromus madritensis* + 5% *Centaurea melitensis* = 38% total exotics) by the total % cover of all the layers when added up (e.g. 15% tree + 5% low tree + 25% shrub + 40% herbs = 85% total) and multiply by 100 to get the % relative cover of exotics (e.g. 38% total exotics/85% total cover = 45% relative exotic cover). L = 0-33% relative cover of exotics; M = 34-66% relative cover, and H = > 66% relative cover. See code list for impacts.

List percent of WBP impacted by Mountain Pine Beetle (39-MPB/L/approx. % impacted) and White Pine Blister Rust (40-WPBR/H/approx. % impacted) within the stand. For Mountain Pine Beetle, search the bole for entry holes (reddish colored pitch) or frass. For WPBR, search for 'signs' of an active canker (i.e., a canker with visible aecia, or fruiting bodies containing spores), or 'symptoms' of any of the following five indicators: rodent chewing, flagging, swelling, roughened bark, and oozing sap. Explain signs and symptoms in the notes and take photos when necessary.

## II. HABITAT AND VEGETATION DESCRIPTION

### ***California Wildlife-Habitat Relationships (CWHR)***

For CWHR, identify the size/height class of the stand using the following tree, shrub, and/or herbaceous categories. These categories are based on functional life forms.

**Tree DBH:** Circle one of the tree size classes provided when the tree canopy closure exceeds 10 percent of the total cover, or if young tree density indicates imminent tree dominance. Size class is based on the average diameter at breast height (dbh) of each trunk (standard breast height is 4.5ft or 137cm). When marking the main size class, make sure to estimate the mean diameter of all trees over the entire stand, and weight the mean if there are some larger tree dbh's. The "**T6 multi-layered**" dbh size class contains a multi-layered tree canopy (with a size class T3 and/or T4 layer growing under a T5 layer and a distinct height separation between the classes) exceeding 60% total cover. Stands in the T6 class need also to contain at least 10% cover of size class 5 (>24" dbh) trees growing over a distinct layer with at least 10% combined cover of trees in size classes 3 or 4 (>11-24" dbh). This is weighted: In your representative area add number of trees for each category and record above (T1,T2,T3, etc). Can square root later to get the weighted average for this category (if there are many sizes).

**Shrub:** Circle one of the shrub size classes provided when shrub canopy closure exceeds 10 percent (except in desert types) by recording which class is predominant in the survey. Shrub

size class is based on the average amount of crown decadence (dead standing vegetation on live shrubs when looking across the crowns of the shrubs).

**Herb:** Circle one of the herb height classes when herbaceous cover exceeds 2 percent by recording the predominant class in the survey. Note: *This height class is based on the average plant height at maturity, not necessarily at the time of observation.*

**Desert Palm/Joshua Tree:** Circle one of the palm or Joshua tree size classes by averaging all the stem-base diameters (*i.e.* mean diameter of all stem-base sizes). Diameter is measured at the plant's base above the bulge near the ground.

**Desert Riparian Tree/Shrub:** Circle one of the size classes by measuring mean stem height (whether tree and/or shrub stand).

### ***Overall Cover of Vegetation***

Provide an estimate of cover for the following categories below (based on functional life forms). Record a specific number for the total aerial cover or "bird's-eye view" looking from above for each category, estimating cover for the living plants only. Litter/duff should not be included in these estimates. The porosity of the vegetation should be taken into consideration when estimating percent cover (how much of the sky can you see when you are standing under the canopy of a tree, or how much light passes through the canopy of the shrub layer?).

To come up with a specific number estimate for percent cover, first use generalized cover classes as reference aids such as the CWHR cover classes (<2%, 2-9%, 10-24%, 25-39%, 40-59%, 60-100%) or the modified Braun-Blanquet cover-abundance scale (<1%, 1-5%, >5-15%, >15-25%, >25-50%, >50-75%, >75%). While keeping these intervals in mind, you can then refine your estimate to a specific percentage for each category below.

**% Total NonVasc cover:** The total cover of all lichens, bryophytes (mosses, liverworts, hornworts), and cryptogammic crust on substrate surfaces including downed logs, rocks and soil, but not on standing or inclined trees or vertical rock surfaces.

**% Total Vasc Veg cover:** The total cover of all vascular vegetation taking into consideration the porosity, or the holes, in the vegetation. This is an estimate of the absolute vegetation cover, disregarding overlap of the various tree, shrub, and/or herbaceous layers and species. Could use densitometer to calibrate, but sometimes this provides an over-estimate.

### ***% Cover by Layer***

**% Conifer Tree /Hardwood Tree:** The total foliar cover (considering porosity) of all live tree species, disregarding overlap of individual trees. Estimate conifer and hardwood covers separately.

**Please note:** These cover values should not include the coverage of regenerating tree species (*i.e.*, tree seedlings and saplings).

**% Regenerating Tree:** The total foliar cover of seedlings and saplings, disregarding overlap of individual recruits. See seedling and sapling definitions below.

**%Shrub:** The total foliar cover (considering porosity) of all live shrub species disregarding overlap of individual shrubs.

**%Herbaceous:** The total cover (considering porosity) of all herbaceous species, disregarding overlap of individual herbs.

### **Height Class by Layer**

Modal height for conifer tree /hardwood tree, shrub, and herbaceous categories: Provide an estimate of height for each category listed. Record an average height value per each category by estimating the mean height for each group. Please use the following height intervals to record a height class: 01 =< 1/2m, 02=1/2-1m, 03 = 1-2 m, 04 = 2-5 m, 05 = 5-10 m, 06 = 10-15 m, 07 = 15-20 m, 08 = 20-35 m, 09 = 35-50 m, 10 => 50m.

### **Species List and Coverage**

- If mistletoe present add in what species it is living on
- Record absolute percent cover of dead tree species (can include saplings and seedlings)

**For rapid assessments,** list the 10-20 species that are dominant or that are characteristically consistent throughout the stand. These species may or may not be abundant, but they should be constant representatives in the survey. When different layers of vegetation occur in the stand, make sure to list species from each stratum. As a general guide, make sure to list at least 1-2 of the most abundant species per stratum.

**For relevés,** list all species present in the plot, using the second species list page if necessary.

**For both sample types,** provide the stratum:

**T = Tree.** A woody perennial plant that has a single trunk.

**S = Shrub.** A perennial, woody plant, that is multi-branched and doesn't die back to the ground every year.

**H = Herb.** An annual or perennial that dies down to ground level every year.

**E = SEedling.** A tree species clearly of a very young age that is < 1" dbh.

**A = SApling.** 1" - <6" dbh and young in age, OR small trees that are < 1" diameter at breast height, are clearly of appreciable age, and kept short by repeated browsing, burning, or other disturbance.

**N = Non-vascular.** Includes moss, lichen, liverworts, hornworts, cryptogammic crust, and algae.

Be consistent and don't break up a single species into two separate strata. The only time it would be appropriate to do so is when one or more tree species are regenerating, in which case the Seedling and/or Sapling strata should be recorded for that species. These may be noted on the same line, e.g.:

<b>Strata</b>	<b>Species</b>	<b>%Cover</b>	<b>C</b>
T/E/A	Quercus douglasii	40/<1/<1	

If a species collection is made, it should be indicated in the collection column with a "C" (for collected). If the species is later keyed out, cross out the species name or description and write the keyed species name in pen on the data sheet. Do not erase what was written in the field, because this information can be used if specimens get mixed up later. If the specimen is then thrown out, the "C" in the collection column should be crossed out. If the specimen is kept but is

still not confidently identified, add a “U” to the “C” in the collection column (CU = collected and unconfirmed). In this case the unconfirmed species epithet should be put in parentheses [e.g. *Hordeum (murinum)*]. If the specimen is kept and is confidently identified, add a “C” to the existing “C” in the collection column (CC = Collected and confirmed).

Use Jepson Manual nomenclature. Write out the genus and species of the plant. Do not abbreviate. When uncertain of an identification (which you intend to confirm later) use parentheses to indicate what part of the determination needs to be confirmed. For example, you could write out *Brassica (nigra)* if you are sure it is a *Brassica* but you need further clarification on the specific epithet.

Provide the % absolute aerial cover for each species listed. When estimating, it is often helpful to think of coverage in terms of the following cover intervals at first:

<1%, 1-5%, >5-15%, >15-25%, >25-50%, >50-75%, >75%.

Keeping these classes in mind, then refine your estimate to a specific percentage. All species percent covers may total over 100% because of overlap.

Include the percent cover of snags (standing dead) of trees and shrubs. Note their species, if known, in the “Stand history, stand age and comments” section.

For rapid assessments, make sure that the major non-native species occurring in the stand also are listed in the space provided in the species list with their strata and % cover. For relevés, all non-native species should be included in the species list.

Also for relevés, you can record the <1% cover in two categories: r = trace (i.e., rare in plot, or solitary individuals) and + = <1% (few individuals at < 1% cover, but common in the plot).

**Unusual species:** List species that are locally or regionally rare, endangered, or atypical (e.g., range extension or range limit) within the stand. This field will be useful to the Program for obtaining data on regionally or locally significant populations of plants.

## INTERPRETATION OF STAND

**Field-assessed vegetation alliance name:** Name of alliance or habitat following the most recent CNPS classification system or the Manual of California Vegetation (Sawyer J.O., Keeler-Wolf T., and Evens, J. 2009). Please use scientific nomenclature, e.g., *Quercus agrifolia* forest. An alliance is based on the dominant or diagnostic species of the stand, and is usually of the uppermost and/or dominant height stratum. A dominant species covers the greatest area. A diagnostic species is consistently found in some vegetation types but not others.

Please note: The field-assessed alliance name may not exist in the present classification, in which case you can provide a new alliance name in this field. If this is the case, also make sure to state that it is not in the MCV under the explanation for “Confidence in alliance identification.”

**Field-assessed association name** (optional): Name of the species in the alliance and additional dominant/diagnostic species from any strata, as according to CNPS classification. In following naming conventions, species in differing strata are separated with a slash, and species in the uppermost stratum are listed first (e.g., *Quercus douglasii/Toxicodendron diversilobum*).

Species in the same stratum are separated with a dash (e.g., *Quercus lobata-Quercus douglasii*).

Please note: The field-assessed association name may not exist in the present classification, in which you can provide a new association name in this field.

**Adjacent Alliances/direction:** Identify other vegetation types that are directly adjacent to the stand being assessed by noting the dominant species (or known type). Also note the distance away in meters from the GPS waypoint and the direction in degrees aspect that the adjacent alliance is found

(e.g., *Amsinckia tessellata* / 50m, 360° N *Eriogonum fasciculatum* /100m, 110°).

**Confidence in Identification: (L, M, H)** With respect to the “field-assessed alliance name”, note whether you have L (=Low), M (=Moderate), or H (=High) confidence in the interpretation of this alliance name.

**Explain:** Please elaborate if your “Confidence in Identification” is low or moderate. Low confidence can occur from such things as a poor view of the stand, an unusual mix of species that does not meet the criteria of any described alliance, or a low confidence in your ability to identify species that are significant members of the stand.

**Phenology:** Indicate early (E), peak (P) or late (L) phenology for each of the strata.

**Other identification problems or mapping issues:** Discuss any further problems with the identification of the assessment or issues that may be of interest to mappers. Note if this sample represents a type that is likely too small to map. If it does, how much of the likely mapping unit would be comprised of this type. For example: “this sample represents the top of kangaroo rat precincts in this general area, which are surrounded by vegetation represented by CARR000x; this type makes up 10% of the mapping unit.” Depending on who mapped polygon (Calveg, etc); we should denote that information here.

**Is polygon >1 type: Yes / No** (circle one): In areas that have been delineated as polygons on aerial photographs/imagery for a vegetation-mapping project, assess if the polygon is mapped as a single stand. “Yes” is noted when the polygon delineated contains the field-assessed alliance and other vegetation type(s), as based on species composition and structure. “No” is noted when the polygon is primarily representative of the field-assessed alliance.

**If yes, explain:** If “Yes” above, explain the other vegetation alliances that are included within the polygon, and explain the amount and location that they cover in the polygon.

**Other CNDDDB/Whitebark Pine (WBP) monitoring Data:**

Trees/stems are assessed within a representative portion of the stand (using a specific radius or area for averaging).

**Mountain Pine Beetle (MPB) Level: Should equal 100%.**

Note the level of mountain pine beetle attack using the following:

0 = No evidence of attack or beetle pitch tubes or unknown

1 = less than 5 observable beetle pitch tubes ('hits')

2 = less than 50% of the bole is attacked; sporadic pitch tubes spread on most parts of the bole or several localized areas with a high density (>10) pitch tubes

3 = greater than 50% of the bole is attacked; numerous pitch tubes spread on many parts of the bole

**% of WBP Cones (female only):** Should equal 100%.

Record the number of cones in the tree/stem using the following numeric system:

0 = no cones

1 = 1 to 10 cones

2 = 11 to 100 cones

3 = greater than 100 cones

**Total # WBP individuals or clumps and size (CNDDDB):**

The number of individuals observed/detected during assessment. This should be recorded as clumps (or # of stems within # of clumps) per defined area (square meters, hectares, acres, etc.).

**Phenology of WBP (CNDDDB):** Should equal 100%.

The average percent of WBP that is vegetative, flowering (nascent female cones) and/or fruiting (mature female cones).

**% WBP mortality:**

These percentages are for mortality of trees/stems from mountain pine beetle (MPB) or white pine blister rust (WPBR); 'Other' can be % mortality from both MPB and WPBR; including WPBR mortality on other species E.g. WPBR-PIMO/PIBA 5% (white pine blister rust on *Pinus monticola* or *Pinus balfouriana* at 5% cover) or unknown causes.

**Overall site/occurrence quality/viability (site + population) (CNDDDB):**

Is the likely persistence of the occurrence into the future Excellent, Good, Fair, or Poor? This is an assessment of the overall viability of this occurrence. Both the quality & condition of the site and of the occurrence must be considered when scoring. Take into account population size, demography, viability over time, site condition, and any disturbances. And also see additional characteristics at: <http://www.natureserve.org/explorer/eorankguide.htm>

**Determination of WBP:** Please indicate how the species identification was determined.





Other identification or mapping information:	Phenology (E,P,L): Herb ___ Shrub ___ Tree ___
Is poly >1 type: Yes / No If yes, explain:	

**CNPS and CDFG Combined Vegetation Rapid Assessment and Relevé Field Form (modified for WBP project)  
Other CNDDDB/Whitebark Pine Monitoring Data:**

Polygon/Stand #:
MBP Level: 0=no attack ___% 1=>5 hits ___% 2=<50% of bole attacked ___% 3=>50% of bole attacked ___%
Avg % of WBP Cones: No cones ___% 1-10 cones ___% 11-100 ___% >100 ___%
Total # individuals or clumps (WBP) and size (CNDDDB) ___ # per ___ hectares
Phenology of WBP (CNDDDB): Vegetative ___% Flowering (cones) ___% Fruiting (cones) ___%
%WBP mortality: MPB ___% WPBR ___% Other: ___% ___%
Overall site/occurrence quality/viability (site + population) (CNDDDB): <input type="checkbox"/> Excellent <input type="checkbox"/> Good <input type="checkbox"/> Fair <input type="checkbox"/> Poor
Determination of WBP: Keyed ___ By another person (name) ___ Compared with photo/drawing ___ Other ___

## Field Reconnaissance Form

Surveyors: _____							Date: _____				
Polygon #: _____		GPS waypoint #: _____ GPS in stand? <u>Y / N</u> If No, distance/bearing: _____ / _____									
Correct <u>Y / N</u>		UTME _____			UTMN _____			Error: +/- _____ GPS name: _____			
Aspect: _____ Elevation: _____ ft/m							Size of stand: _____ acre				Photograph #'s: _____
Field alliance name: _____							Site Impacts: _____				
Comments: _____ _____											
Tree cover/ht /dbh: _____ / _____ / _____			Shrub cover/ht: _____ / _____			Herbaceous cover/ht: _____ / _____			% Density _____		
Strata	Species	% cover	Strata	Species	% cover	Strata	Species	% cover			
Polygon #: _____		GPS waypoint #: _____ GPS in stand? <u>Y / N</u> If No, distance/bearing: _____ / _____									
Correct <u>Y / N</u>		UTME _____			UTMN _____			Error: +/- _____ GPS name: _____			
Aspect: _____ Elevation: _____ ft/m							Size of stand: _____ acre				Photograph #'s: _____
Field alliance name: _____							Site Impacts: _____				
Comments: _____ _____											
Tree cover/ht /dbh: _____ / _____ / _____			Shrub cover/ht: _____ / _____			Herbaceous cover/ht: _____ / _____			% Density _____		
Strata	Species	% cover	Strata	Species	% cover	Strata	Species	% cover			
Polygon #: _____		GPS waypoint #: _____ GPS in stand? <u>Y / N</u> If No, distance/bearing: _____ / _____									
Correct <u>Y / N</u>		UTME _____			UTMN _____			Error: +/- _____ GPS name: _____			
Aspect: _____ Elevation: _____ ft/m							Size of stand: _____ acre				Photograph #'s: _____
Field alliance name: _____							Site Impacts: _____				
Comments: _____ _____											
Tree cover/ht /dbh: _____ / _____ / _____			Shrub cover/ht: _____ / _____			Herbaceous cover/ht: _____ / _____			% Density _____		
Strata	Species	% cover	Strata	Species	% cover	Strata	Species	% cover			

CNPS and CDEG Combined Vegetation Rapid Assessment and Relevé Field Form (modified for WBP project)

Relevé or Rapid Assessment (circle one) (Revised June 28, 2013)

For Office Use:	Final database #:	Final vegetation type name:	Alliance Association
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I. LOCATIONAL/ENVIRONMENTAL DESCRIPTION

Polygon/Stand #: ELDO 0404 Air photo: - Date: 8/12/2013 Name(s) of surveyors (circle recorder): sm, dlh, CR

GPS wpyt #: - GPS name: 1 Datum: - or NAD83. Bearing, left axis at SW pt (degrees) of Long / Short side  
 UTME 239482 UTMN 4204751 Zone: 10 11 (circle one) Error: ±2.7 ft / m / pdop

GPS within stand? Yes / No If No, cite from waypoint to stand, distance (meters) & bearing (degrees)

Elevation: 2737 ft/m Camera Name/Photograph #'s: newark 43-46 47-50 (in forest)

Stand Size (ac/ha): <1, 1-5 >5 ac 3 ac ha Plot Size (m): 10/100/400 Plot Shape x m or Circle Radius 60x100 m

Exposure, Actual °: 310 NE NW SE SW Flat Variable All | Steepness, Actual °: 2 0° 1-5° 5-25° >25

Topography: Macro: top upper mid lower bottom | Micro: convex flat concave undulating

Geology code: Garnite Soil Texture code: - | Upland or Wetland/Riparian (circle one)

% Surface cover: (Incl. outcrops) (>60cm diam) (25-60cm) (7.5-25cm) (2mm-7.5cm) (Incl sand, mud)  
 H20: 0 BA Stems: 1 Litter: 10 Bedrock: 1 Boulder: 10 Stone: 10 Cobble: 10 Gravel: 50 Fines: 8 =100%

% Current year bioturbation 0 Past bioturbation present? Yes / No | Fire evidence: Yes 0 No (if yes, explain below)

Habitat description, surrounding land use, comments (CNDDDB): open stand of whitebark pine w/ some patches of mountain hemlock. Some dead trees from mixed mPB & WPB. Photo taken. Madalume wilderness near Winnemucca Lake. Whitebark pine extends along Elphont's back above Campfire trail.

Disturbance / Intensity (L,M,H) 15/L / / / WBP Impact 39 / / 40 / /

II. HABITAT AND VEGETATION DESCRIPTION

Tree DBH: T1 (<1" dbh), T2 (1-6" dbh), T3 (6-11" dbh), T4 (11-24" dbh), T5 (>24" dbh), T6 multi-layered (T3 or T4 layer under T5, >60% cover)

Shrub: S1 seedling (<3 yr. old), S2 young (<1% dead), S3 mature (1-25% dead), S4 decadent (>25% dead)

Herbaceous: H1 (<2" plant ht.), H2 (>12" ht.) % Non Vasc cover: + % Vasc Veg cover: 38

% Cover - Conifer tree / Hardwood tree: -17 Regenerating Tree: + Shrub: 8 Herbaceous: 25

Height Class - Conifer tree / Hardwood tree: -105 Regenerating Tree: 03 Shrub: 01 Herbaceous: 01

Height classes: 01=<1/2m 02=1/2-1m 03=1-2m 04=2-5m 05=5-10m 06=10-15m 07=15-20m 08=20-35m 09=35-50m 10=>50m

Species, Stratum, and % cover. Stratum categories: T=Tree, S=Shrub, H=Herb, E=SEedling, A=Sapling, N=Non-vascular.  
 % cover intervals for reference: <1%, 1-5%, >5-15%, >15-25%, >25-50%, >50-75%, 75%

Strata	Species	% dead	% cover	C	Strata	Species	% dead	% cover	C
S	Artemisia tridentata		7		H	Lupinus sp.		1	
E	P. albicaulis	+	6/4/4		T	Tsugamertensiana		+	
H	Heraklia fusca		4		N	Lichen		+	
H	Polyscaumdauidisii		3		H	POACEAE sp.		1	
H	Weinmannia mollis		2						
H	Phlox sp.		3						
S	Ribes munitigenum S1-S4 (Kawcam)		+	✓					
H	Eriogonum umbellatum		1						

Other rare taxa in stand (CNDDDB)

III. INTERPRETATION OF STAND

Field-assessed vegetation alliance name: Pinus albicaulis

Field-assessed association name (optional): -

Adjacent alliances/direction: P. albicaulis N, S, E, W

Confidence in alliance identification: L M (H) Explain: -

Other identification or mapping information: Phenology (E,P,L): Herb P Shrub P Tree E

Is poly >1 type: Yes / No If yes, explain:



Field Recon Eldorado NF

Surveyors: Smt Date: 8/13/2013

Polygon #: FLD00003 GPS waypoint #: 236817 GPS in stand? Y N If No, distance/bearing: 1  
 Correct Y N UTMN 4293403 Error: +1.7 GPS name: 1

Aspect: 342° Elevation: 2791 ft/m Size of stand: < 1 acre Photograph #'s: New cam (N) 66-69

Field alliance name: Pinus albicaulis Site Impacts: no MPB, some lvs w

Comments: Small stand in steep rock ripup P. albicaulis in clumps ~ 30 meters N of Sta Smith discolored spots from WPBR?

Tree cover/ht/dbh:		Shrub cover/ht:		Herbaceous cover/ht:		% Density	
Strata	Species	% cover	Strata	Species	% cover	Strata	Species
T	Pinus albicaulis	50					
S	Ribes cereum	+					

slope 19°

Polygon #: FLD00004 GPS waypoint #: 236400 GPS in stand? Y N If No, distance/bearing: 1  
 Correct Y N UTMN 4292840 Error: +1.8 GPS name: 1

Aspect: 120° Elevation: 2766 ft/m Size of stand: 1.0 ha Photograph #'s: CAM 17 (N) 85-88

Field alliance name: Tsuga mertensiana Site Impacts: no MPB or WPBR detected

Comments: mixed stand dominated by T. mertensiana w P. albicaulis & P. monticola dispersed through out. Saplings + seedlings of all conifers present

slope 23°  
 calc veg pole  
 # biccaul  
 # 47

Tree cover/ht/dbh:		Shrub cover/ht:		Herbaceous cover/ht:		% Density	
Strata	Species	% cover	Strata	Species	% cover	Strata	Species
T/E/A	T. mertensiana	20/H	T/E	P. monticola	H+		
T/E	P. albicaulis	H+	H	Castilleja sp.	+		

Polygon #: FLD00011 GPS waypoint #: 236799 GPS in stand? Y N If No, distance/bearing: 1  
 Correct Y N UTMN 4293290 Error: +1.3 GPS name: 1

Aspect: N Elevation: 2957 ft/m Size of stand: 1 acre Photograph #'s: CAM 7 (N) 95-98

Field alliance name: Pinus albicaulis Site Impacts: discolored needles WPBR?

Comments: clustered Krummholz P. albicaulis stand on very steep rocky hill slope. Didnt find host species for WPBR in area (Ribes or Castilleja)

slope 30°

Tree cover/ht/dbh:		Shrub cover/ht:		Herbaceous cover/ht:		% Density	
Strata	Species	% cover	Strata	Species	% cover	Strata	Species
T	P. albicaulis	11					

Polygon #: FLD00021 GPS waypoint #: 237361 GPS in stand? Y N If No, distance/bearing: 1  
 Correct Y N UTMN 4294018 Error: +1.2 GPS name: 1

Aspect: 270° Elevation: 2819 ft/m Size of stand: 1 acre Photograph #'s: New cam (N) 99-102

Field alliance name: Pinus albicaulis Site Impacts: trail; discoloration in needles

Comments: Stand is dense and runs along narrow drain from upslope to downslope. P. albicaulis stands nearby ~ 30m N as are similar in aspect/slope/elevation. WPBR? Disc 103-109 (disc of red scattered stems)

slope 11°

Tree cover/ht/dbh:		Shrub cover/ht:		Herbaceous cover/ht:		% Density	
Strata	Species	% cover	Strata	Species	% cover	Strata	Species
T/A	Pinus albicaulis	35/H	T	P. albicaulis	1		
S	Ribes (Voluntarium)	+					

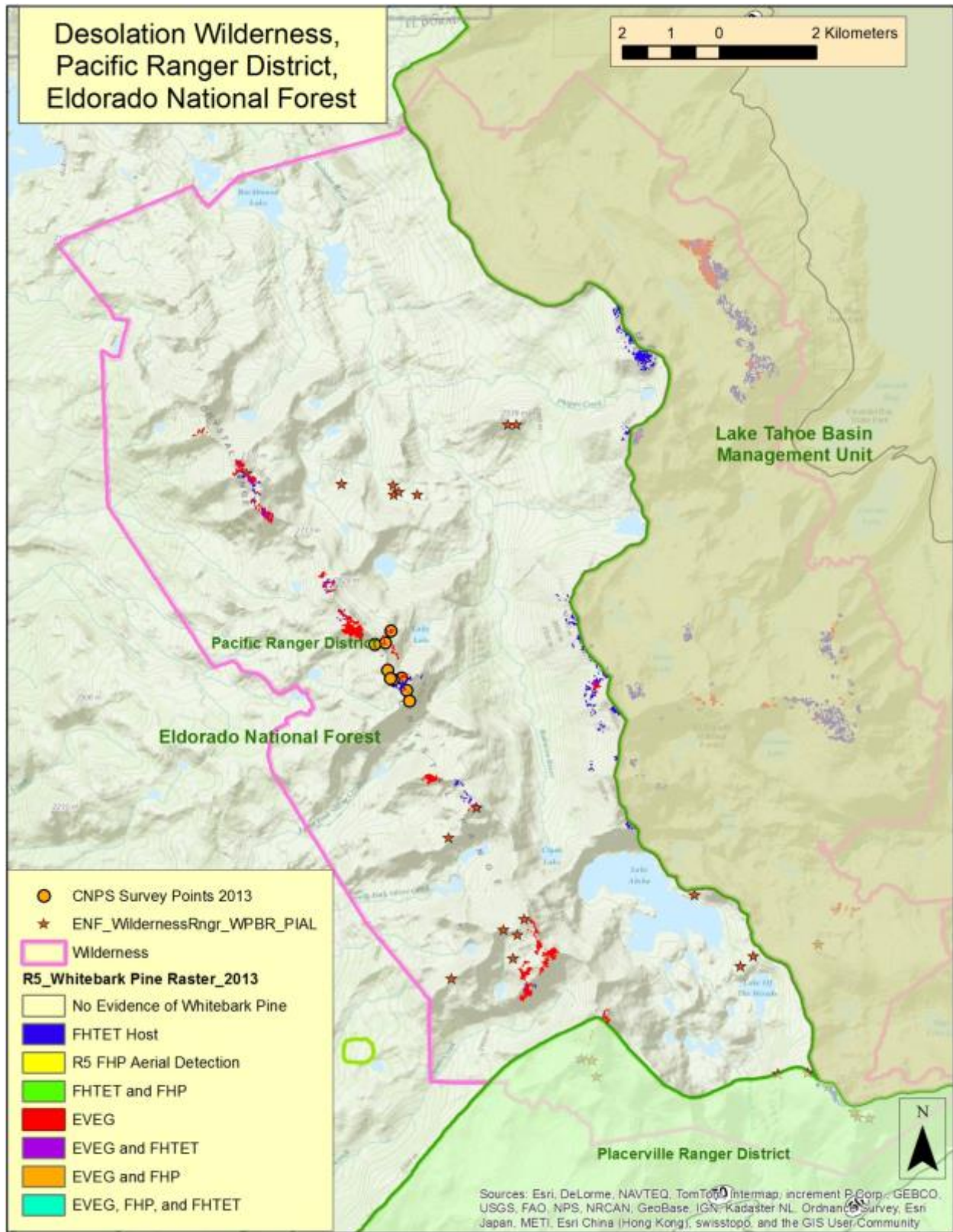
P. albicaulis stands nearby ~ 30m N as are similar in aspect/slope/elevation. WPBR? Disc 103-109 (disc of red scattered stems)

(nodal spines)

### Appendix 3: Overview Maps of 2013 Locations Visited on the National Forest



**Figure 3.** Overview map of Eldorado National Forest with forest areas and vegetation data. Figure by Kendra Sikes.



**Figure 4.** Overview map of Desolation Wilderness with vegetation data. Figure by Kendra Sikes.



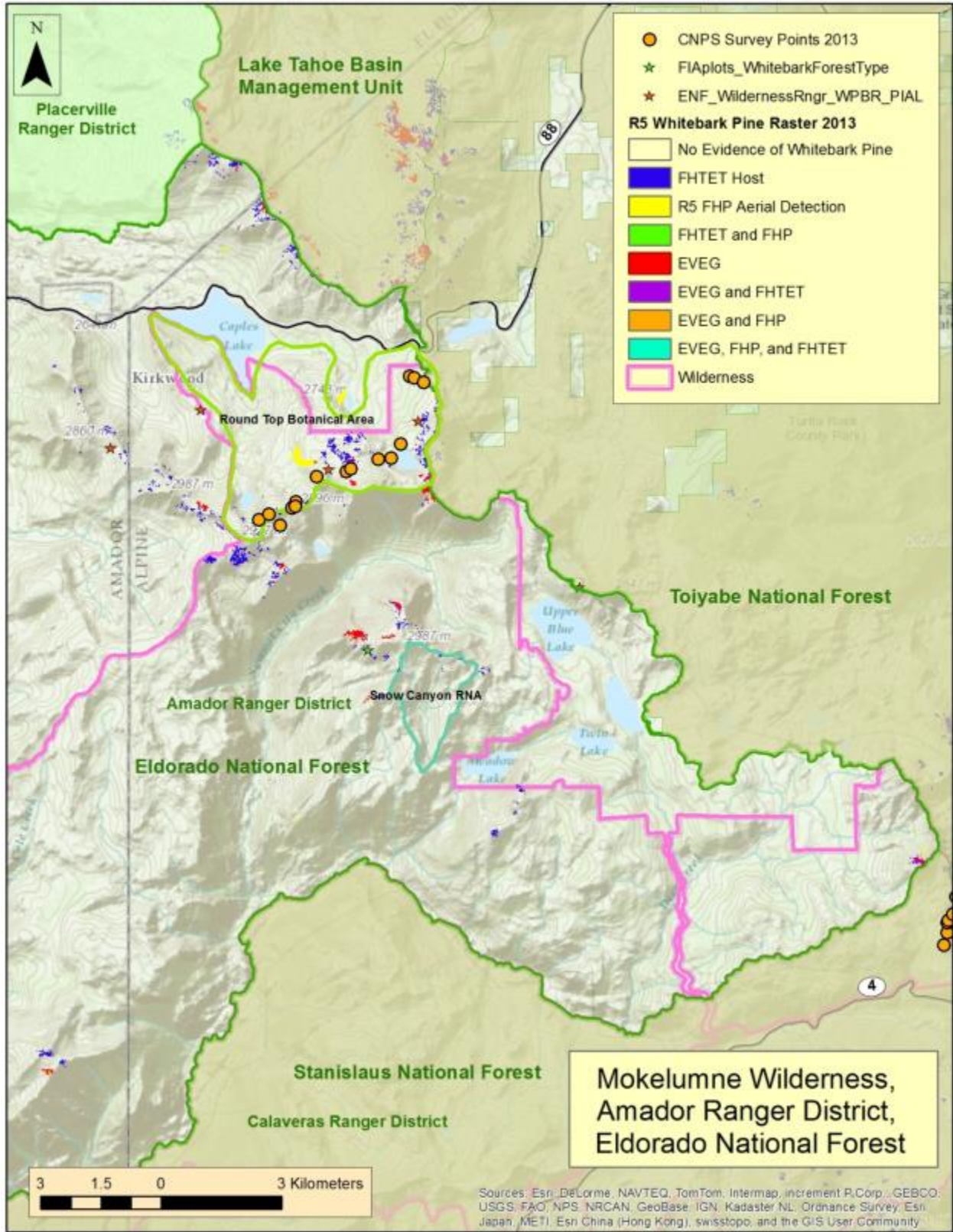


Figure 5. Overview map of Mokelumne Wilderness with vegetation data. Figure by Kendra Sikes.

## Appendix 4: Summary Tables from the CNDDDB Rare Plant Occurrence Forms and the CNPS Vegetation Rapid Assessment/Relevé Form

**Table 4.** Rapid Assessment summary, Eldorado NF

DbaseID	County	Ranger District	Wilderness	Site name	Alliance	Estimated Pct Cover PIAL	PIAL Seedlings Present	PIAL Saplings Present	Altitude (m)	Impacts
WBP0004	Alpine	Amador	Mokelumne	Round Top	<i>Pinus albicaulis</i>	6	yes	yes	2737	Road/trail construction/maint. (low)
WBP0006	Alpine	Amador	Mokelumne	Round Top	<i>Pinus albicaulis</i>	25				
WBP0007	Alpine	Amador	Mokelumne	Round Top	<i>Pinus albicaulis</i>	40	yes		2916	
WBP0010	Alpine	Amador	Mokelumne	Round Top	<i>Pinus albicaulis</i>	3		yes	2833	
WBP0012	Alpine	Amador	Mokelumne	Round Top	<i>Pinus albicaulis</i>	30				Rust (20%)
WBP0017	El Dorado	Pacific	Desolation	Lake Lois	<i>Pinus albicaulis</i>	40		yes	2773	MPB (trace)
WBP0024	El Dorado	Pacific	Desolation	Lake Lois	<i>Pinus albicaulis</i>	13	yes	yes	2799	MPB (8%)
WBP0025	El Dorado	Pacific	Desolation	Lake Lois	<i>Pinus albicaulis</i>	30	yes	yes	2772	MPB (5%), Rust (10%)

**Table 5.** *Pinus albicaulis* attributes from Rapid Assessments in Eldorado NF

DbaseID	Site name	Stand Size	Clumps per hectare	Stems per hectare	Percent Vegetative	Percent Fruiting	Mortality by MPB	Total Mortality	Quality
WBP0004	Round Top	1-5 acres	29.2	87.5	1	99	0	trace	Excellent
WBP0006	Round Top	> 5 acres	50.0	150.0	80	20	0	0	Excellent
WBP0007	Round Top	1-5 acres	62.5	312.5	95	5	0	0	Excellent
WBP0010	Round Top	1-5 acres	22.5	67.5	100	0	0	trace	Excellent
WBP0012	Round Top	> 5 acres	75.0	225.0	30	70	0	1%	Good
WBP0017	Lake Lois	1-5 acres	250.0	750.0	55	45	0	1%	Excellent
WBP0024	Lake Lois	1-5 acres	70.0	140.0	60	40	8%	8%	Excellent
WBP0025	Lake Lois	1-5 acres	100.0	400.0	1	99	0	0	Good

**Table 6.** Reconnaissance summary, Eldorado NF

DbaseID	County	Ranger District	Wilderness	Site name	Alliance	Stand size	Estimated Pct Cover PIAL	PIAL Seedlings Present	PIAL Saplings Present	Altitude (m)	Impacts
WBP0009	Alpine	Amador	Mokelumne	Fourth of July Peak	<i>Tsuga mertensiana</i>	1-5 acres	Trace	yes		2766	
WBP0001	Alpine	Amador	Mokelumne	Round Top	mixed conifer	< 1 acre	Trace				
WBP0002	Alpine	Amador	Mokelumne	Round Top	mixed conifer	1-5 acres	2			2662	Road / trail construction / maint. (low)
WBP0003	Alpine	Amador	Mokelumne	Round Top	<i>Pinus albicaulis</i>	n/a	1			2671	Road / trail construction / maint. (low)
WBP0005	Alpine	Amador	Mokelumne	Round Top	<i>Pinus albicaulis</i>	> 5 acres	5			2755	Road / trail construction / maint. (low)
WBP0008	Alpine	Amador	Mokelumne	Round Top	<i>Pinus albicaulis</i>	< 1 acre	50			2791	
WBP0011	Alpine	Amador	Mokelumne	Round Top	<i>Pinus albicaulis</i>	1-5 acres	11			2857	
WBP0013	Alpine	Amador	Mokelumne	Round Top	<i>Pinus albicaulis</i>	> 5 acres	Trace				
WBP0014	Alpine	Amador	Mokelumne	Round Top	<i>Pinus albicaulis</i>	< 1 acre	35		yes	2819	Road / trail construction / maint. (low)
WBP0015	Alpine	Amador	Mokelumne	Round Top	<i>Pinus albicaulis</i>	1-5 acres	13			2732	
WBP0016	El Dorado	Pacific	Desolation	Lake Lois	<i>Tsuga mertensiana</i>	n/a	0			2800	
WBP0018	El Dorado	Pacific	Desolation	Lake Lois	<i>Tsuga mertensiana</i>	> 5 acres	0			2631	
WBP0019	El Dorado	Pacific	Desolation	Lake Lois	<i>Tsuga mertensiana</i>	1-5 acres	10			2707	
WBP0020	El Dorado	Pacific	Desolation	Lake Lois	<i>Tsuga mertensiana</i>	1-5 acres	2			2696	
WBP0021	El Dorado	Pacific	Desolation	Lake Lois	<i>Pinus albicaulis</i>	1-5 acres	6			2812	
WBP0022	El Dorado	Pacific	Desolation	Lake Lois	<i>Pinus albicaulis</i>	< 1 acre	2	yes	yes	2797	
WBP0023	El Dorado	Pacific	Desolation	Lake Lois	<i>Pinus albicaulis</i>	> 5 acres	22				
WBP0026	El Dorado	Pacific	Desolation	Lake Lois	<i>Pinus albicaulis</i>	n/a	10			2762	

## Appendix 5: Photos from 2013 Field Work



**Figure 6.** *Pinus albicaulis* along Camp Irene Trail, Mokelumne Wilderness. Photo by CNPS.



**Figure 7.** Unknown stem mortality on *Pinus albicaulis* along Camp Irene Trail, Mokelumne Wilderness. Photo by CNPS.

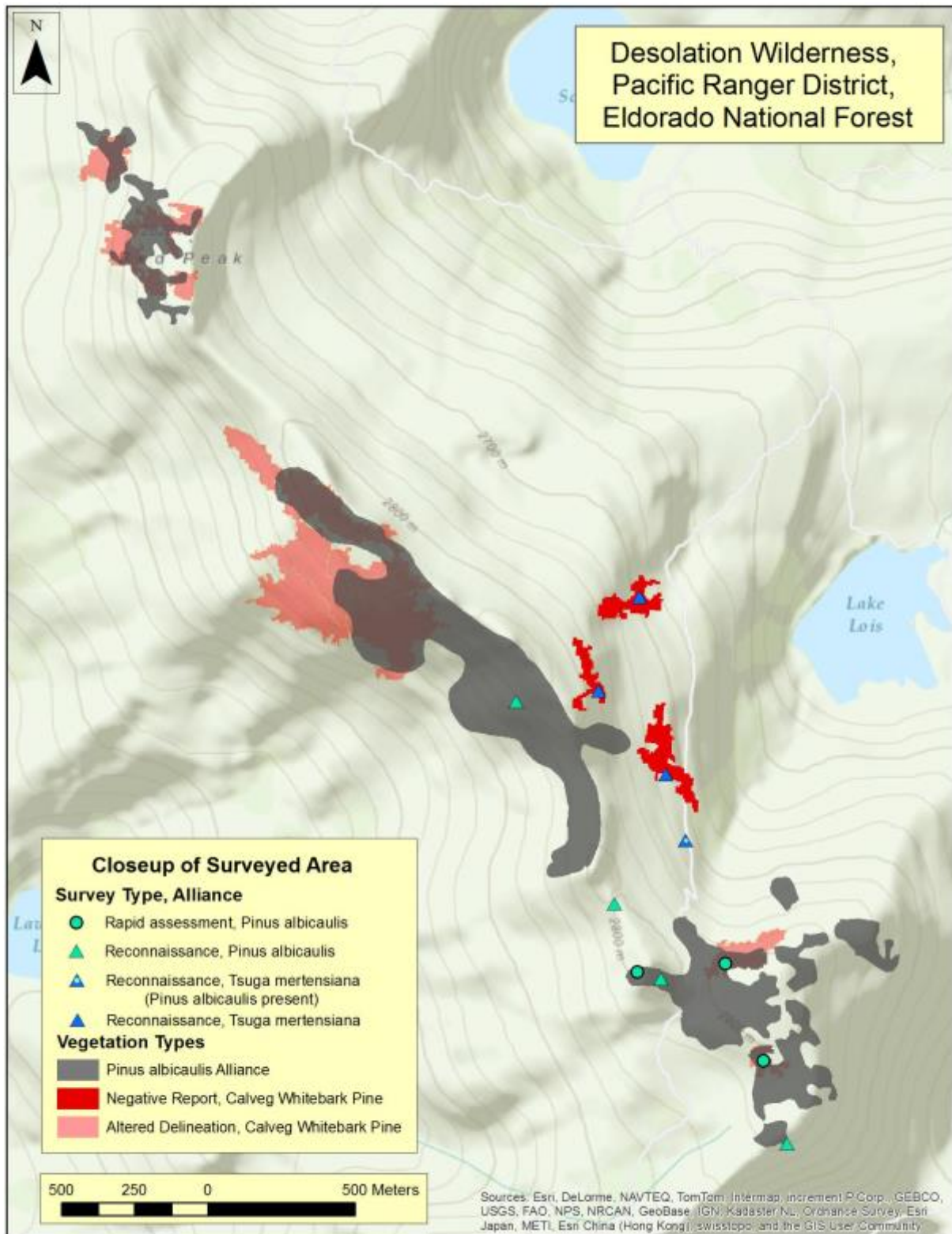


**Figure 8.** Heavy pitching on *Pinus albicaulis* stem near Red Peak, Desolation Wilderness. Photo by CNPS.



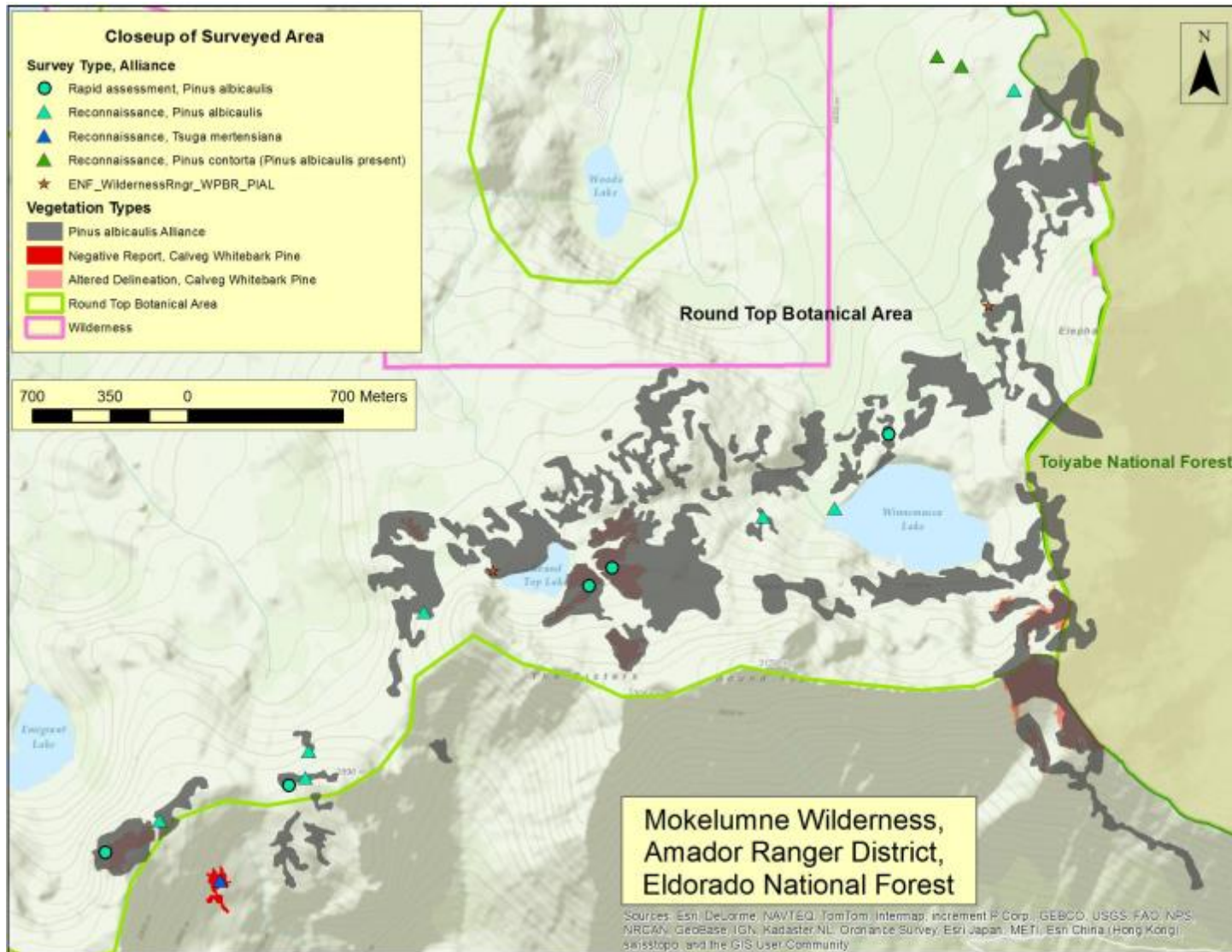
**Figure 9.** Krummholz *Pinus albicaulis* stand above Lois Lake, Desolation Wilderness. Photo by CNPS.

## Appendix 6: Detailed Maps of Positive and Negative Data for Whitebark Pine



**Figure 10.** Map of positive and negative vegetation data for Desolation Wilderness. Figure by Kendra Sikes. (Note: Some reconnaissance, *Pinus albicaulis*, stands are too small to be mapped and therefore not included in the delineated *Pinus albicaulis* Alliance)





**Figure 11.** Map of positive and negative vegetation data for Mokelumne Wilderness. Figure by Kendra Sikes. (Note: Some reconnaissance, *Pinus albicaulis*, stands are too small to be mapped and therefore not included in the delineated *Pinus albicaulis* Alliance)

## Appendix 7: Recommended Protocols for Future Work

### Whitebark Pine Inventory and Monitoring Plot Protocol

Revised: May 16, 2013

#### Introduction:

This protocol was developed collaboratively by the USFS Region 5 Ecology Program and Forest Health Protection Program to provide inventory and status-and-trend monitoring data in stands dominated by whitebark pine (*Pinus albicaulis*) or lodgepole pine (*P. contorta*) with whitebark pine as a codominant species. It also focuses on stands that have experienced recent tree mortality related to insects (mountain pine beetle) or diseases (white pine blister rust). This protocol was developed using elements of the Regional Ecology Program post-fire regeneration monitoring protocol and the Forest Health Protection Whitebark Pine Monitoring Plot Protocol for the Warner Mountains, Modoc National Forest (the FHP protocol is based on *Greater Yellowstone Whitebark Pine Monitoring Working Group [GYWPMWG] Interagency Whitebark Pine Monitoring Protocol for the Greater Yellowstone Ecosystem 2007*).

#### I. Site attributes:

- Record the location (geographic or watershed scale), site (topographic scale), and plot number (micro-scale).
- Use a GPS device to locate plot center - take care to avoid biasing the location.
- Monument permanent plots (established for monitoring rather than inventory) with 2-foot long rebar driven approximately 1.5 ft into the ground at plot center. Label with plot number and mount safety cap. Include brief notes of plot location using distinctive landscape features, if any.
- Record the date that data were collected.
- Record the crew names of the people collecting the data.
- Establish a plot with a radius of 12.6 m, which is approximately 0.05 ha (0.124 acres). Flag four places around the perimeter for reference.
- Record the dominant tree species present.
- Take one photograph from a point 12.6 m south of the plot center, looking north. Make sure you have something (pin flag) at plot center so it can be relocated. using the photo. Take another photograph from a point 12.6 m north of the plot center, looking south (toward pin flag). Record both photo numbers.
- Record the average slope of the plot in percent (use clinometer).
- Record the average aspect of the plot in degrees (use compass [make sure you have the right declination])

#### II. Vegetation and ground cover attributes

- Estimate the cover (%) of: *basal vegetation* (i.e. the area covered by the bases of tree boles, shrub stems, herbs), *litter*, *bare ground*, *rock* (>2 mm diameter), and *woody debris* (>3 inches [7.5 cm] diameter), summing to 100% (imagine chopping off all vegetation at ground level, what do you have left?; it is rare for basal vegetation to be more than 5%, unless there are trees or many large shrubs in the plot). Record cover values to nearest 5%, using 0.5% as trace cover
- Estimate vegetation cover to nearest 1% (1-10% cover), 5% (10-30%) or 10% (30-100%):

- % Overstory veg cover = cover of plants >2 m in height (trees and tall shrubs; this is a snapshot of total canopy cover taken from above, i.e. it is the % of the plot that has trees/tall shrubs covering it. Tree/tall shrubs growing completely beneath other trees/tall shrubs are not counted as they cannot be seen from above) (see Figure 1)
  - Estimate cover of live trees and tall shrubs
  - Also estimate % dead cover (trace circles around the remnants of dead trees >2 m in height). When this value is added to the live cover it should give us an estimate of the total pre-beetle mortality live cover.
- % Shrub and Herbaceous plant cover = cover of understory vegetation <2 m in height (this is a snapshot of total understory cover taken from above, i.e. it is the % of the plot that has understory vegetation covering it. Understory plants growing completely beneath other plants are not counted, as they cannot be seen from above) (see Figure 1).
- Record separately the cover of aspen <3 m in height. Aspen >3 m height should be recorded as overstory cover.

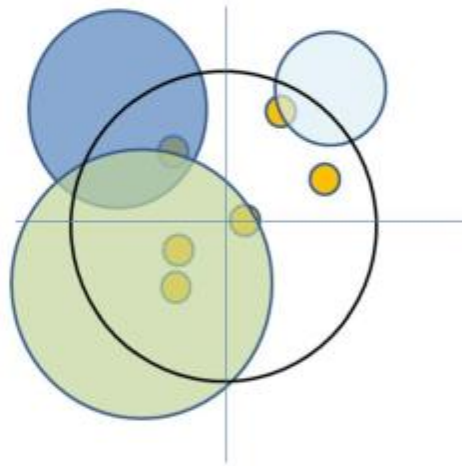


Fig. 1. Circular plot, with four species of understory plants (colored). The blue crosshairs are added to aid in estimating cover. The understory vegetation cover is about 64% (the total plot area minus the area that is not covered by live vegetation). The gray species (shrub) has 49% cover, the dark blue species (shrub) has 17% cover, the light blue species (grass) has 4%, and the orange species (forb) has 6% (each orange circle is 1% in this case). Due to plant overlap, summing the different species' cover values gives a value that is larger than the total understory vegetation cover (76% vs. 64%). Overall shrub cover in this plot is 58% (two shrub species, subtracting overlap; summed up [i.e., ignoring overlap], the two species have 66% cover between them). Herb cover is 9.5%, forb cover is 6%, grass cover is 4%. Each shrub species will have its own cover entered in the species-cover section of the datasheet. Cover is measured by drawing a line around the outside of the plant canopy, ignoring gaps that may be found within the perimeter. For plots of this size (500 m<sup>2</sup>), your clipboard is about 0.015% of the plot area.

### III. Basal area, snags, and litter depth

- Use the basal area gauge (20 factor) to record the basal area of live and dead whitebark pine and other tree species (e.g., lodgepole pine) in the stand
  - Swinging the gauge around the plot center, tally the number of trees that are larger than the 20 factor aperture. Count live and dead trees separately for each species.
- Record the species and dbh of any older snags (>7 years; **prior to 2005**) in the plot. Only record snags that are >1.37 m tall.
- Measure litter depth at 3 locations midpoint between plot center and plot perimeter in 3 directions (0°, 120°, and 240°).

### IV. Tree regeneration attributes

- Tally the number of seedlings and saplings (trees less than 7.6 cm dbh of each tree species for each age class)
  - Use a separate row for each species and basal cluster (see below).
  - Count the number of live and dead stems arising from each seedling or sapling cluster. Clusters are defined using the following two criteria:
    - Stems are less than 10 cm at the base from the cluster of other stems
    - Diameter of stem (saplings only) must not exceed 25% of next largest stem in the cluster
  - Determine minimum age by counting the bud scars, subtracting the current year
  - Record dbh for saplings (>1.37 m height) only
  - In the Health Code column, note the number of seedlings or saplings in each cluster that exhibit health issues and include the appropriate health codes for these numbers (e.g., 2-a). Health codes include:
    - C = cankers or stem swelling
    - SC = stalactiform canker (*P. contorta* only) as spindle-like in middle of bole
    - P = pitching
    - F = branch flagging
    - S = needle spots
    - T = twig beetle sign (e.g. terminal branch flagging and pitch tubes)
    - 2 = secondary beetle
    - M = dwarf mistletoe
    - R = native rusts – take photo and collect sample when available
    - H = sapsucker/woodpecker holes
    - A = aecia (i.e., rust fruiting body) or aeciospores
      - Take closeup photos of any branches displaying aecia and consider collecting samples for laboratory identification
      - Aecia could be a sign on WPBR or a native rust
  - Record the height for the tallest individual seedling of each species

#### V. Understory vegetation attributes

- Measure the modal height and overall cover for the four most common (by % cover) shrub and herbaceous plant species in the plot. Additional understory species may be noted in the Notes section. Especially note the presence of species in the genera *Ribes*, *Castilleja*, and *Pedicularis* (WPBR secondary hosts)
  - Measure cover to nearest 5%, 0.5% = trace cover
  - Modal height is the most common height

#### VI. Notes section

Items of interest to record in the notes section:

- If fire scars or other evidence of fire are in the plot
- If plot is located on a unique (non-granitic) substrate (e.g., pumice soils)
- If plot has been treated in some way - specify
- If non-native species are on plot or adjacent to plot - specify
- If other mortality agents (insects, diseases) are present - specify
- If WPBR, mountain pine beetle, twig beetle, or other potential mortality agents are observed adjacent to plot but not recorded within the plot
- If conifer stumps are present from trees that may have parented seedlings before they were cut
- Additional understory species if more than four shrubs or herbaceous plants
- Other notes?

#### VII. Tree attributes

For all trees (>7.6 cm dbh) record the following information

- Species ID, and number live and dead stems in each cluster. Tree clusters are defined by stems that are less than 1 m at the base from the cluster of other stems of similar size (diameter and height).
- Individual stems growing in close proximity will be defined as individual tree stems or branches using the following GYWPMWG (2007) criteria:
  - 1) There must be a discernible growth groove that separates that stem from other stems of the tree.
  - 2) The diameter of a given stem must be more than 25% of the diameter of the largest stem.
  - 3) The stem must be less than one foot from the “mother” tree to which it is associated. Otherwise it is to be considered as a separate seedling, sapling, or tree.
  - 4) The angle of the stem in question must be no less than a 45° angle from the main stem.
- For each cluster, provide a consecutively-numbered cluster ID number. For each stem within a cluster, provide a stem ID value.
- Record the dbh of all live and dead stems in each cluster.

- For monumented monitoring plots, nail aluminum tags to all live trees that are counted with the basal area gauge (20 factor) sweep. Begin consecutively-numbered tags at the northernmost tree proceeding clockwise. Nail tags at dbh so that each tag faces plot center, leaving approximately one inch of space between the nail head and the tree bole in order to avoid damage during tree growth. Enter tag numbers in the Notes column.
- Note with a checkmark whether live basal sprouts are present for a given tree cluster. These basal sprouts are defined as smaller-diameter (typically <7.6 cm dbh) live stems located at the base and often surrounding clusters of larger live and dead tree clusters (typically with stems exceeding 20 cm dbh).
- Note the % of live crown in the stem (largest live is the default) in increments of 10% using the following coding system: 1 = 10%, 2 = 20%, 3 = 30%, etc.
- Note the level of mountain pine beetle attack using the following:
  - 0 = No evidence of attack or beetle pitch tubes or unknown
  - 1 = less than 5 observable beetle pitch tubes ('hits')
  - 2 = less than 50% of the bole is attacked; sporadic pitch tubes spread on most parts of the bole or several localized areas with a high density (>10) pitch tubes
  - 3 = greater than 50% of the bole is attacked; numerous pitch tubes spread on many parts of the bole
- Estimate the time since mountain pine beetle attack based on the following system:
  - 0 = less than one year since attack (occurred during current season); typically little sign of crown discoloration or dead needles but evidence of beetle attack
  - 1 = approximately one year since attack (last season); crown shows significant density of dead or dying needles (substantial portion of crown contains brown/orange colored needles)
  - 2 = two years since attack; entire crown consists of dead (brown/orange colored) needles that are mostly intact
  - 3 = three years since attack; most but not all of dead needles have fallen from crown, with few clusters of dead needles retained
  - 4 = four to seven years since attack; no dead needles retained in crown; smaller branches may have broken off and fallen, with most larger to medium branches retained
- Record the number of cones in the tree using the following numeric system:
  - 0 = no cones
  - 1 = 1 to 10 cones
  - 2 = 11 to 100 cones
  - 3 = greater than 100 cones
- Record the health code for each tree using the codes listed under the tree regeneration attributes section (see above)
- In Notes column record any remarkable observations pertaining to a tree or tree cluster, including:
  - lightning or fire scars

- evidence of other damage caused by wildlife, humans, or unknown causes
- Other notable features or observations

#### VIII. Seed-Caching Wildlife Point Counts (optional, if time permits)

- At end of vegetation sampling period, return to each plot and spend 5 minutes noting any visual or auditory sign of Clark's Nutcracker (*Nucifraga columbiana*), Douglas' squirrel (*Tamiasciurus douglasii*), lodgepole chipmunk (*Neotamias speciosus*), golden-mantled ground squirrel (*Callospermophilus lateralis*), or any other seed-eating species within 50 m of each side of transect. Record plot number, observer, time and date of survey, and number of each species observed at each sample point (i.e., plot).
- Note any observations of seed caching, seed dispersal, or seed predation during survey period.
- Record data on separate field notebook

# 2018 Update

## Whitebark Pine Pilot Fieldwork Report

### Eldorado National Forest



By Jennifer Buck-Diaz, Raphaela Floreani Buzbee,  
Julie Evens, Michael Kauffmann, and Sydney Magner

In collaboration with:

Matt Brown, Forest Botanist, Eldorado National Forest

Diane Ikeda, Regional Botanist, Pacific Southwest Region, USDA Forest Service

NOVEMBER 2018



CALIFORNIA  
NATIVE PLANT SOCIETY





## Methods and Materials

The California Native Plant Society (CNPS) obtained updated GIS data from various sources including the USFS Pacific Southwest - Region Remote Sensing Lab's CALVEG maps (USFS 2018), and California Department of Fish and Wildlife (CDFW) - High Elevation Species Sightings Sierra Nevada (CDFW 2018). In addition, we used the updated species profile from the CNPS Rare Plant Program, which maps the distribution of whitebark pine (*Pinus albicaulis*) using many sources such as herbarium specimens and other observational data (Serkanic and Sims 2018).

CNPS reviewed the CNPS/CDFW Vegetation Rapid Assessment protocol used in the 2013 pilot project for evaluating whitebark pine vegetation and insect/disease impacts. We made minor edits and clarification to the data sheet and protocol in order to collect standardized data across the five forests. A reconnaissance (recon) form was used to gather simplified, general information about stands of vegetation, especially for whitebark pine stands that were near or adjacent to stands already sampled by a full Rapid Assessment.

CNPS held a field training for whitebark pine sampling on August 1, 2018 at Carson Pass in the Eldorado National Forest. Trainers and attendees included:

- Jennifer Buck-Diaz (CNPS)
- Julie Evens (CNPS)
- Raphaela Floreani Buzbee (CNPS)
- Sydney Magner (CNPS)
- Marc Hoshovsky (volunteer)
- Matt Brown (USFS - Eldorado)
- Torrance Haynes (USFS - Eldorado)
- Taylor Blevins (USFS - Eldorado)
- Sarah Hauck (USFS - Eldorado)
- Nat Israel (USFS - Eldorado)
- Hailey Henderson (USFS - Eldorado)
- Crystal Neuenschwander (USFS - Eldorado)
- Quinn Young (USFS - Lake Tahoe Basin)
- Trish Winn (USFS - Lake Tahoe Basin)
- Michelle Rambo (USFS - Lake Tahoe Basin)
- Samuel Bohannon (USFS - Lake Tahoe Basin)
- Kathryn Daly (USFS - Lake Tahoe Basin)
- Margaret Willits (USFS - Stanislaus)
- Martin MacKenzie (USFS – Stanislaus)
- Beverly Bulaon (USFS – Region 5)

Forest Service Southern Sierra Service Area Pathologist, Martin MacKenzie, and the R5 Forest Health Protection Entomologist, Beverly Bulaon, assisted CNPS in the field training. They providing tips for identifying Whitebark Pine blister rust (WPBR) and Mountain Pine Beetle (MPB) infestations on whitebark pine and other conifer species.

Upon evaluating existing datasets and obtaining input from local National Forest staff, Matt Brown, we identified areas to ground-truth in order to determine the distribution and health/status of whitebark pine on National Forest lands. Priorities included sampling areas outside of wilderness lands that did not have existing surveys. Eldorado National Forest staff also contributed to the collection of field data and mapping of whitebark pine presence.

## Results

In August 2018, CNPS staff and a volunteer assessed whitebark pine in Amador and Placerville Ranger Districts on Eldorado National Forest. Over four days, 12 Rapid Assessments and 2 Recons were completed. One Rapid Assessment was made on the Humboldt-Toiyabe National Forest.

A CNPS workshop was held to train CNPS and USFS staff on the whitebark pine survey protocol and forest diseases and impacts. During the training 1 Rapid Assessment was completed at Frog Lake on the Carson Ranger District of Humboldt-Toiyabe National Forest in the Mokelumne Wilderness. This stand was in ‘Good’ condition with very little WPBR observed (<1%) but the site had some minor impacts from recreational use.

On Thunder Mountain on the Amador Ranger District, CNPS staff assessed prior USFS Ranger observations of whitebark pine and mapped delineations. CNPS staff made 2 Rapid Assessments on Thunder Mountain, while Eldorado NF staff made a third Rapid Assessment near Covered Wagon Peak; all observations were dominated by whitebark pine. These stands around 2,800 m (9,180 ft) were in ‘Excellent’ condition with 3% mortality from MBP and WPBR.

Around Little Round Top, on Amador and Placerville Ranger Districts, CNPS staff conducted 4 Rapid Assessments and 2 Recons (all dominated by whitebark pine). The whitebark pine occurred in areas ranging from about 2,800 m (9,180 ft) to 2,900 m (9,550 ft). The stands were in ‘Good’ condition overall with an average of 4% mortality from MPB and average of 6% mortality from WPBR, although the impacts were patchily distributed.

Additional, isolated prior observations were also assessed by CNPS. Near the Meiss Trailhead, a small clump of whitebark pine was found but the stand was dominated by lodgepole pine. The whitebark at this location was in ‘Fair’ condition with 20% mortality from MPB.

No whitebark pine was found at other suspected locations at Lake Kirkwood, Woods Lake, and Plasse Resort. A Rapid Assessment was conducted at each of these sites: the vegetation at Lake Kirkwood and Woods Lake was dominated by lodgepole pine. At Plasse, red fir was the dominant tree type in a mixed conifer forest. The elevation for these sites, 2,600 m (8,540 ft) and below, is on the lower edge of elevation tolerance for whitebark pine.

### **Little Round Top region – Amador and Placer Ranger Districts**

1. Ground truth existing polygons along the Sierra crest adjacent to the Tahoe Basin Management Unit to assess the health and extent of whitebark pine populations.
2. The updated delineations show areas previously mapped as whitebark pine (CALVEG) with corrections made in the field, in some cases, areas not previously mapped were found to have whitebark pine dominant or present. Appendix 1 shows selected photos from field sites across the Eldorado National Forest.

# Overview of Whitebark Pine Surveys, Amador and Placerville Ranger Districts, Eldorado National Forest

**Legend**

**2018 Surveys**

**Survey Type, Alliance**

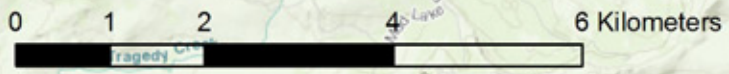
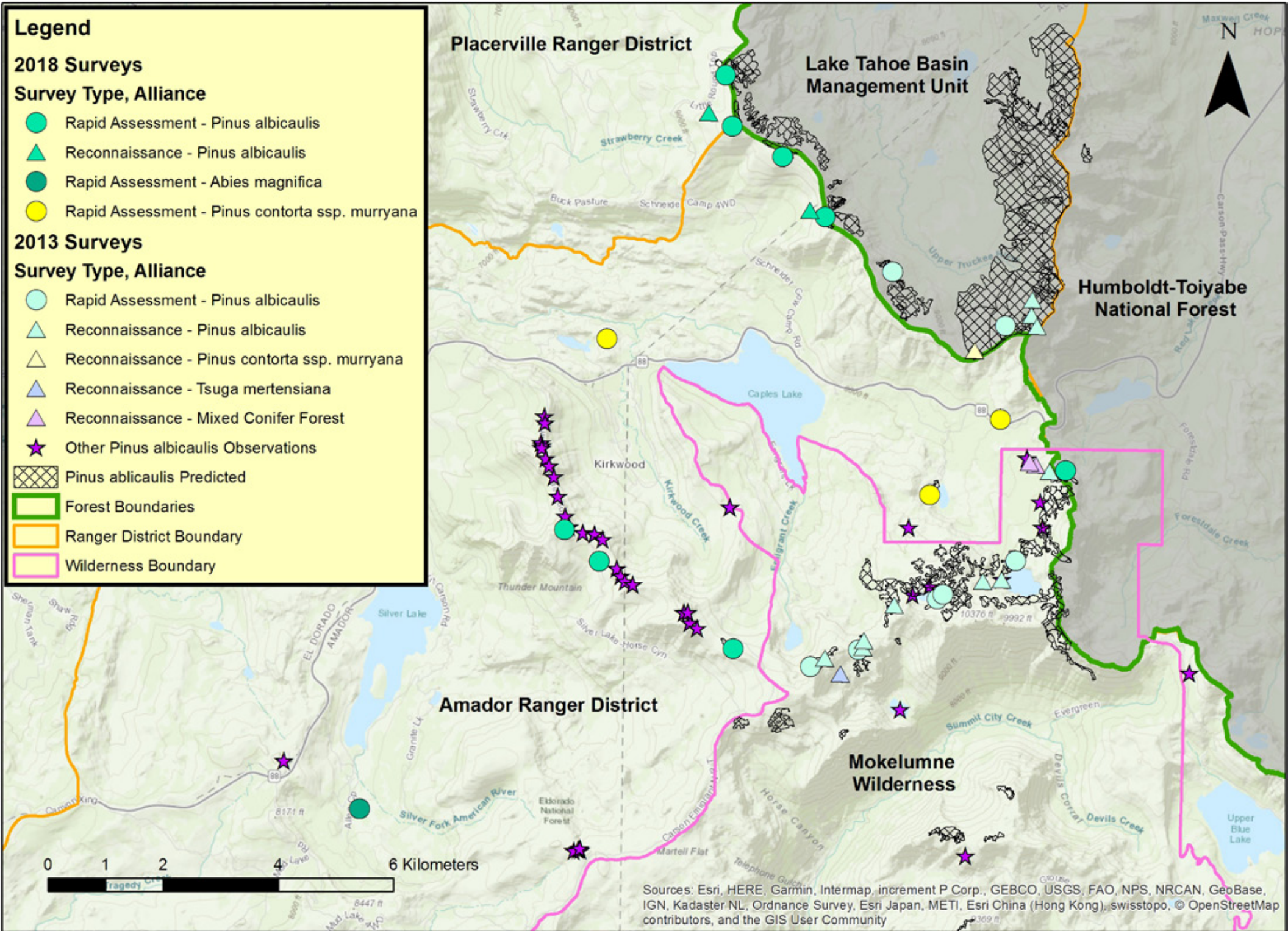
- Rapid Assessment - *Pinus albicaulis*
- ▲ Reconnaissance - *Pinus albicaulis*
- Rapid Assessment - *Abies magnifica*
- Rapid Assessment - *Pinus contorta* ssp. *murrayana*

**2013 Surveys**

**Survey Type, Alliance**

- Rapid Assessment - *Pinus albicaulis*
- ▲ Reconnaissance - *Pinus albicaulis*
- △ Reconnaissance - *Pinus contorta* ssp. *murrayana*
- ▲ Reconnaissance - *Tsuga mertensiana*
- ▲ Reconnaissance - Mixed Conifer Forest
- ★ Other *Pinus albicaulis* Observations

- Pinus albicaulis* Predicted
- Forest Boundaries
- Ranger District Boundary
- Wilderness Boundary



Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, © OpenStreetMap contributors, and the GIS User Community

## Conclusions and Discussion

Whitebark pine field work in Eldorado National Forest was important in assessing the overall distribution of this species. CNPS used the California Natural Diversity Database (CNDDDB) protocol for documenting overall quality and viability of whitebark pine habitat. Stands observed in the Eldorado National Forest had good to excellent viability (probability of persistence) over the next 20 years.

## Future Whitebark Pine Priorities: Eldorado National Forest

### Desolation Wilderness region

Survey and ground truth predicted polygons along the Crystal Range and around Desolation Valley to assess the health and extent of whitebark pine populations.

### Mokelumne Wilderness region

Survey and ground truth predicted polygons and observations around Deadwood Peak (9846’).

### Amador Ranger District

Survey observations along ridges and peaks around Meadow Lake and high ridges near The Nipple (9339’) east of Upper Blue Lake to assess the health and extent of whitebark pine populations.

## Literature Cited





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- Serkanic, S. and A. E. Sims. 2018. *Pinus albicaulis* Engelm. (whitebark pine). Plant Species Evaluation Form, DRAFT FINAL Version 1, 2018-06-19. USDA Forest Service. 81 pp.
- UC Berkeley. 2013. Consortium of California Herbaria. Data provided by the participants of the Consortium of California Herbaria. Data available at:  
[http://ucjeps.berkeley.edu/cgi-bin/get\\_consort.pl?taxon\\_name=Pinus%20albicaulis](http://ucjeps.berkeley.edu/cgi-bin/get_consort.pl?taxon_name=Pinus%20albicaulis)
- USDA Forest Service. 2018. Whitebark Pine (*Pinus albicaulis*) range map in California. Pacific Southwest Region, Remote Sensing Lab and Region 5 Ecology Program.

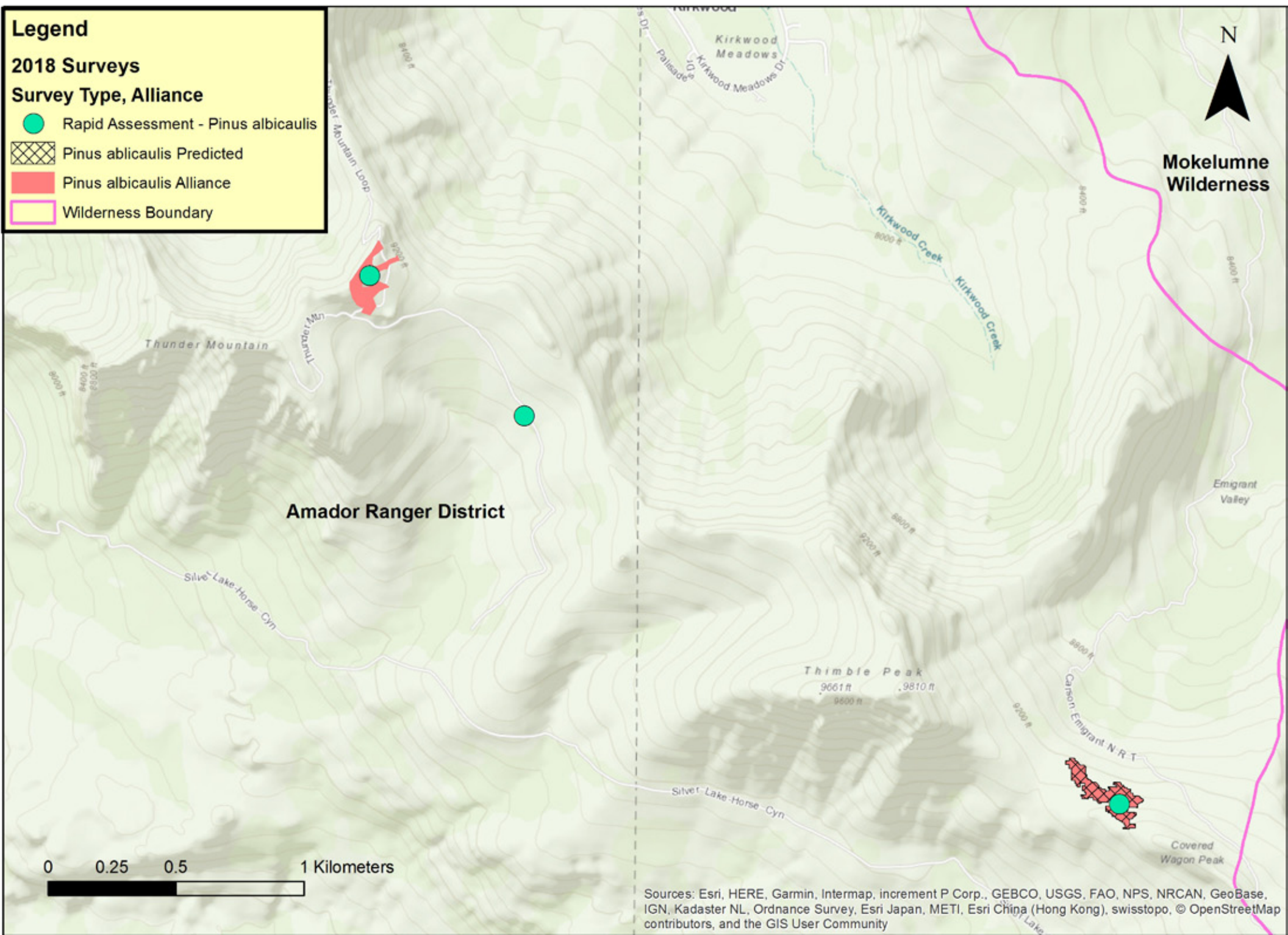
# Thunder and Thimble Mountain, Amador Ranger District, Eldorado National Forest

**Legend**

**2018 Surveys**

**Survey Type, Alliance**

-  Rapid Assessment - *Pinus albicaulis*
-  *Pinus albicaulis* Predicted
-  *Pinus albicaulis* Alliance
-  Wilderness Boundary









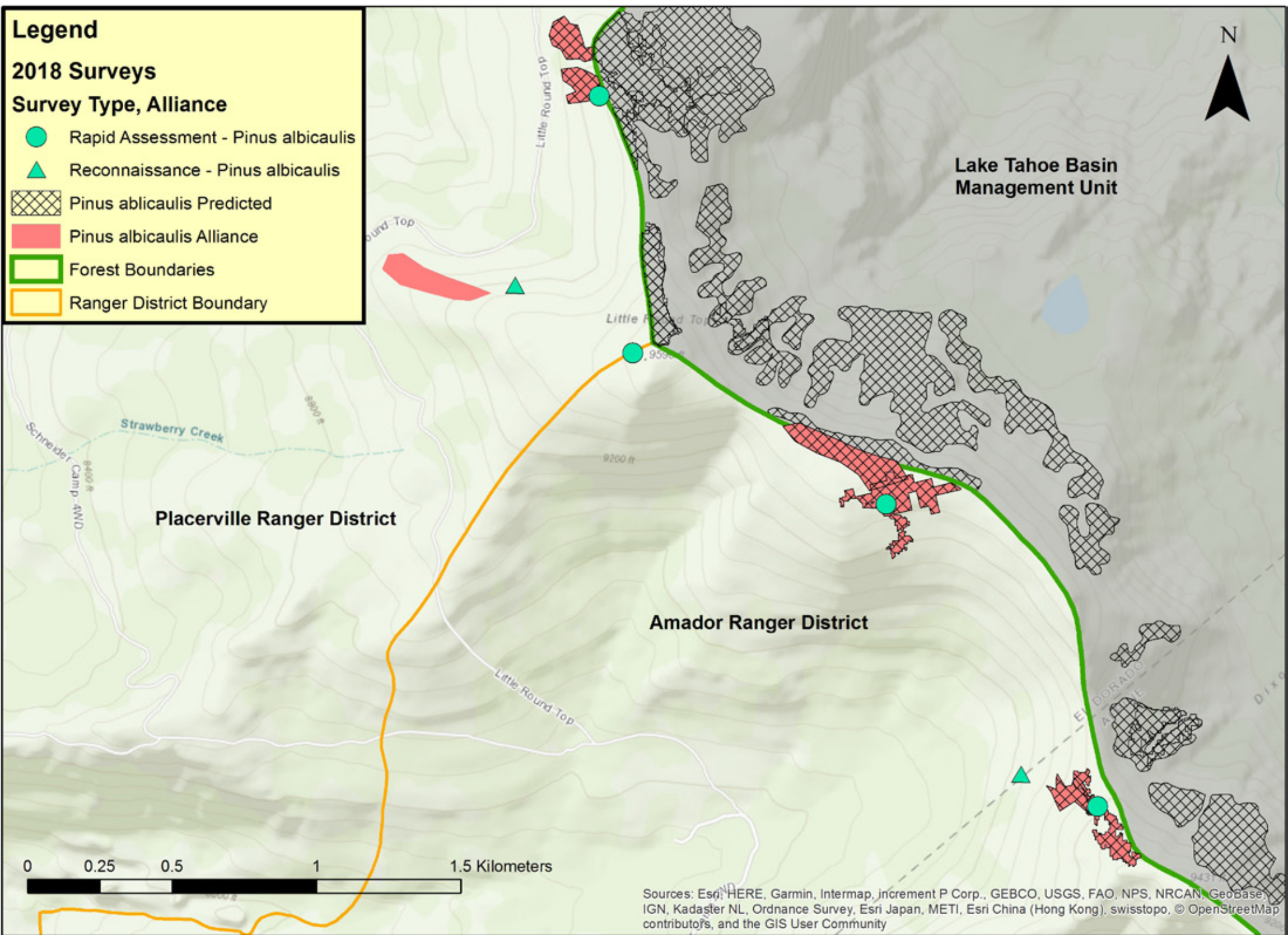
# Little Round Top, Amador and Placerville Ranger Districts, Eldorado National Forest

**Legend**

**2018 Surveys**

**Survey Type, Alliance**

-  Rapid Assessment - *Pinus albicaulis*
-  Reconnaissance - *Pinus albicaulis*
-  *Pinus albicaulis* Predicted
-  *Pinus albicaulis* Alliance
-  Forest Boundaries
-  Ranger District Boundary



Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, © OpenStreetMap contributors, and the GIS User Community

## Appendix 1: Photos and Tables from 2018 Field Work



Figure 1. *Pinus albicaulis* along ridge north of Little Round Top. Photo by CNPS.



Figure 2. Unknown *Pinus albicaulis* mortality along ridge north of Little Round Top. Photo by CNPS.





Figure 3. White pine blister rust on *Pinus albicaulis* on Little Round Top. Photo by CNPS.



Figure 4. Unknown *Pinus albicaulis* mortality south of Little Round Top. Photo by CNPS



**Figure 5.** Presumed mountain pine beetle attack on *Pinus albicaulis* mortality along ridge north of Little Round Top. Photo by CNPS.



Figure 6. *Pinus albicaulis* on Little Round Top. Photo by CNPS.

**Table 1.** Rapid Assessment summary, Eldorado National Forest

<b>DbaseID</b>	<b>County</b>	<b>Ranger District</b>	<b>Wilderness</b>	<b>Site Name</b>	<b>Alliance</b>	<b>Estimated Pct Cover PIAL</b>	<b>Altitude (m)</b>	<b>Impacts</b>
WBP0200	Alpine	Carson	Mokelumne	Frog Lake	<i>Pinus albicaulis</i>	10	2710	Foot traffic/trampling (low), Recreational use (non-ORV) (low), WPBR (0.2%)
WBP0201	Alpine	Amador	n/a	Covered Wagon	<i>Pinus albicaulis</i>	10	2846	WPBR (5%)
WBP0300	Amador	Amador	n/a	Thunder Mountain	<i>Pinus albicaulis</i>	2	2839	Grazing (low), Foot traffic/trampling (low), WPBR (2%)
WBP0301	Amador	Amador	n/a	Thunder Mountain	<i>Pinus albicaulis</i>	30	2714	Foot traffic/trampling (low), WPBR (30%)
WBP0302	El Dorado	Placerville	n/a	Little Round Top	<i>Pinus albicaulis</i>	11	2818	MPB (15%), WPBR (2%)
WBP0303	El Dorado	Amador	n/a	Little Round Top	<i>Pinus albicaulis</i>	23	2912	WPBR (5%)
WBP0304	El Dorado	Amador	n/a	Little Round Top	<i>Pinus albicaulis</i>	16	2841	WPBR (10%)
WBP0305	Alpine	Amador	n/a	Little Round Top	<i>Pinus albicaulis</i>	16	2801	WPBR (10%)
WBP0306	El Dorado	Amador	n/a	Kirkwood Lake	<i>Pinus contorta ssp. murryana</i>	0	2376	Vandalism/dumping/litter (low)
WBP0307	Alpine	Amador	n/a	PCT from Meiss trailhead	<i>Pinus contorta ssp. murryana</i>	1	2604	MPB (90%), WPBR (5%)
WBP0308	El Dorado	Alpine	n/a	Woods Lake	<i>Pinus contorta ssp. murryana</i>	0	2537	None
WBP0309	Amador	Amador	n/a	Plasse	<i>Abies magnifica</i>	0	2250	Vandalism/dumping/litter (low)

**Table 2.** Whitebark pine attributes from Rapid Assessments, Eldorado National Forest

DbaseID	Site name	Stand size	Clumps per hectare	Stems per hectare	Percent Vegetative	Percent Flowering	Percent Fruiting	Mortality by MPB	Mortality by WPBR	Total Mortality	Quality
WBP0200	Frog Lake	> 5 acres	4	14	20	73	7	0	0	0	Good
WBP0201	Covered Wagon	> 5 acres	199	159	0	70	30	0	5	5	Good
WBP0300	Thunder Mountain	1-5 acres	7	93	40	50	10	0	1	3	Excellent
WBP0301	Thunder Mountain	< 1 acre	44	889	5	85	10	0	0	0	Excellent
WBP0302	Little Round Top	> 5 acres	64	357	5	55	40	15	2	17	Good
WBP0303	Little Round Top	1-5 acres	179	510	12	40	48	0	0	0	Excellent
WBP0304	Little Round Top	> 5 acres	28	310	25	10	65	0	12	12	Good
WBP0305	Little Round Top	1-5 acres	71	411	15	25	60	0	10	10	Good
WBP0306	Kirkwood Lake	1-5 acres	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
WBP0307	PCT from Meiss trailhead	< 1 acre	5	84	80	20	0	20	0	20	Fair
WBP0308	Woods Lake	> 5 acres	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
WBP0309	Plasse	> 5 acres	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a